

# PROJECT MANUAL

# Arkansas Forest Health Research Center

The University of Arkansas at Monticello

October 22, 2024

**Architects:**  
**SCM ARCHITECTS PLLC**

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Forest Research  
The University of Arkansas at Monticello  
Monticello, Arkansas

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SUBCONTRACT AGREEMENT

Subcontract Location: [JobCity], [JobState] Subcontract No.: [SL]
For: [Scopeofwork] Subcontract Date [StartDate]

Between CLARK Contractors, LLC (also referred to as "Contractor") and:
[FirmName] [udaddtinfo]

Attn: [ContactFName] [ContactLName] Phone: [Phone]

E-Mail Address: [EMail] Fax: [Fax]

Address: [MailAddress], [MailCity], [MailState] [MailZip]

Amount: Zero Dollars and No/100

\$[TotalSubcontr Contractor's License No. [udLicenseRequirements] Federal ID No. [TaxId]
act] [udLicense]

CLARK CONTRACTORS, LLC on [udContractDate] either entered into Contract or plans to enter into a
contract (hereinafter "Contract") with:

[Customer]
[CustAddress]
[CustCity], [CustState] [CustZIP] (hereinafter "Owner")

Wherein said CLARK CONTRACTORS, LLC agreed to fully and faithfully perform all the labor and furnish all the
material for the complete construction of: [ProjectDescription]

[JobAddress]
[JobCity], [JobState] [JobZip]

in accordance with plans, drawings, specifications, and addenda in the Contract prepared by [ArchEngName] (hereinafter
"Architect") and requires Substantial Completion of the Entire Project on or before See Exhibit "B", which requires the
Subcontractor to complete the Work, herein defined, in accordance with the Project Schedule attached hereto as Exhibit "B"
and the scheduling requirements contained in Article 2 of this Subcontract Agreement ("Subcontract").

CLARK CONTRACTORS, LLC hereby subcontracts to the Subcontractor the furnishing of all labor, material,
insurance, taxes, equipment, scaffolding, hoisting, hoisting equipment, supervision, permits, fees, etc., required for the
following portion or subdivision of the completion of said Project, hereinafter referred to as the "Work," to-wit:

For All [Scopeofwork] in accordance with the Contract Documents defined in Exhibit "D".

Table with 2 columns: Description and Amount. Row 1: SUBCONTRACT AMOUNT. Row 2: 1. Total Contract Amount \$ [TotalSubcontract]. Row 3: 2. Performance & Payment Bonds \$ See Exhibit "A". Row 4: TOTAL SUBCONTRACT AMOUNT \$ [TotalSubcontract].

II. RETAINAGE:
1. Retainage shall be [SubRetainage]% percent in accordance with Article 7.1 of this Subcontract.

III. REFER TO EXHIBIT "A" FOR THE FOLLOWING:

- 1. Schedule of Values Recap.
2. Specifications.
3. Scope of Work.
4. Exclusions.
5. Alternates.
6. Allowances.
7. Unit Prices.
8. Special Terms and Conditions.

IV. NOTES:

1. "Scope of Work" is hereby made a part of this Subcontract Agreement as Exhibit "A".
2. CLARK Contractors, LLC Schedule dated <<udscheduledate>> is hereby made a part of this Subcontract Agreement as Exhibit "B".
3. Sample Insurance Certificate is hereby made a part of this Subcontract Agreement as Exhibit "C". All cost associated with meeting this certificate is to be included in this Subcontractors bid. No change orders will be issued for additional cost related to insurance.
4. "List of Contract Documents" is hereby made a part of this Subcontract Agreement as Exhibit "D".
5. This Subcontractor will provide sufficient manpower to meet the Project Schedule, including any overtime required to maintain the schedule, at no additional charge unless the necessity for overtime is caused by others failing to maintain their schedule through no fault of this Subcontractor or circumstances beyond control (such as "acts of God").
6. This Subcontractor shall comply with the requirements of the Bidding Requirements and Conditions of the Contract and Division 1 – General Requirements as contained in the Specifications.

CLARK Project Manager:	<u>&lt;&lt;ProjectManager&gt;&gt;</u>	Office Phone:	<u>&lt;&lt;PMPhone&gt;&gt;</u>
E-Mail Address:	<u>&lt;&lt;PMEmail&gt;&gt;</u>	Office Fax:	<u>&lt;&lt;PMFax&gt;&gt;</u>
CLARK Project Superintendent:	<u>&lt;&lt;SuperFName&gt;&gt; &lt;&lt;SuperLName&gt;&gt;</u>	Job Phone:	<u>&lt;&lt;SuperCell&gt;&gt;</u>
E-Mail Address:	<u>&lt;&lt;SuperEmail&gt;&gt;</u>	Job Fax:	<u>TBD</u>
For truck material delivery address, use:	<u>&lt;&lt;ShipAddress&gt;&gt;</u>		
(This is not a mailing address)	<u>&lt;&lt;ShipCity&gt;&gt;, &lt;&lt;ShipState&gt;&gt;, &lt;&lt;ShipZip&gt;&gt;</u>		

IN CONSIDERATION WHEREOF, it is agreed, by and between said CLARK CONTRACTORS, LLC and Subcontractor, that Subcontractor will fully and faithfully perform all labor and furnish all material aforesaid necessary to be used in the completion of the above-mentioned Work at Subcontractor's cost and expense, in accordance with, and reasonably inferable from, the plans, drawings, specifications and addenda aforesaid listed in Exhibit "D" as prepared by Architect and in accordance with the Contract between CLARK CONTRACTORS, LLC and the Owner. Subcontractor shall be bound to Contractor by the terms of the Contract Documents, herein defined, and assume toward Contractor all of the obligations and responsibilities of Contractor toward the Owner with respect to the Work.

**ARTICLE 1  
CONTRACT DOCUMENTS**

1.1 **CONTRACT DOCUMENTS:** The "Contract Documents" consist of this Subcontract, Exhibits to this Subcontract, the Contract, Conditions of the Contract (General, Supplementary and other Conditions), including but not limited to all drawings, plans, specifications and addenda to each, issued prior to the execution of either, respectively, and all modifications issued subsequent to the execution of either, respectively, all of which are hereby incorporated herein for all purposes by this reference and made a part of this Subcontract. A list of the items comprising the Contract Documents as of the date of the execution of this Subcontract is attached hereto as Exhibit "D". Within a reasonable time, after written request received from the Subcontractor, the Contractor shall make available for inspection and copying, at the Subcontractor's expense, all Contract Documents.

1.2 **ASSIGNMENT TO OWNER:** If required by the Contract Documents, Subcontractor agrees that the Work and this Subcontract may be assigned by Contractor to the Owner according to the terms of the Contract Documents.

1.3 **GENERAL AND SUPPLEMENTARY CONDITIONS:** The Subcontractor shall comply with the requirements of the General Conditions, Supplementary General Conditions, and Division 1 - "General Requirements" as contained in the Specifications.

1.4 Any preprinted terms or conditions contained in proposals, quotations, bids, etc. are hereby null and void, unless repeated in this Subcontract Agreement.

1.5 Exclusions or qualifications contained in proposals, quotations, bids, etc. are hereby null and void, unless repeated in this Subcontract Agreement or any properly executed change order.

**ARTICLE 2  
SUBMITTALS, WORK SCHEDULE, COMMENCEMENT, AND COMPLETION**

2.1 **SUBMITTAL REQUIREMENTS:** Submittals, in accordance with specifications, are to be provided in the following quantities as soon as possible.

Product Data	<u>«ProductData»</u>	Shop Drawings	<u>«Shop»</u>
Samples	<u>«Samples»</u>	Other	<u>«Other»</u>

If submittals cannot be provided within 15 days of the Subcontract Date, please advise immediately. Subcontractor's field personnel shall maintain an up-to-date set of as-built documents, incorporating all contractual revisions and field changes to their work. All closeout documents, in accordance with specifications, are to be kept up to date as required and provided upon completion of the Work authorized herein. Submittals, closeout documents, and communications regarding same should be directed to:

Name: «PAFName» «PALName» «PAEmail» Telephone: «PACell»  
Address «PAMailAddress», «PAMailCity», «PAMailState» «PAMailZIP»

2.1.1 **VISUAL INSPECTION:** Subcontractor acknowledges that it has visited the Project site and visually inspected the general and local conditions, including but not limited to the availability of skilled labor, which could affect the Work. Any failure of the Subcontractor to reasonably ascertain from a visual inspection of the site the general and local conditions which could affect the Work will not relieve the Subcontractor from its responsibility to properly complete the Work without additional expense to the Contractor.

2.1.2 **APPROVAL OF SUBMITTALS:** Subcontractor acknowledges that it has reviewed the Contract Documents, including but not limited to the plans, specifications, and addenda. The approval of any Subcontractor's submittal shall not be deemed to authorize deviations, substitutions, or changes in the requirements of the Contract Documents, unless approved pursuant to Article 12.

2.1.3 **DESIGN ERRORS OR OMISSIONS:** Any design errors or omissions noted by the Subcontractor shall be reported promptly to the Contractor in writing and in no event after the time required in the Contract Documents.

2.2.1 **WORK SCHEDULE:** The Subcontractor shall commence the Work under this Subcontract as directed by CLARK CONTRACTORS, LLC. Routing of all materials to be subject to designation and control of CLARK CONTRACTORS, LLC. It will be the responsibility of the Subcontractor to check with the Project Superintendent for scheduling, delivery of material, and time for work to start at the job sites for all items covered by this Subcontract. Time is of the essence for the performance of this Subcontract. Subcontractor shall cooperate in scheduling and performing the Work to avoid conflicts or interference in the Subcontractor's Work and the work of others.

2.2.2 **WEEKLY MEETINGS:** Subcontractor must have a representative at the weekly jobsite meetings beginning two (2) weeks before the Subcontractor's start date and thereafter until the Work is completed. Subcontractor's representative at the weekly jobsite meetings must have the authority to make commitments on behalf of this Subcontractor. Failure of Subcontractor to attend these meetings will not relieve Subcontractor of the responsibility to perform the Work or otherwise comply with instructions given out during the meeting.

2.2.3 **DAILY DIARY:** Subcontractor must turn in to the Project Superintendent (daily) a copy of the daily diary, which must include manpower quantities, work activities, and potential problems.



2.2.4 MATERIAL EXPEDITING SCHEDULE: Subcontractor must submit a completed material expediting schedule which will show product, contact person, phone number, fabrication time, and proposed delivery date to be reviewed by the Project Superintendent. The material expediting schedule must be at the jobsite office within 15 days of contract award. (See attached form.)

2.2.5 TIMELY PERFORMANCE: Each Subcontractor must complete the Work in accordance with the Contract Documents and the latest revisions of the CLARK Project Schedule in a manner not to delay other contractors or subcontractors. This Subcontractor will provide sufficient manpower to meet the Project Schedule, including any overtime required to maintain the schedule, at no additional charge.

2.2.6 BEHIND SCHEDULE: Should the Work fall behind schedule, Subcontractor shall provide a written plan of action with means by which Subcontractor intends to regain compliance with the schedule. Subcontractor shall work overtime, weekends, bring in additional personnel, or provide any other measures necessary to comply with the schedule without additional expense to Contractor.

2.2.7 PERMITS, LICENSES, ETC.: The Subcontractor shall, without additional charge to CLARK CONTRACTORS, LLC, obtain and pay for all necessary permits and licenses pertaining to the Work and shall comply with all federal, state, and municipal laws, ordinances, rules, and regulations, whether provided for by the said plans, drawings, specifications, and addenda, or not so provided for, without additional charge or expense to CLARK CONTRACTORS, LLC, and shall be responsible for any and all corrections of any violations thereof to the Work included in this Subcontract, and **the Subcontractor shall indemnify and hold harmless CLARK CONTRACTORS, LLC from and against any and all loss, expense, damage, or injury caused or occasioned, directly or indirectly, by its failure to comply with the provisions of the said laws, ordinances, rules, regulations and requirements, and furnish to CLARK CONTRACTORS, LLC upon demand an affidavit showing such compliance on its part.**

2.2.8 SITE MAINTENANCE: Subcontractor shall provide sufficient, safe, and proper facilities at all times for the inspection by Owner, Architect or CLARK CONTRACTORS, LLC of the Work in the field, at shops or at any other place where materials required hereunder are in course of preparation, manufacture, treatments, or storage, and he shall, within twenty-four (24) hours after receiving written notice from CLARK CONTRACTORS, LLC to that effect, proceed to remove from the site all materials condemned by Architect, whether worked or unworked, and to take down all portions of the work which Architect or CLARK CONTRACTORS, LLC shall upon written notice condemn as unsound or improper, or as in any way failing to conform to the plans, drawings, specifications, and addenda and shall make good all work in other lines damaged by such removal. In the event that all or any portion of the Work as condemned shall be of such nature, or the time available should be so limited, that in the judgment of Architect or CLARK CONTRACTORS, LLC it would not be expedient to order the same replaced or corrected, CLARK CONTRACTORS, LLC at its option may deduct from the payments due or to become due to Subcontractor such amount or amounts as, in the opinion of Architect, shall represent the difference between the fair and reasonable value of the work so condemned and its value had it been executed in conformity with the plans, drawings, specifications and addenda.

2.2.9 CLEANUP: Subcontractor shall clean from the Project site daily all debris resulting from Subcontractor's operations as it accumulates. If this condition is not complied with after twenty-four (24) hours' written notice given by CLARK CONTRACTORS, LLC, removal will be accomplished by CLARK CONTRACTORS, LLC and the cost charged to Subcontractor. In addition to each Subcontractor's daily cleanup responsibilities, once a week there will be an overall job cleanup. Each Subcontractor will supply one or more men for the weekly overall job clean-up, dependent on their crew sizes at the time. CLARK CONTRACTORS, LLC will supervise the weekly overall job cleanup.

### ARTICLE 3 CODES, LAWS & REGULATIONS

3.1 GENERAL: Subcontractor shall comply with all federal, state, and municipal laws, codes, regulations, and ordinances in effect and as enforced where the Work is to be performed, including but not limited to OSHA regulations, safety, working hours, noise, traffic, pollution control, etc. Subcontractor shall provide all adequate notices to authorities regarding the Work and obtain and pay for all permits, fees, licenses, assessments, inspections, and taxes necessary to complete the Work in accordance with the Contract Documents. Any deviation, conflict, or discrepancy between Contract Documents and such laws, rules, regulations, ordinances, or codes shall be brought to the immediate attention of the Contractor in writing.

3.2 EMPLOYMENT TAXES: Subcontractor accepts exclusive liability for all taxes and contributions required of Subcontractor, including federal withholding taxes, taxes under the Federal Social Security Act, and any unemployment compensation law or similar law of any state, with respect to the employees of Subcontractor taking part in the performance of the Work hereunder, and shall, if requested, furnish Contractor with suitable written evidence that Subcontractor has discharged such liability. If Subcontractor fails to furnish such evidence, Contractor may (at its option and without any obligation to do so) pay or reserve for payment said taxes and contributions and deduct the amount so paid or reserved from payments due or to become due Subcontractor or require Subcontractor or its surety, if any, to reimburse Contractor for such expenditures.

3.3 SALES TAXES: Subcontractor shall pay all sales or use taxes and all other federal, state, or local taxes and any penalties or additional charges of any nature in connection therewith applicable in any way to the Work, regardless of the person upon whom such tax is levied. In the event Subcontractor does not make such payment, Contractor (at Contractor's option and without any obligation to do so) may make the payment and deduct the amounts thereof from any sums due or to become due Subcontractor or require Subcontractor or its surety, if any, to reimburse Contractor for such expenditures.

3.4 **TAXES:** The Subcontract amount stated herein includes any and all federal, state, or municipal taxes now levied or in force, or imposed during the life of this Subcontract on any and all tangible personal property sold or transferred to CLARK CONTRACTORS, LLC or the Owner under this Subcontract, and the Subcontractor agrees to pay such tax or taxes on such property, the cost of which shall be considered included in the Subcontract amount mentioned herein. The Subcontractor agrees to pay, and hereby accepts exclusive liability for, any tax, assessment, or contribution for unemployment insurance or Social Security and income tax levied by the federal or any state government on the salaries or wages of all persons employed directly or indirectly by the Subcontractor, and the Subcontractor hereby agrees to comply with all the rules, regulations, and requirements of the federal, state, or municipal authority having jurisdiction thereof in order to relieve CLARK CONTRACTORS, LLC of liability.

ARTICLE 4  
BONDS

4.1 **PERFORMANCE AND PAYMENT BONDS:** Bonds for maintenance, guarantee of workmanship and material, and to insure prompt and faithful performance of the obligations of the Subcontractor, including all warranties and obligations, shall be furnished by Subcontractor as specified or required by CLARK CONTRACTORS, LLC.

**A. None Required**

4.2 **CONTENTS OF BONDS:** All performance bonds and payment bonds shall incorporate this Subcontract by reference and shall provide that the surety waives consent to all changes, modifications, and amendments to this Subcontract. Any such changes, modifications, or amendments which decrease the Subcontract amount shall not in any way alter the amount of the performance bond and payment bond. Any changes, amendments, or modifications which increase the Subcontract amount shall be supported by an increase in the amount of the performance bond and the payment bond to the extent necessary to equal 100 percent of the Subcontract amount as increased.

ARTICLE 5  
INSURANCE, INDEMNITY, AND ATTORNEYS' FEES

5.1.1 **INSURANCE REQUIREMENTS:** Subcontractor further agrees to comply with the more stringent of the project specific insurance requirements or the following minimum insurance requirements, use an insurance company satisfactory to CLARK CONTRACTORS, LLC (A. M. Best, A Minus VII or better), and furnish a certificate of insurance in duplicate immediately, and the endorsement naming CLARK CONTRACTORS, LLC and the Owner as an additional insured, covered as fully as the primary insured under Subcontractor's general liability, automobile liability, and excess liability policy. Should the subcontractor's actual coverage limits exceed those of the project specific insurance requirements or the minimum insurance requirements of CLARK CONTRACTORS, LLC shown in this Agreement or its Exhibits, the subcontractors coverage shall not be limited to the lesser project specific insurance requirements, any minimum limits set forth in this Agreement, or those amounts listed in the Sample Certificate, Exhibit "C". Subcontractor agrees to maintain coverages below for a period of five years or the statute of repose in the state the work is performed, whichever is longer.

**A. WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY – Requirements listed on Sample Certificate, Exhibit "C".**

1. Minimum Employers' Liability Limits of:
  - \$500,000 E.L. Each Accident
  - \$500,000 E.L. Disease Each Employee
  - \$500,000 E.L. Disease – Policy Limit
2. Where permitted by law, coverage shall contain a waiver of subrogation in favor of CLARK Contractors, LLC and the Owner.

**B. GENERAL LIABILITY - Requirements listed on Sample Certificate, Exhibit "C".**

1. Minimum Limits of Liability (but show Maximum Limit Carried on Certificate):
  - \$1,000,000 Each Occurrence
  - \$100,000 Damage to Rented Premises
  - \$10,000 Medical Expense
  - \$1,000,000 Personal & Advertising Injury
  - \$2,000,000 General Aggregate
  - \$2,000,000 Products-Completed Operations Aggregate
2. Commercial general liability coverage shall include contractual liability assumed and shall not contain any separate exclusionary endorsements amending the definition of "insured contract" in the ISO document CG0001 (10/01) or later form. Form CG2139 is **not acceptable** as endorsement.
3. CLARK Contractors, LLC and Owner shall be named as additional insureds on a primary and non-contributory basis. Additional Insured status must apply to both "ongoing & completed operations coverage" and a copy of Additional Insured Endorsement CG 2010 (10/01) **and** CG 2038 (12/19) **and** CG 2037 (10/01) shall be attached to certificate of insurance (or state applicable ISO forms if these forms do not comply in your state). Attachment of policy form pages is not an acceptable alternative to the endorsement.
4. Commercial general liability coverage shall include coverage for "XCU" (explosion, collapse, and underground hazards) as provided in the ISO document CG0001. The coverage shall not contain any endorsements restricting or deleting any portion of the coverage.
5. Commercial general liability coverage shall include the "general aggregate per project".
6. Coverage shall contain a waiver of subrogation in favor of CLARK CONTRACTORS, LLC, and the Owner.
7. Products & completed operations coverage shall be maintained for a minimum of 5 years after completion of work.

**C. AUTOMOBILE LIABILITY - Requirements listed on Sample Certificate, Exhibit "C".**

1. Minimum Limits of Liability (but show Maximum Limit Carried on Certificate):
  - \$1,000,000 Combined Single Limit

2. CLARK CONTRACTORS, LLC and Owner shall be named as an additional insured. Endorsements shall be attached to certificate of insurance.
3. Coverage shall contain a waiver of subrogation in favor of CLARK CONTRACTORS, LLC, and the Owner.

D. **UMBRELLA/EXCESS LIABILITY** - *Requirements listed on Sample Certificate, Exhibit "C".*

1. Minimum Limit of Liability (but show Maximum Limit Carried on Certificate):  
     \$1,000,000 Each Occurrence  
     \$1,000,000 Aggregate
2. CLARK CONTRACTORS, LLC and Owner shall be named as an additional insured. Endorsements shall be attached to certificate of insurance.
3. Coverage shall contain a waiver of subrogation in favor of CLARK CONTRACTORS, LLC, and the Owner.
4. Coverage shall Follow Form over underlying GL, Auto & WC policies.

E. **PROFESSIONAL LIABILITY INSURANCE [IF APPLICABLE] - <udProfessionalLiability>**

*Requirements listed on Sample Certificate, Exhibit "C" and tables below.*

Professional Liability insurance is required to be obtained by the Subcontractor for its acts or those for whom the Subcontractor is legally liable. Subcontractor shall maintain, at its own expense, a professional liability policy with a limit of liability not less than the amount shown in the applicable line of the tables below. Such insurance shall cover professional liability of the Subcontractor and indemnify the Contractor and Owner for any claims or damages arising out of the actual or alleged negligent acts, errors, or omissions in the rendering of or failure to render professional services. Insurance shall include a waiver of subrogation (endorsements shall be attached to certificate of insurance) by Subcontractor's insurer in favor of CLARK CONTRACTORS, LLC and Owner and meet the limits of liability indicated below:

The following Trades are Required to Provide <b>Professional Liability</b> Coverage (limits per table below):			
Site Utilities	Door Frame Installation	Plumbing	Post Tension
Site Concrete	Drywall	Pneumatic Tube	Skylights
Asphalt Paving & Base	Exterior Tile	Electrical	Geopiers
Building Concrete	Ext. Glass and Glazing	Fire Alarm	Elevators
Masonry/Precast	Steel Supplier	Fire Protection	Retaining Walls
Structural Steel	Glass Handrail System	Roof Davits	Water Features
Waterproofing	Exterior Painting	Shoring	Low Voltage Systems
Exterior Siding	Swimming Pool	Structure Bracing	HVAC
EIFS	Kitchen Equipment	Pre-engineered Metal Bldg	Roofing

Subcontract / Work Order Value	Minimum Professional Liability Coverage
Less than \$2,000,000	\$1,000,000 per claim / \$1,000,000 aggregate
\$2,000,000 - \$3,000,000	\$2,000,000 per claim / \$2,000,000 aggregate
\$3,000,000 - \$5,000,000	\$2,000,000 per claim / \$5,000,000 aggregate
\$5,000,000 or more	\$2,000,000 per claim / \$10,000,000 aggregate

F. **POLLUTION INSURANCE [IF APPLICABLE] - <udPollution>**

*Requirements listed on Sample Certificate, Exhibit "C" and table below.*

Pollution insurance is required to be obtained by the Subcontractor. The Subcontractor shall maintain, at its own expense, a pollution liability policy with a limit of liability of \$1,000,000 per occurrence/\$1,000,000 aggregate. Such insurance shall cover all pollution legal liability of the Subcontractor and indemnify CLARK CONTRACTORS, LLC and Owner for any claims or damages arising out of a pollution event. CLARK CONTRACTORS, LLC and Owner shall be named as an additional insured. Insurance shall include a waiver of subrogation by Subcontractor's insurer in favor of CLARK CONTRACTORS, LLC and Owner. Endorsements for additional insured and waiver of subrogation shall be attached to certificate of insurance.

Coverage under Sections E. & F. may be procured through a Combined Professional Liability and Pollution Liability insurance policy.

The following Trades are Required to Provide <b>Pollution Liability</b> Coverage:	
Abatement	Exterior Wall Tile
Masonry	Roofers
EIFS	Wall Panels/Siding
Waterproofing	

- G. CLARK CONTRACTORS, LLC and Owner MUST be named on the certificate as Additional Insured under Subcontractor's General Liability and Automobile Liability. A copy of the Additional Insured Endorsements CG 2010 (10/01) and CG 2038 (12/19) and CG 2037 (10/01) (10/01) shall be attached to the certificate of insurance (or state applicable ISO forms if these forms do not comply in your state). Attachment of policy form pages is not an acceptable alternative to the endorsement.
- H. It will be the responsibility of the Subcontractor to maintain an equipment floater policy. CLARK CONTRACTORS, LLC does not have insurance coverage on the Subcontractor's equipment.
- I. Evidence of workers compensation in the form of a certificate from a temporary labor agency will not be accepted.

5.1.2 The Subcontractor shall maintain in effect all insurance coverage required under this Subcontract at the Subcontractor's sole expense and with insurance companies mutually agreeable to the Contractor and Subcontractor. All insurance policies shall contain the provision that the coverages afforded thereunder shall not be canceled until at least thirty (30) calendar days' prior written notice has been given to the Contractor but in no event shall the notice be less than the number of days required by the Contract Documents for the Contractor to give notice to the Owner of any changes in coverage. If the Subcontractor's insurance carrier(s) will not endorse policies to provide thirty (30) day notice of cancellation to CLARK CONTRACTORS, LLC, the Subcontractor and its Insurance Agent of Record agree to notify CLARK CONTRACTORS, LLC within two days of receipt of such cancellation notice from the insurance carrier. In the event coverage is not renewed or canceled for non-payment of premium the Subcontractor and its Insurance Agent of Record agree to notify Clark in writing within two (2) days of receipt of such notice from the insurance carrier.

5.1.3 **NO IMPLIED WAIVER:** Any waiver of the subcontractor's obligation to furnish such certificate or maintain such evidence must be by written change order and signed by a Managing Member (Officer) of CLARK CONTRACTORS, LLC. Failure of CLARK CONTRACTORS, LLC to demand such certificate or other evidence of full compliance with these insurance requirements or failure of CLARK CONTRACTORS, LLC to identify a deficiency from evidence that is provided shall not be construed as a waiver of the subcontractors obligations to furnish and maintain such insurance, or as a waiver to the enforcement of any of the provisions at a later date.

**5.2.1 INDEMNIFY, DEFEND, AND HOLD HARMLESS: Subcontractor shall defend, indemnify, and hold harmless Clark Contractors, LLC, the Owner, and their respective employees, members, owners, officers, and agents, from all claims, expenses (including attorney's fees), costs, damages, demands, actions, or liability for damage or destruction of property and for injury or death of persons arising from or related to the Subcontractor's performance of the Work and this Subcontract, but only to the extent of the Subcontractor's negligence or fault. Subcontractor's indemnity liability under this provision is not limited by the insurance requirements of this Subcontract or any provision of a workers' compensation statute. Notwithstanding the above, the Subcontractor shall defend, indemnify, and hold harmless Clark Contractors, LLC, the Owner, and their respective employees, members, owners, officers, and agents (the "Indemnitees") from and against all claims, expenses (including attorney's fees), costs, damages, demands, actions or liability arising from or related to the bodily injury or death of an employee of the Subcontractor, its agents, or Subcontractor's subcontractors of any tier.**

**5.2.2 It is the intention of the Subcontractor to defend and indemnify CLARK CONTRACTORS, LLC even in the event that any such claims, expenses, costs, damages, demands, actions, or liability arises in whole or in part from breach of contract, breach of warranties, express or implied, defects in material, products, workmanship or design or condition of property or premises.**

**5.2.3 Subcontractor shall also indemnify CLARK CONTRACTORS, LLC for any and all expenses incurred by CLARK CONTRACTORS, LLC for fines, penalties and corrective measures that result from acts by Subcontractor, its agents, employees, and assignees, in failing to comply with all safety rules, and regulations, including but not limited to Occupational Safety and Health Administration (OSHA) requirements and standards.**

5.3 **ATTORNEYS' FEES:** Should CLARK CONTRACTORS, LLC employ an attorney to enforce any of the provisions hereof, or protect its interest in any matter arising under this Subcontract, or to collect damages for the breach of this Subcontract, or to prosecute or defend any suit resulting from this Subcontract, or to recover on the surety bond given by Subcontractor under this Subcontract, then Subcontractor and its surety, jointly and severally, agree to pay CLARK CONTRACTORS, LLC all reasonable costs, charges, expenses and attorney fees expended or incurred in connection therewith. Included within this indemnity provided in this Article 5, **the Subcontractor shall indemnify CLARK CONTRACTORS, LLC for all premiums, costs, fees, including attorneys' fees, incurred by CLARK CONTRACTORS, LLC to remove liens filed against the Project by subcontractors, suppliers, or otherwise as a result of nonpayment by the Subcontractor.**

## ARTICLE 6 WARRANTY AND DEFECTIVE WORK

6.1 **WARRANTY:** The Subcontractor warrants all Work against defects in material or workmanship for the greater of (a) one (1) year from the date evidenced by the Certificate of Substantial Completion or (b) the period of time required in the Contract Documents.

6.2 **PERFORMANCE WARRANTY:** Subcontractor warrants that the Work shall be performed strictly in accordance with this Subcontract, the plans, specifications, addenda, manufacturer's recommendations and all other Contract Documents, and all Work shall be executed in a workmanlike manner by skilled and reputable workmen.

6.3 **SUBCONTRACT PERFORMANCE:** The Subcontractor shall use its best care, skill, and diligence in supervising and directing the Work. The Subcontractor shall have responsibility and control over performance of the Work, including construction methods, techniques, and means for coordinating and completing the various portions of the Work, unless the Subcontract gives other specific instructions concerning these matters.

6.4 **CONTRACTOR'S EQUIPMENT:** The Subcontractor, its agents, employees, subcontractors, or suppliers shall not use the Contractor's equipment, except upon receipt of express written permission of the Contractor's Project Superintendent and then only in accordance with the Contractor's terms and conditions for such use.

6.5 **DEFECTIVE WORK:** Subcontractor shall correct in a timely fashion any Work rejected by the Contractor or Owner or Architect for failing to comply with the Contract Documents, whether observed prior to the commencement of the warranty period(s) or during the warranty period(s) established by the Contract Documents. The Subcontractor shall make corrections at its own cost and time and bear the expense of additional services for any nonconforming Work for which it is responsible.

## ARTICLE 7 PAYMENT

7.1 **PAYMENTS:** In consideration of the faithful performance by the Subcontractor of all the covenants and conditions, to be paid as the work progresses, on requests to be made of the proportionate amount of materials delivered and accepted and work properly done by Subcontractor, such payments to be **!Undefined Bookmark, SUBRETAIN%** of the amount of such request to be made within seven (7) days after the like amount of each request is received from the Owner by CLARK CONTRACTORS, LLC and in proportion to the amount of such request, the remaining **SubRetainage%** to be paid after that part of the Work and material herein provided for is finally completed to the satisfaction of the Owner and the Architect and has been paid for by the Owner to CLARK CONTRACTORS, LLC, and after all waivers of lien, submittals, closeout documents, and communications have been submitted to CLARK CONTRACTORS, LLC. Notwithstanding anything in this Subcontract to the contrary, all progress payments and the final payment under this Subcontract are contingent upon Owner's acceptance of all Work performed and upon Contractor's receipt of payment from Owner for Work performed by the Subcontractor.

7.2 **WAIVERS OF LIEN:** Subcontractor shall submit a complete list of suppliers and/or subcontractors who will be providing material and/or labor for the operation of this Subcontract and shall include in their schedule of values for each payment request a complete list of all subcontractors, suppliers and other third party obligations, amount owed each supplier and/or subcontractor, and waivers of lien and surety bond claims for the previous month from each supplier and/or subcontractor. The payment request form, monthly partial and final lien and surety bond claim release forms to be used are included with these documents. Subcontractor agrees to provide other such lien releases, sworn statements, etc. as may be requested by the Owner or the Owner's Lender.

7.3 **PAYMENT REQUESTS:** The Subcontractor's original payment request shall be in CLARK CONTRACTORS, LLC Corporate Office, Post Office Box 17361, Little Rock, Arkansas 72222 on or before the 20th day of the month. CLARK CONTRACTORS, LLC will accept payment requests electronically only if the notary seal is clearly visible in the electronic copy. Payment requests shall be submitted in accordance with the sample form attached. The Subcontractor must submit a monthly payment request with their schedule of values broken down as to divisions of work on the payment request form, and shall include in their schedule of values a complete list of all subcontractors, suppliers and other third party obligations, amount owed each supplier and /or subcontractor, and waivers of lien and surety bond claims for the previous month from each supplier and/or subcontractor. CLARK CONTRACTORS, LLC shall have the right to approve or disapprove the breakdown and detail of Subcontractor's payment request. Forms not filled out properly will be returned. Requests received after the cut off date will be held until the following month. No payments will be made until signed Subcontract, request forms, waivers, hazard communication information, performance and payment bonds, if applicable, and insurance certificates are received by CLARK CONTRACTORS, LLC. Payment of any payment request shall not be considered a waiver by Contractor or imply acceptance of the Work.

7.4 **JOINT CHECKS:** CLARK CONTRACTORS, LLC reserves the right to write joint checks to the Subcontractor and its suppliers, subcontractors, etc., if in the sole discretion of CLARK CONTRACTORS, LLC it is necessary to insure payment to those parties or if those parties have issued a notice of nonpayment, a lien, or an intent to lien.

7.5 **RIGHT TO WITHHOLD PAYMENT:** Contractor, without waiver or limitation of any rights or remedies of Contractor, shall be entitled to deduct from any amounts due or owed by Contractor to Subcontractor, in connection with this Subcontract, any and all amounts owed by Subcontractor to Contractor or Owner in connection with this Subcontract including, but not limited to, disputed payment applications or amounts, back charges, payments to sub-subcontractors, payments to providers of material, liquidated damages assessed by the Owner, rework or repairs caused by Subcontractor, or other similar items.

## ARTICLE 8 FINAL PAYMENT

### 8.1 **FINAL PAYMENT:**

- (A) Subcontractor shall submit the final payment request for the original Subcontract amount, plus any approved change orders.
- (B) Subcontractor shall submit a separate payment request for retainage to the Corporate Office in Little Rock, Arkansas. Payment requests for retainage will not be accepted on the same payment request form with any other payment request.
- (C) The request for retainage shall contain a complete list of all third party obligations; amount owed each supplier and/or subcontractor, and final waivers of lien from each supplier and/or subcontractor.
- (D) The request for retainage shall contain a sworn statement that Subcontractor has no other outstanding claims for labor or materials furnished to the Project (other than retainage), and, upon receipt of final payment and retainage, Subcontractor waives all claims for payment against CLARK CONTRACTORS, LLC and the Owner.

8.2 **CLOSEOUT REQUIREMENTS:** All closeout requirements, per specifications, must be received as soon as possible after completion of this Subcontract, but no later than 30 days after the substantial completion date for the Project. (Closeout documents must be received prior to release of final payment.)

ARTICLE 9  
STORAGE AND EQUIPMENT

9.1 **STORED MATERIALS:** Billing for materials is allowed only when submitted in accordance with the Contract Documents and when the material is stored in a bonded warehouse or on the jobsite. The Subcontractor is cautioned not to bring large amounts of materials on the jobsite without prior approval from the Project Superintendent. Stored material on jobsite refers to long lead-time items only. No "storage" will be paid for materials that can be purchased "off-the-shelf" or otherwise readily obtainable. CLARK CONTRACTORS, LLC is not responsible for theft or damage to any material stored off-site. The Subcontractor must submit pictures of all materials stored off-site, clearly marked for this Project, and proof of insurance on the materials stored off-site.

ARTICLE 10  
SAFETY

10.1 **SAFETY REPRESENTATIVE:** The Subcontractor is required to designate an individual at the site in the employ of the Subcontractor who shall act as the Subcontractor's designated safety representative with a duty to prevent accidents. Unless otherwise identified by the Subcontractor in writing to the Contractor, the designated safety representative shall be the Subcontractor's Project Superintendent. The Safety Representative shall identify each Competent Person for specific work activities as required by OSHA.

10.2 **PREVENTION OF ACCIDENTS:** Prevention of accidents at the site is the responsibility of the Subcontractor and all other subcontractors, persons, and entities at the site, including the Contractor. Establishment of a safety program by the Contractor shall not relieve the Subcontractor or other parties of their safety responsibilities. The Subcontractor shall establish its own safety program implementing safety measures, policies, and standards conforming to those required or recommended by the governmental and quasi-governmental authorities having jurisdiction and by the Contractor and Owner, including, but not limited to, requirements imposed by the Contract Documents. The Subcontractor shall comply with the reasonable recommendations of insurance companies having an interest in the Project and shall stop any part of the Work which the Contractor deems unsafe until corrective measures satisfactory to the Contractor shall have been taken. The Contractor's failure to stop the Subcontractor's unsafe practices shall not relieve the Subcontractor of the responsibility.

10.3 **SAFETY REPORT:** Subcontractor shall submit to the Contractor weekly written reports, including but not limited to weekly safety inspections, equipment inspections, weekly safety meeting notes, and any accident reports, on a form acceptable to Contractor.

10.4 **HAZARDOUS SUBSTANCES:** In the event Subcontractor encounters asbestos, lead, polychlorinated biphenyl (PCB), or other hazardous substances at the site which potentially are harmful to persons or property, Subcontractor shall take all steps required by the Contract Documents and by law to protect persons and property from injury or damage, including stopping the Work in the affected areas, and promptly advising the Contractor in writing of the conditions encountered at the site. Should the Subcontractor be required to stop work in any area of the Project as a result of hazardous substances located at the site, then the Subcontractor shall not resume its Work in the affected area until (a) the hazardous substances have been removed or made harmless; (b) the Contractor and Subcontractor agree in writing to commence work in all or a portion of the area; (c) the Owner orders the Work to proceed in the affected area, and the parties agree; or (d) the dispute is resolved as provided for in this Subcontract. The Subcontractor shall not be required to perform work in areas containing asbestos, lead, PCBs, or any other hazardous substances defined by the Contract Documents, without the Subcontractor's consent.

ARTICLE 11  
CLAIMS

11.1 **WRITTEN CLAIM:** The Subcontractor agrees to make all claims against the Contractor for which the Owner is or may be liable in the same manner and within time allowed for the Contractor to make claims against the Owner after the event giving rise to the claim and in sufficient time for the Contractor to make such claims against the Owner. Such claims shall be made in writing and comply with this paragraph to be valid.

11.2 **NOTICE:** The Subcontractor shall give the Contractor written notice of all claims not included in the foregoing paragraph within fourteen (14) calendar days after the date when the Subcontractor knew, or should have known, of the facts giving rise to the event for which claim is made; otherwise, such claims shall not be valid.

11.3 **CLAIM DEFINITION:** A claim is a demand or assertion by the Contractor or the Subcontractor seeking an adjustment in the Subcontract amount and/or time for performance of the Work, an adjustment or interpretation of the Subcontract terms, or other relief arising under or relating to this Subcontract, including the resolution of any matters in dispute between the Contractor and Subcontractor in connection with the Project.

11.4 The Subcontractor shall carry on the Work and maintain the Schedule of Work pending final resolution of a claim, unless the Subcontractor has been terminated or the Work suspended as provided for in the Contract with the Owner, or the parties otherwise agree in writing to a partial or total suspension of the Work. If the Subcontractor is continuing to perform in accordance with this Subcontract, Contractor shall continue to make payments as required by the Subcontract.

11.5 **RESOLUTION BY CHANGE ORDER:** Whenever the Subcontractor submits a claim for adjustment under any clause of the Subcontract, such claim shall include all types of adjustments in the total amounts to which the clause entitles the Subcontractor, including but not limited to adjustments arising out of delays or disruptions or both caused by such change. Except as the parties may otherwise expressly agree, the Subcontractor shall be deemed to have waived (i) any adjustments to which it otherwise might be entitled under the clause where such claim fails to request such adjustments, and (ii) any increase in the amount of equitable adjustments additional to those requested in the claims. Execution of any related change order forecloses, settles, and releases Contractor from any other claims or liability for additional time or adjustment of the subcontract amount for all matters included in the timely written claim.

ARTICLE 12  
CHANGES

12.1 **CHANGES:** Subcontractor shall perform any and all changes from the original plans and specifications without nullifying the Subcontract when specifically ordered to do so in writing by the Contractor. Subcontractor, prior to commencement, shall submit to Contractor within 14 days after request written copies of the cost or credit proposal, with sufficient breakdowns and documentation, for such work in a manner consistent with the Contract Documents. Breakdowns and documentation to include, but not be limited to, quantities, man hours, labor rates, labor burden rates, material unit prices, sales tax and equipment for each line item of work, overhead & profit, copies of change order requests and/or quotations from subcontractors and suppliers with equivalent breakdowns and documentation, and any other evidence required by the Owner, Architect or CLARK CONTRACTORS, LLC.

12.2.1 **FIELD WORK AUTHORIZATION OR FIELD PURCHASE ORDER:** The Contractor may order work not a part of the scope of this Subcontract, including the purchase of materials and the furnishing of labor. In such a case the extra work will be invoiced and paid as a separate work item. Authorizations for "extra work" shall not be used to circumvent the intent or scope of the Work of this Subcontract. Only signed CLARK Work Authorization Forms or CLARK Field Purchase Orders can authorize changes to the Work.

12.2.2 **PRIOR APPROVAL:** There will be no consideration given by the Contractor for requests for payments in excess of the Subcontract amount, unless specifically authorized, in writing, and approved by the Project Manager before the extra work is done. Any liens instituted as a result of an unauthorized claim will be the sole responsibility of the Subcontractor to release before any scheduled monthly pay requests are paid or retainage is released.

12.3 **INCIDENTAL CHANGES:** The Contractor may direct the Subcontractor to perform incidental changes in the Work which do not involve adjustments in the Subcontract price or Subcontract time. Incidental changes shall be consistent with the scope and intent of the Contract Documents. The Contractor shall initiate an incidental change in the Work by issuing a written order to the Subcontractor. Such written orders shall be carried out promptly and are binding on the parties.

ARTICLE 13  
REMEDIES

13.1 **REMEDIES:** If the Subcontractor refuses or fails: (i) to correct any Work rejected by the Contractor, Architect or Owner; (ii) to supply enough properly skilled workers, proper materials, or maintain the Schedule of Work; or (iii) to make prompt payment to workers, subcontractors, or suppliers, or disregards law, ordinances, rules, regulations or orders of any public authority having jurisdiction, or otherwise is guilty of a material breach of a provision of this Subcontract, the Subcontractor may be deemed in default of this Subcontract. If the Subcontractor fails within seventy-two (72) hours after written notification to commence and continue satisfactory correction of such default with diligence and promptness, then the Contractor, without prejudice to any other rights or remedies, shall have the right to any or all of the following remedies:

- (i) supply such number of workers and quantity of materials, equipment, and other facilities as the Contractor deems necessary for the satisfactory correction of such default, which the Subcontractor has failed to complete or perform after the aforesaid notice, and charge the cost thereof to the Subcontractor, who shall be liable for the payment of same, including reasonable overhead, profit, and attorneys' fees;
- (ii) contract with one or more additional contractors, to perform such part of the Work as the Contractor shall determine will provide the most expeditious correction of the default and charge the cost thereof to the Subcontractor;
- (iii) withhold payment, in the amount deemed necessary by the Contractor to protect the Contractor, of moneys due the Subcontractor in accordance with this Subcontract; and
- (iv) in the event of an emergency affecting the safety of persons or property, the Contractor may proceed to commence and continue satisfactory correction of such default, without first giving seventy-two (72) hours' written notice to the Subcontractor, but shall thereafter give prompt written notice of such action to the Subcontractor.
- (v) in the event the Subcontractor fails to provide manpower to the project or completely abandons the project for a period of seventy-two (72) hours, the Contractor may proceed to commence and continue satisfactory correction of such default, without first giving seventy-two (72) hours' written notice to the Subcontractor, but shall thereafter give prompt written notice of such action to the Subcontractor.

13.2 **TERMINATION OF SUBCONTRACTOR:** If the Subcontractor fails to commence and satisfactorily continue to cure correction of a default after seventy-two (72) hours' written notification issued under the above paragraph, then the Contractor may, in lieu of or in addition to the remedies set forth in this numbered paragraph, issue a written notice of termination to the Subcontractor and terminate this Subcontract.

13.3.1 **CONTRACTOR'S RIGHTS TO PERFORM:** The Contractor also may furnish materials and equipment and/or employ such workers or subcontractors as the Contractor deems necessary to maintain the orderly progress of the Work.

13.3.2 All costs incurred by the Contractor in performing the Work, including reasonable overhead, profit, and attorneys' fees, shall be deducted from any monies due or to become due the Subcontractor under this Subcontract. The Subcontractor shall be liable for the payment of any amount by which such expense exceeds the unpaid balance of the Subcontract amount. If the unpaid balance of the Subcontract amount exceeds the expense of finishing the Work, such excess shall be paid to the Subcontractor.

13.3.3 If the Contractor performs the Work under this Article, or subcontracts such work to be so performed, the Contractor and/or the persons to whom the Work has been subcontracted shall have the right to take and use any materials, implements, equipment, appliances or tools furnished by, belonging or delivered to the Subcontractor and located at the Project for the purpose of completing any remaining Work. Immediately upon completion of the Work, any remaining materials, implements, equipment, appliances or tools not consumed or incorporated in performance of the Work, and furnished by, belonging to, or delivered to the Project by or on behalf of the Subcontractor, shall be returned to the Subcontractor in substantially the same condition as when they were taken, normal wear and tear excepted.

13.4 **LIQUIDATED DAMAGES:** If the Contract Documents provide for liquidated damages for delay beyond the completion date set forth in the Contract Documents, and such damages are assessed by the Owner against the Contractor, then the Contractor, in its discretion, may assess and apportion such damages against the Subcontractor in proportion to its share of the responsibility for such delay and damage, but no more. The amount of such assessment against the Subcontractor, if any, shall not exceed the Subcontractor's proportionate share of the responsibility for such delay and damage and shall never exceed the amount assessed against the Contractor by the Owner. Nothing in this paragraph shall limit the Contractor's right to actual damages sustained by the Contractor as a result of Subcontractor's delay.

13.5 **BACK CHARGES BY SUBCONTRACTOR:** Charges from Subcontractor to CLARK CONTRACTORS, LLC or any subcontractor on this Project will not be honored or paid by CLARK CONTRACTORS, LLC unless charges are authorized and approved in writing by an authorized representative of CLARK CONTRACTORS, LLC.

13.6 **LABOR STRIKES OR WORK STOPAGES:** Subcontractor shall at all times supply a sufficient number of skilled workers to perform the work covered by this subcontract with promptness and diligence. Should any workers performing work covered by this Subcontract engage in a strike or other work stoppage or cease to work due to picketing or a labor dispute of any kind, CLARK CONTRACTORS, LLC may, at its option and without prejudice to any other remedies it may have, after seventy-two (72) hours written notice to Subcontractor, provide any such labor and deduct the cost thereof from any monies then due or thereafter to become due Subcontractor.

ARTICLE 14  
MISCELLANEOUS

14.1 **GOVERNING LAW AND CONSENT TO JURISDICTION AND VENUE:** The Subcontractor hereby submits to and consents to personal jurisdiction within the State of Arkansas should a dispute arise out of this Subcontract. Subcontractor agrees that Little Rock, Pulaski County, Arkansas shall be the exclusive venue for litigation. The Subcontractor specifically agrees that this Subcontract shall be interpreted and construed according to Arkansas law, including its conflicts of law rules, and that all disputes arising out of the Subcontract shall be governed by Arkansas law.

14.2 **FURTHER ASSISTANCE:** The Subcontractor agrees that from time to time hereafter, upon request of CLARK CONTRACTORS, LLC, Subcontractor will execute, acknowledge, and deliver such other instruments and documents and take such further action as may be reasonably necessary to carry out the intent of this Subcontract.

14.3 **MODIFICATION:** No provision contained herein may be modified, amended, or waived, except by written change order signed by both parties.

14.4 **HEADINGS AND CAPTIONS:** Subject headings and captions are included for convenience purposes only and shall not affect the interpretation of this agreement.

14.5 **NOTICE:** All notices, consent, requests, demands, and other communications permitted or required hereunder shall be in writing and either (i) delivered in person; (ii) sent by express mail or other overnight delivery service providing receipt of delivery; (iii) mailed by certified mail, postage prepaid, return receipt requested; or (iv) sent by telecopy or other facsimile transmission (except for payment requests) as follows:

If to CLARK CONTRACTORS, LLC addressed or delivered in person to:

William E. Clark, Managing Member  
CLARK CONTRACTORS, LLC  
15825 Cantrell Road  
Little Rock, Arkansas 72223  
Facsimile Number: (501) 868-3104

If to Subcontractor, addressed or delivered in person to:

«FirmName» «udaddtlnfo»

(name)

«MailAddress»

(street address)

«MailCity», «MailState» «MailZip»

«FirmFax»

(facsimile number)

or to such other address as either party may designate by written notice. Email does not constitute written notice under this Subcontract.

14.6 **SEVERABILITY:** If any portion of this Subcontract is held invalid, illegal, or unenforceable, such determination shall not impair the enforceability of the remaining terms and provisions herein.

14.7 **NO ASSIGNMENT BY SUBCONTRACTOR:** It is agreed that no part of this Subcontract will be assigned or delegated by Subcontractor without written approval of CLARK CONTRACTORS, LLC.

14.8 **REMOVAL OF LIENS:** Subcontractor agrees to hold CLARK CONTRACTORS, LLC harmless from the filing of any liens arising out of the operation of this Subcontract. Should any such lien be filed, Subcontractor will immediately cause same to be removed in any manner provided by the laws of the state where the Project is located.



14.9 WAIVER: No waiver of a breach or violation of any provision of this Subcontract shall operate or be construed as a waiver of any subsequent breach or limit or restrict any right or remedy otherwise available.

14.10 RIGHTS AND REMEDIES CUMULATIVE: The rights and remedies expressed herein are cumulative and not exclusive of any rights and remedies otherwise available.

14.11 ENTIRE AGREEMENT: This document (together with the plans, drawings, specifications, addenda, schedules, and exhibits attached hereto or referred to herein) constitutes the entire agreement of the parties and supersedes any and all other prior agreements, oral or written, with respect to the subject matter contained herein. There are no representations, warranties, covenants, or agreements between the parties hereto with respect to this transaction, except those expressly set forth herein.

14.12 INCORPORATION BY REFERENCE: All schedules, exhibits, drawings, specifications, addenda, and documents referred to in this Subcontract shall be deemed incorporated herein by any reference thereto as if fully set out.

14.13 AUTHORITY: Each individual signing this Subcontract in a representative capacity acknowledges and represents that he/she is duly authorized to execute this Subcontract in such capacity in the name of, and on behalf of, the designated corporation, partnership, trust, or other entity.

14.14 RIGHT OF OFFSET: CLARK CONTRACTORS, LLC has the right to offset against amounts otherwise owed by CLARK CONTRACTORS, LLC to the Subcontractor pursuant to this Subcontract against other amounts which Subcontractor may owe to CLARK CONTRACTORS, LLC pursuant to this Subcontract or any other obligations owed by Subcontractor to CLARK CONTRACTORS, LLC, whether related to this Subcontract, other subcontracts, or based upon common law rights and obligations.

14.15 CONFIDENTIALITY. The Subcontractor shall not publish, permit to be published, or distribute for public consumption or otherwise, any information, oral or written concerning the Work, the Contractor, the Contract Documents, contract performance, or any other matter relating to the Contractor without the prior written consent of the Contractor, except to its attorneys, counsel, representatives and other advisors and Subcontractors, all of which the Subcontractor shall ensure are subject to this same confidentiality restriction.

## ARTICLE 15

### TERMINATION FOR CONVENIENCE

15.1 In addition to other rights the Contractor may have at law or under this Subcontract with respect to cancellation or termination, the Contractor may terminate performance or Work under this Subcontract in whole or, from time to time, in part, if the Contractor determines that a termination is appropriate for its convenience or Contractor fails to enter into the Contract with the Owner. The Contractor shall terminate by delivering to the Subcontractor a written Notice of Termination for Convenience specifying the extent of termination and the effective date.

15.2 After receipt of a Notice of Termination, and except as directed by the Contractor, the Subcontractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this Clause:

15.2.1 Stop work as specified in the Notice of Termination;

15.2.2 Place no further subcontracts or orders (referred to as subcontracts in this paragraph) for materials, services, or facilities, except as necessary to complete the continued portion of the Contract;

15.2.3 Terminate all subcontracts to the extent they relate to the Work terminated;

15.2.4 Assign to the Contractor, as directed by the Contractor, all right, title, and interest of the Subcontractor under the subcontracts terminated, in which case the Owner shall have the right to settle or to pay any termination settlement proposal arising out of those terminations;

15.2.5 With approval or ratification to the extent required by the Contractor, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this paragraph;

15.2.6 As directed by the Contractor, transfer title and deliver to the Contractor (a) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (b) the completed or partially completed plans, drawings, information and other property that if the Subcontract had been completed, would be required to be furnished to the Contractor;

15.2.7 Complete performance of the work not terminated;

15.2.8 Take any action that may be necessary, or that the Contractor may direct, for the protection and preservation of the property related to this Subcontract that is in the possession of the Subcontractor and in which the Contractor has or may acquire an interest; and

15.2.9 Use its best efforts to sell, as directed or authorized by the Contractor, any property of the types referred to in Clause 15.2.6 of this Subparagraph; provided, however, that the Subcontractor (a) is not required to extend credit to any purchaser and (b) may acquire the property under the conditions prescribed by, and at prices approved by, the Contractor. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Contractor under this Contract, credited to the price or cost of the Work, or paid in any other manner directed by the Contractor.

15.3 The Contractor and Subcontractor may agree upon the whole or any part of the amount to be paid because of termination. The amount shall not exceed the original Subcontract Sum (as adjusted by Change Orders previously made) reduced by the amount of payments previously made and by the price of work not terminated and not then completed (as measured by the then current schedule of values).

15.4 If the Contractor and Subcontractor fail to agree on the whole amount, the Contractor shall pay and the Subcontractor shall accept as full satisfaction amounts determined as follows, but without duplication of any amounts agreed upon in the above paragraph.

15.4.1 For Subcontract Work performed and not paid for before the effective date of termination, the value of said Work so long as that amount is not in dispute, as depicted in the then current schedule of values, and the actual reasonable costs of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of this Contract; and

15.4.2 The actual reasonable costs of settlement of the work terminated, including accounting, legal, clerical, other expenses necessary for the preparation of termination settlement proposals and supporting data, storage, transportation and other costs necessary for the preservation, protection or disposition of termination inventory; but not including anticipated profits on any work not performed and unabsorbed overhead allocated to any work not performed.

15.5 Except for normal spoilage, and except to the extent that the Contractor expressly assumed the risk of loss, the Contractor shall exclude from the amounts payable to the Subcontractor, the fair value, as determined by the Contractor, of property that is destroyed, lost, stolen or damaged so as to become undeliverable to the Contractor.

15.6 In arriving at the amount due the Subcontractor, there shall be deducted:

15.6.1 All unliquidated advance or other payments to the Subcontractor under the terminated portion of this Contract;

15.6.2 Any Claim which the Contractor has against the Subcontractor under this Contract; and

15.6.3 The agreed price for, or the proceeds of sale of materials, supplies, or other things acquired by the Subcontractor or sold under the provisions of the Paragraph and not recovered by or credited to the Contractor.

15.7 If the termination is partial, the Subcontractor may file a proposal with the Contractor for an adjustment of the prices(s) of the continued portion of the Contract. The Contractor may make any adjustment agreed upon. Any proposal by the Subcontractor for an adjustment under this Paragraph shall be requested within thirty (30) days from the effective date of termination unless extended in writing by the Contractor.

15.8 The Contractor may, under the terms and conditions prescribed herein, make partial payments and payments against costs incurred by the Subcontractor for the terminated portion of the Contract, if the Contractor believes the total of these payments will not exceed the amount to which the Subcontractor will be entitled.

15.9 The Subcontractor shall maintain all records and documents to the terminated portion of this Subcontract for three (3) years after final settlement. This includes all books and other evidence bearing on the Subcontractor's costs and expenses under this Contract. The Subcontractor shall make these records and documents available to the Contractor in accordance with the audit and access to records provisions of this Contract.

*EXECUTION OF THIS DOCUMENT INDICATES THAT BOTH PARTIES HAVE REVIEWED AND UNDERSTAND ALL PAGES (as enumerated at the bottom of this page) OF THIS SUBCONTRACT AGREEMENT AND EXHIBITS TO THIS SUBCONTRACT AGREEMENT.*

Dated this \_\_\_\_\_ Day of \_\_\_\_\_ 20\_\_\_\_\_ At \_\_\_\_\_ Little Rock, Arkansas \_\_\_\_\_

«FirmName» «udaddtlinfo» \_\_\_\_\_ CLARK CONTRACTORS, LLC

By: \_\_\_\_\_ By: \_\_\_\_\_

Printed Name: \_\_\_\_\_ William E. Clark / Managing Member

Printed Title: \_\_\_\_\_ Authorized Representative Authorized Representative

ADDRESS CORRESPONDENCE TO CLARK CONTRACTORS, LLC, P.O. BOX 17361, LITTLE ROCK, ARKANSAS 72222-7361



# CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)  
 <Show Date Here>

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER  <Show Producer Name & Address Here>	CONTACT NAME: <Show Producer Contact Name Here> PHONE (A/C, No, Ext): <Show Phone #>      FAX (A/C, No): <Show Fax #> E-MAIL: <Show E-mail Here> ADDRESS: <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:80%;">INSURER(S) AFFORDING COVERAGE</th> <th style="width:20%;">NAIC #</th> </tr> </thead> <tbody> <tr> <td>INSURER A: Show exact name of Insurance Company</td> <td>Show NAIC #</td> </tr> <tr> <td>INSURER B: Show exact name of Insurance Company</td> <td>Show NAIC #</td> </tr> <tr> <td>INSURER C: Show exact name of Insurance Company</td> <td>Show NAIC #</td> </tr> <tr> <td>INSURER D: Show exact name of Insurance Company</td> <td>Show NAIC #</td> </tr> <tr> <td>INSURER E: Show exact name of Insurance Company</td> <td>Show NAIC #</td> </tr> <tr> <td>INSURER F: Show exact name of Insurance Company</td> <td>Show NAIC #</td> </tr> </tbody> </table>	INSURER(S) AFFORDING COVERAGE	NAIC #	INSURER A: Show exact name of Insurance Company	Show NAIC #	INSURER B: Show exact name of Insurance Company	Show NAIC #	INSURER C: Show exact name of Insurance Company	Show NAIC #	INSURER D: Show exact name of Insurance Company	Show NAIC #	INSURER E: Show exact name of Insurance Company	Show NAIC #	INSURER F: Show exact name of Insurance Company	Show NAIC #
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INSURER E: Show exact name of Insurance Company	Show NAIC #														
INSURER F: Show exact name of Insurance Company	Show NAIC #														
INSURED  <Show Insured Name & Address Here>															

**COVERAGES**

**CERTIFICATE NUMBER:**

**REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE   <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY   <input checked="" type="checkbox"/> PROJECT   <input type="checkbox"/> LOC			Show Policy # Here	MM/DD/YY	MM/DD/YY	EACH OCCURRENCE \$ <b>1,000,000</b> DAMAGE TO RENTED PREMISES (Ea occurrence) \$ <b>100,000</b> MED EXP (Any one person) \$ <b>10,000</b> PERSONAL & ADV INJURY \$ <b>1,000,000</b> GENERAL AGGREGATE \$ <b>2,000,000</b> PRODUCTS - COMP/OP AGG \$ <b>2,000,000</b>
	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS			Show Policy # Here	MM/DD/YY	MM/DD/YY	COMBINED SINGLE LIMIT (Ea accident) \$ <b>1,000,000</b> BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
	<input checked="" type="checkbox"/> UMBRELLA LIAB   <input checked="" type="checkbox"/> OCCUR <input type="checkbox"/> EXCESS LIAB   <input type="checkbox"/> CLAIMS-MADE DED      RETENTION \$			Show Policy # Here	MM/DD/YY	MM/DD/YY	EACH OCCURRENCE \$ <b>1,000,000</b> AGGREGATE \$ <b>1,000,000</b> \$ Show maximum Limits Carried
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICE/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y / N	N / A	Show Policy # Here	MM/DD/YY	MM/DD/YY	<input checked="" type="checkbox"/> WC STATUTORY LIMITS   <input type="checkbox"/> OTHER E.L. EACH ACCIDENT \$ <b>500,000</b> E.L. DISEASE - EA EMPLOYEE \$ <b>500,000</b> E.L. DISEASE - POLICY LIMIT \$ <b>500,000</b>
	Professional Liability Pollution Liability			Show Policy # Here Show Policy # Here	MM/DD/YY MM/DD/YY	MM/DD/YY MM/DD/YY	<b>See Chart in Contract</b> <b>\$1,000,000 Occurrence/Aggregate</b>

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Project Name: <List Project Here>

See Attached Addendum for Additional Remarks

**CERTIFICATE HOLDER**

Sample Sub Contractor Certificate>

Clark Contractors, LLC  
 P O Box 17361  
 Little Rock AR 72222

**CANCELLATION**

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

<Signature of Agent Must Be Shown Here>



### ADDITIONAL REMARKS SCHEDULE

<b>AGENCY</b> <Show Agency Name Here>		<b>NAMED INSURED</b>	
<b>POLICY NUMBER</b>		<Show Insured Name Here>	
<b>CARRIER</b>	<b>NAIC CODE</b>	<b>EFFECTIVE DATE:</b>	

**ADDITIONAL REMARKS**

THIS ADDITIONAL MARKS IS A SCHEDULE TO ACCORD FORM,

**FORM NUMBER 25** **FORM TITLE:** Certificate of Liability (05/19/2022)

Clark Contractors, LLC & Project Owner(s) are included as Additional Insured under the Auto Liability and Additional Insured under the General Liability for both "Ongoing Operations" per CG2010 (10/01) and CG2038 (12/19) and "Products/Completed Operations" per CG2037 (10/01), endorsements attached as required by written contract. (or state applicable ISO forms if these forms do not comply in your state)

Clark Contractors, LLC and Project Owner MUST be named on the certificate of insurance as Additional Insured under the Subcontractor's General Liability, Automobile Liability, Umbrella Liability, and Pollution Liability, endorsements attached as required by written contract.

A Waiver of Subrogation in favor of Clark Contractors, LLC & Project Owner(s) applies to the General Liability, Auto Liability, Umbrella Liability, Workers Compensation, Professional Liability, and Pollution Liability, endorsements attached as required by written contract.

The Umbrella/Excess policy follows over the above terms and conditions as required by written contract.

The General Liability, Auto Liability, Workers Compensation & Umbrella policies have been endorsed to provide prior written notice of cancellation to Clark Contractors, LLC as required by written contract.

## SECTION 00 70 00

### GENERAL CONDITIONS

#### ARTICLE 1 -- GENERAL PROVISIONS

##### 1.1 DEFINITIONS

- 1.1.1 Contract Documents: Contract Documents consist of Agreement; Invitation to Bid; Instruction to Bidders; the Bid Form; the Bid and the Performance and Payment bonds; General and Supplementary Conditions; Specifications; Drawings; Addenda issued prior to execution of the Contract; all Owner approved Change Orders; other documents listed or referred to in the Agreement; and modifications issued after execution of the Contract and signed by Contractor and Owner.
- 1.1.2 Contract: The Contract Documents form the Contract for construction. The Contract Documents will not be construed to create a contractual relationship between the Design Professional and Contractor, between the Owner and a subcontractor, between the Owner and Design Professional, or between entities other than the Owner and Contractor.
- 1.1.3 Work: Construction and services required by the Contract Documents whether completed or partially completed, include tools, labor, equipment, supplies, transportation, handling, and incidentals provided by the Contractor.
- 1.1.4 Project: The total capital improvement project described in the Contract Documents.
- 1.1.5 Drawings: Graphic and textual portions of the Contract Documents showing the design, location, and dimensions and size of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.1.6 Specifications: Written requirements for materials, equipment, systems, standards, and workmanship for the Work, and performance of related services.
- 1.1.7 Project Manual: Volume, which may include the bidding requirements, forms, contracting requirements, and the Specifications.
- 1.1.8 Owner: The person or entity identified as such in the Contract Agreement referred to throughout the Contract Documents as singular in number. The term Owner means the Owner and the Owner-authorized representative.
- 1.1.9 Contractor: The person or entity identified as such in the Contract Agreement referred to throughout the Contract Documents as singular in number. The term Contractor means the Contractor or the Contractor-authorized representative.
- 1.1.10 Design Professional (Architect/Engineer/Consultant): The person or entity identified as such in the Agreement, lawfully licensed to practice architecture or engineering or another field of expertise and under contract to Owner to provide design service, advice, and consultation, referred to throughout the Contract Documents as if singular in number. The term Design Professional means the Architect/Engineer/ Consultant or the authorized representative.
- 1.1.11 Subcontractor: Any person, firm, or corporation with a direct contract with the Contractor who acts for or in behalf of the Contractor in executing a portion of the Work. The term subcontractor is referred to as singular in number and means the subcontractor or the subcontractor-authorized representative.

1.1.12 Inspector: A duly authorized representative of the Owner, and Design Professional, designated for detailed inspection of materials, construction, workmanship, and methods of construction.

1.1.13 Site: The particular location of that part of the project being considered.

1.1.14 State: The Owner.

## 1.2 INTENT

1.2.1 The intent of the Contract Documents is to set forth the standards of construction, the quality of materials and equipment, the guarantees that are to be met, and to include items necessary for proper execution and completion of the Work. The Contract Documents are complementary and what is required by one will be as binding as if required by all. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable as necessary to produce indicated results.

1.2.2 Organization of the Specifications into divisions, sections, and articles, and arrangement of Drawings will not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

1.2.3 Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

## 1.3 CAPITALIZATION

1.3.1 Terms capitalized in the Contract Documents include those which are specifically defined, the titles to numbered sections and articles, identified references to paragraphs, and the titles of other published documents.

## 1.4 INTERPRETATION

1.4.1 Whenever in these Contract Documents the words "as ordered", "as directed", "as required", "as permitted", "as allowed", or words or phrases of like import are used, it shall be understood that the order, direction, requirement, permission, or allowance of the Owner and Design Professional is intended.

1.4.2 Whenever in these Contract Documents the word "product" is used, it shall be understood that the materials, systems, and equipment will be included.

1.4.3 Whenever in these Contract Documents the word "provide" is used, it shall be understood that it means to "furnish and install".

1.4.4 The Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an", but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

## ARTICLE 2 -- OWNER

### 2.1 LAND

2.1.1 The Owner will provide the lands shown on the Drawings upon which the Work shall be performed. The Owner will provide a right-of-way for access to the project site.

2.1.2 The Owner will provide base lines for the location of the principle component parts of the Work with a suitable number of bench marks adjacent to the Work.

## 2.2 **RIGHT OF ENTRY BY OWNER**

2.2.1 The Owner and his authorized representative will have the right to enter the property or location on which the Work shall be constructed. The Owner further reserves the right to construct or have his authorized agents construct such work as the Owner will desire, so long as these operations do not interfere with or delay the work being constructed under this Contract.

## 2.3 **OWNER'S RIGHT TO CARRY OUT THE WORK**

2.3.1 If the Contractor defaults or neglects to perform the Work in accordance with the Contract Documents, including the requirements with respect to the schedule of completion, and fails after ten days written notice from the Owner to correct the deficiencies, the Owner may deduct the cost thereof from the payment then or thereafter due the Contractor.

## **ARTICLE 3 -- CONTRACTOR**

### 3.1 **GENERAL**

3.1.1 The Contractor shall perform the Work in accordance with the Contract Documents.

3.1.2 The Contractor shall furnish labor, materials, equipment, and transportation necessary for the proper execution of the work unless specifically noted otherwise. The Contractor shall do all the work shown on Drawings and described in Specifications and all incidental work considered necessary to complete the project in a substantial and acceptable manner, and to fully complete the work or improvement, ready for use, occupancy and operation by the Owner. Drawings and Specifications shall be interpreted by the Design Professional or the Owner if no Design Professional exists for the project.

3.1.3 The Contractor shall cooperate with the Owner, Design Professional, inspectors, and with other contractors on the Project. Contractor shall allow inspectors acting in an official capacity, to have access to the project site.

3.1.4 The Contractor shall determine that the final and completed work on the project is in accordance with the Contract Documents. The failure of the Design Professional to find or correct errors or omissions in the use of materials or work methods during the progress of the work shall not relieve the Contractor from his responsibility to correct all the defects in the project.

3.1.5 The Contractor shall assist in making final inspections and shall furnish such labor and equipment as may be required for the final tests of equipment, piping, and structures.

### 3.2 **REVIEW OF FIELD CONDITIONS**

3.2.1 Before ordering material or doing Work, the Contractor shall verify all measurements involved and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of difference between actual dimensions and the measurements indicated on Drawings; differences which may be found, shall be submitted to Design Professional for consideration before proceeding with the Work.

3.2.2 Drawings may show the location or existence of certain exposed and buried utilities as well as existing surface and subsurface structures. The Owner assumes no responsibility for failure to show any or all such utilities and structures on the Drawings or to show such in the exact location. It is mutually agreed such failure will not be considered sufficient basis for claims for extra work or for

increasing the pay quantities in any manner unless the obstruction encountered necessitates substantial changes in the lines or grades or requires the building of a special structure.

### **3.3 REVIEW OF CONTRACT DOCUMENTS**

3.3.1 The Contractor shall study and compare Drawings, Specifications, and other instructions and shall report to the Design Professional at once any error, inconsistency, or omission discovered.

3.3.2 In the event of conflict among the Contract Documents, interpretations will be based on the following order of precedence, stated highest to lowest:

- a. The Agreement
- b. This Division Zero (0) shall control in the event of conflict between this Division Zero (0) and other Divisions 1 through 16
- c. Addenda to Drawings and Specifications with those of later date having precedence.
- d. Drawings and Specifications

3.3.3 Since the Contract Documents are complementary, the Contractor shall take no advantage of any apparent error or omission in the Drawings and Specifications. The Owner or Design Professional shall furnish interpretations as deemed necessary for the fulfillment of the intent of the Drawings and Specifications.

3.3.4 Discrepancies found between the Drawings and Specifications and actual site conditions or any errors or omissions in the Drawings or Specifications shall be immediately reported to the Design Professional or in the case where a Design Professional is not on the Project, the Owner shall be notified, who shall address such error or omission in writing. Work done by the Contractor after discovery of such discrepancies, errors, or omissions shall be at the Contractor's risk and expense.

### **3.4 REQUEST FOR SUPPLEMENTARY INFORMATION**

3.4.1 The Contractor shall make timely requests of the Owner or Design Professional for additional information required for the planning and production of the Work. Such requests shall be submitted as required, but shall be filed in ample time to permit appropriate action to be taken by all parties involved so as to avoid delay. Contractor understands and agrees that it is Contractor's duty to determine the need for, and to request said additional information in writing from the Design Professional by such date as allows Design Professional to provide the information to the Contractor by a date that will not adversely affect Contractor's ability to complete the Work by the date specified in the Contract.

3.4.2 Additional instructions may be issued by the Design Professional during the progress of the Work to clarify the Drawings and Specifications or as may be necessary to explain or illustrate changes in the Work.

### **3.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

3.5.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

3.5.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.



3.5.3 Samples are physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged.

3.5.4 The Contractor shall provide shop drawings and other submittals, settings, schedules, and other drawings as may be necessary for the prosecution of the Work in the shop and in the field as required by the Drawings, Specifications, or Design Professional instructions.

### **3.6 LABOR AND MATERIALS**

3.6.1 Except as otherwise specifically stated in the Contract, the Contractor shall provide, but not be limited to, all materials, labor, tools, equipment, water, light, heating and cooling, power, transportation, superintendence, temporary construction of every nature, taxes legally collectible because of the work, and all other services and facilities of every nature whatsoever necessary to complete the Work in accordance with the Contract Documents in an orderly and efficient manner. The sequence of construction operations shall follow the schedule of construction as approved by the Design Professional. The Work shall not be discontinued by the Contractor without approval of the Design Professional. Should prosecution of the Work be discontinued for any reason, the Contractor shall notify the Design Professional at least twenty-four hours in advance of resuming the Work.

3.6.2 Materials and equipment furnished under this Contract will be subject to inspection by the Owner's authorized representative or by independent laboratories. Defective material, equipment, or workmanship may be rejected at any time before the acceptance of the Work even though the defective material, equipment, or workmanship may have been previously overlooked and estimated for payment. The Contractor shall replace defective equipment and material in accordance with the Contract Documents at no additional cost to the Owner.

3.6.3 The Contractor shall provide materials and supplies not subject to conditional sales agreements, or other agreement reserving unto the seller any right, title, or interest therein. All materials and supplies shall become the property of the Owner upon final acceptance of this Contract by the Owner.

3.6.4 If shop tests are to be conducted, the Contractor shall notify the Owner of such tests so a representative may witness tests, if desired.

3.6.5 The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Design Professional, and in accordance with a Change Order.

### **3.7 UNAUTHORIZED WORK**

3.7.1 Work done without lines and grades having been given or work done beyond the lines or not in conformity with the grades shown on the Drawings or as provided by the Owner, except as provided herein, and work completed without proper inspection and supervision or any extra or unclassified work completed without written authority and prior agreement shall be at the Contractor's risk. Such unauthorized work, at the option of the Design Professional, may not be measured and paid for and may be ordered removed at the Contractor's expense.

### **3.8 SUPERINTENDENCE**

3.8.1 The Contractor shall supervise and direct the Work. The Contractor shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for coordinating portions of the Work under the Contract.

3.8.2 The Contractor shall employ a qualified superintendent during the duration of the Project who is acceptable to the Owner and the Design Professional. The superintendent shall be maintained on the Project site and shall be present on the site at all times work is in progress. The superintendent

shall be capable of reading and understanding the Drawings and Specifications and shall have full authority to act in behalf of the Contractor. All directions and instructions given to the Superintendent shall be considered as given to the Contractor and shall be as binding as if given to the Contractor.

- 3.8.3 Workmanship shall be performed by workmen experienced in their trade and skilled and experienced for the class of work to which assigned. Any person, including supervisory personnel, who does not show and exhibit skill and proficiency in said work shall be removed by the Contractor and replaced by a competent and experienced workman.
- 3.8.4 The Contractor shall, at all times, be responsible for the conduct and discipline of his employees and all Subcontractors and their employees. Disorderly, incompetent or intemperate persons, or persons who commit any crimes or trespass on public or private property in the vicinity of the Work must not be allowed to continue working upon the project which the Contractor has with the State. Any superintendent, foreman or workman employed by the Contractor or a Subcontractor who unreasonably refuses or neglects to comply with the instructions of the Owner, Design Professional, or inspector, shall, at the written request of the Owner or Design Professional, be removed from the work site and shall not be allowed to work further on any portion of the work without the approval of the Owner.
- 3.8.5 The Contractor shall coordinate Work by the various trades to provide uniform and symmetrical layout and spacing of the exposed components which will affect the finished design and appearance. Where spacing and related locations are not specifically shown on Drawings or where in doubt, the Contractor shall consult the Design Professional prior to installation of that part of the Work.

### 3.9 **PERMITS, FEES, AND NOTICES**

- 3.9.1 The Contractor shall purchase and secure all applicable permits and licenses and give all notices necessary and incidental to the prosecution of the Work. However, in accordance with Ark. Code Ann. §22-9-213, public works construction projects conducted by the Owner, a state agency, are exempt from permit fees or inspection requirements of county or municipal ordinances.
- 3.9.2 When new construction under the Contract crosses highways, railroads, streets or utilities under the jurisdiction of the state, county, city, or other public agency, public utility, or private entity, the Contractor shall secure written permission from the proper authority before executing such new construction. A copy of this written permission shall be filed with the Owner before any work is completed. The Contractor shall furnish a release from the proper authority before final acceptance of the Work. Any bonds required for this Work shall be secured and paid for by the Contractor.

### 3.10 **SAMPLES AND TESTS**

- 3.10.1 The Contractor shall provide samples, materials, and equipment necessary or required for testing as outlined in the various sections of the Specifications or as directed by the Owner. The Contractor shall pay all costs for testing. Should materials, methods, or systems fail to meet specified standards, the Contractor shall pay all costs for additional testing as required by the Owner.
- 3.10.2 All tests shall be made by a laboratory approved by the Owner.

### 3.11 **LOCATION, GRADIENT, AND ALIGNMENT**

- 3.11.1 Based upon the site information provided by the Owner, the Contractor shall develop and make detailed surveys necessary for construction including slope stakes, batter boards, and other working points, lines and elevations.

3.11.2 The Contractor shall report any errors, inconsistencies, or omissions to the Design Professional as a request for information.

3.11.3 The Contractor shall preserve benchmarks, reference points and stakes, and in the case of destruction thereof by the Contractor, shall be responsible for damage or mistakes resulting from unnecessary loss or disturbance.

### 3.12 **LAND**

3.12.1 Additional land and access thereto not shown on Drawings that may be required for temporary construction facilities or for storage of materials shall be provided by the Contractor at his expense with no liability to the Owner. The Contractor shall confine his equipment and storage of materials and the operation of his workmen to those areas shown on the Drawings and described in the Specifications, and such additional areas which he may provide or secure as approved by the Owner.

3.12.2 The Contractor shall not enter upon private property for any purpose without first obtaining permission.

3.12.3 The Contractor shall be responsible for the preservation of and prevent damage or injury to all trees, monuments, and other public property along and adjacent to the street and right-of-way. The Contractor shall prevent damage to pipes, conduits and other underground structures, and shall protect from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location, and shall not remove monuments or property marks until directed.

### 3.13 **LIMITS OF WORK**

3.13.1 The Contractor shall conduct Work and operations so as to cause a minimum of inconvenience to the public. At any time when, in the opinion of the Owner or Design Professional, the Contractor is obstructing a larger portion of a road, street, or other public right-of-way than is necessary for the proper execution of the Work, the Design Professional may require the Contractor to finish the sections on which work is in progress before work is commenced on any new sections.

### 3.14 **WARRANTY**

3.14.1 The Contractor shall warrant that all Work, materials, and equipment furnished will be free from defects in design, materials, and workmanship and will give successful service under the conditions required. The warranty period for Work, materials, and equipment furnished by the Contractor shall be one year from the date of the written acceptance of the Work as stated in the Substantial Completion Form approved by the Contractor, Owner and the Design Professional, unless a longer period is agreed upon.

### 3.15 **PATENTS AND ROYALTIES**

3.15.1 If the Contractor is required or desires to use any design, device, material or process covered by letters, patent, or copyright, he shall provide for such use by suitable legal agreement with the patents or Owner. It is mutually understood and agreed that without exception the Contract Sum shall include all royalties or costs arising from patents, trademarks, and copyrights in any way involved in the Work. The Contractor and the surety shall defend, indemnify, and save harmless the Owner and all its officers, agents and employees from all suits, actions, or claims of any character, name and description brought for or on account of infringement or alleged infringement by reason of the use of any such patented design, device, material or process of any trademark or copyright used in connection with the Work agreed to be performed under this Contract, and shall indemnify the Owner for any cost, expense, or damage which it may be obliged to pay by reason of any action or actions, suit or suits which may be commenced against the Owner for any such

infringement or alleged infringement at any time during the prosecution or after the completion of the Work contracted for herein. It is mutually agreed that the Owner may give written notice of any such suit to the Contractor, and thereafter, the Contractor shall attend to the defense of the same and save and keep harmless the Owner from all expense, counsel fees, cost liabilities, disbursements, recoveries, judgments, and executions in any manner growing out of, pertaining to, or connected therewith.

### **3.16 CLEANING UP**

- 3.16.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials.
- 3.16.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

## **ARTICLE 4 -- ADMINISTRATION OF CONTRACT**

### **4.1 DESIGN PROFESSIONAL AUTHORITY**

- 4.1.1 The Design Professional will interpret the requirements of the Contract Documents and decide matters concerning performance thereunder on request of the Owner or Contractor.
- 4.1.2 The Design Professional will provide administration of the Contract as described in the Contract Documents and will be the Owner's representative. The Design Professional will decide any and all questions as to the acceptability of materials or equipment furnished, work performed, interpretation of the Drawings and Specifications, rate of progress of the Work, acceptability of the quality of workmanship provided, and other questions as to the fulfillment of the Contract by the Contractor.
- 4.1.3 The Design Professional will prepare all change orders on the form specified by the Owner. The Design Professional may authorize minor changes in the Work not involving adjustment in Contract Sum or extension of Contract Time and not inconsistent with the intent of the Contract Documents.
- 4.1.4 The Design Professional and his authorized representatives and the Owner will have the right to enter the property or location on which the Work shall be constructed.

### **4.2 CLAIMS**

- 4.2.1 Definition: A claim is a demand or assertion by one of the parties seeking adjustment, or interpretation of Contract terms, payment of money, extension of time, or other relief with respect to the terms of the Contract. The term includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims will be initiated by written notice. The responsibility to substantiate claims shall rest with the party making the claim.
- 4.2.2 Claims of the Contractor or the Owner: Claims regarding the Work of the Contract shall be referred initially to the Design Professional for a decision. The Design Professional will review claims, and 1) reject in whole or in part; 2) approve the claim; 3) suggest a compromise; 4) advise the parties that the Design Professional is unable to resolve the claim.
- 4.2.3 Claims for Concealed or Unknown Conditions: If new and unforeseen items of work are discovered, which cannot be covered by any item or combination of items for which there is a Contract Sum, then the Contractor shall notify the Design Professional as quickly as reasonably possible and shall not continue working on the discovered new or unforeseen items without express written permission from the Design Professional. The Contractor shall complete such work and

furnish such materials as may be required for the proper completion or construction of the work contemplated upon written Change Order from the Design Professional as approved by the Owner. Work shall be performed in accordance with the Contract Documents.

- 4.2.4 Claims for Extensions of Time: The Contractor shall provide written notice to Design Professional within ten days stating the cause of the delay and request an extension of Contract Time. The Design Professional will act on the request in writing. The extension of time shall be for a period equivalent to the time lost by reasons indicated. No extension of time shall be effective until included in a Change Order approved by the Owner and Design Professional.
- 4.2.5 Claims for Changes in the Work: The Contractor shall provide written notice to Design Professional within ten calendar days after the receipt of instructions from the Owner, as approved by the Design Professional, to proceed with changes in the Work and before such Work is commenced. Changes in the Work shall not be commenced before the claim for payment has been approved, except in emergencies endangering life or property. The Contractor's itemized estimate sheets showing labor and material shall be submitted to the Design Professional. The Owner's order (Change Order) for changes in the Work shall specify any extension of the Contract Time and one of the following methods of payment:
- a. Unit prices or combinations of unit prices, which formed the basis of the original Contract.
  - b. A lump sum fee based on the Contractor's estimate, approved by the Design Professional and accepted by the Owner.
  - c. The actual cost of the Work plus an allowance of 12 percent and 5 percent for the General Contractor and Subcontractor, respectively.
- 4.2.6 Claims for Additional Costs: In case of an emergency which threatens loss or injury of property or safety of life, the Contractor shall be allowed to act, without previous instructions from the Design Professional, in a diligent manner. The Contractor shall notify the Design Professional immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted, but in no case more than 7 calendar days following the event causing the emergency, to the Design Professional for consideration. The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided under these General Conditions. No agreement to pay costs for additional work shall be effective until included in a Change Order approved by the Owner, Contractor and the Design Professional.

## **ARTICLE 5 -- SUBCONTRACTORS**

### **5.1 ASSIGNMENT OF CONTRACT**

- 5.1.1 Neither the Owner nor the Contractor shall have the right to sublet, sell, transfer, assign, or otherwise dispose of the "Contract" or any portion thereof without written consent of the other party. No assignment, transfer, or subletting, even with the proper consent, shall relieve the Contractor of his liabilities under this Contract. Should any Assignee or Subcontractor fail to perform the work undertaken by him in a satisfactory manner, the Owner, has the right to annul and terminate the Assignee's or Subcontractor's contract on the project.

### **5.2 SUBCONTRACTS**

- 5.2.1 The subcontracting of the whole or any part of the Work to be done under this Contract will not relieve the Contractor of his responsibility and obligations. All transactions of the Owner or Design Professional shall be with the Contractor. Subcontractors will be considered only in the capacity of employees or workmen and shall be subject to the same requirements as to character and competency.

- 5.2.2 The Contractor shall discharge or otherwise remove from the project any Subcontractor that the Owner or the Design Professional has reasonably determined as incompetent or unfit.
- 5.2.3 The Contractor may not change those Subcontractors listed on the proposal without the written approval of the Owner and Design Professional. The Contractor shall not be relieved of any liabilities under this Contract, but shall be fully responsible for any Subcontractor or work by said Subcontractor where Subcontractor is employed by the Contractor to perform work under this Contract. Nothing contained in the Contract Documents shall create contractual relations between any Subcontractor and the State.
- 5.2.4 No officer, agent, or employee of the Owner, including the Design Professional, shall have any power or authority to bind the Owner or incur any obligation in his behalf to any Subcontractor, material supplier or other person in any manner whatsoever.

## **ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

### **6.1 OTHER CONTRACTS**

- 6.1.1 The Owner reserves the right to award other contracts in connection with the Project. The Contractor shall cooperate with the other contractors with regard to the storage of materials and equipment, access to the site, and execution of their work. It shall be the Contractor's responsibility to inspect the work of other contractors which will affect the work of this Contract and to report to the Owner irregularities which will not permit him to complete his work in a satisfactory manner or in the time allotted. Failure to so report shall constitute an acceptance of the work of other contractors.

### **6.2 DEPENDENCE ON OTHERS**

- 6.2.1 If any part of the Contractor's work depends for proper execution or results upon the work of the Owner or any separate contractor, the Contractor shall, prior to proceeding with the work, promptly report to the Design Professional any apparent discrepancies or defects in such other work that render it suitable for such proper execution and results. Failure of the Contractor to so report shall constitute an acceptance of the work.

## **ARTICLE 7 -- CHANGES IN THE WORK**

### **7.1 GENERAL**

- 7.1.1 The Owner may, as the need arises, without invalidating the Contract, order changes in the work in the form of additions, deletions, or modifications. Compensation to the Contractor for additional work or to the Owner for deductions in the work and adjustments for the time of completion shall be adjusted at the time of ordering such change.
- 7.1.2 Additional work shall be done as ordered in writing by the Owner. The order shall state the location, character, and amount of extra work. All such work shall be executed under the conditions of the Contract, subject to the same inspections and tests.
- 7.1.3 The Design Professional and the Owner reserve and shall have the right to make changes in the Contract Documents and the character or quantity of the work as may be considered necessary or desirable to complete fully and acceptably the proposed construction in a satisfactory manner.

7.2 **CHANGE ORDERS**

- 7.2.1 A Change Order is a written instrument, prepared by the Design Professional and approved by the Owner stating their agreement upon the following, separately or in any combination thereof:
- a. Description and details of the work.
  - b. Amount of the adjustment in the Contract Sum.
  - c. Extent of the adjustment in the Contract Time.
  - d. Terms and conditions of the Contract Documents.

7.2.2 Change Order requests by the Contractor shall be submitted in a complete itemized breakdown, acceptable to the Owner and the Design Professional.

7.2.2.1 Where unit prices are stated in the Contract, Contractor should submit an itemized breakdown showing each unit price and quantities of any changes in the Contract Amount. The value of all such additions and deductions shall then be computed as set forth in Paragraph 7.2.2.3.

7.2.2.2 The Contractor shall present an itemized accounting together with appropriate supporting data for the purposes of considering additions or deductions to the Contract Amount. Supporting data shall include but is not limited to the following:

- a. Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and worker or workmen's compensation insurance;
- b. Cost of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- c. Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- d. Costs of premiums for all bonds and insurance, permit fees, and sales, use of similar taxes related to the Work; and
- e. Additional costs of supervision and field office personnel directly attributable to the change.

The burden of proof of cost rests upon the Contractor. Contractor agrees that Owner or Owner's Representative shall have the right, at reasonable times, to inspect and audit the books and records of Contractor to verify the propriety and granting of such cost.

7.2.2.3 When unit prices are stated in the contract, compute requests for changes be they additions or deductions as follows:

- a. For work performed by the Contract:

Net Cost of Materials	a
State Sales Tax	b
Net Placing Cost	c
W.C. Insurance Premium and FICA Tax	<u>d</u>
	a+b+c+d
Overhead and Profit, 12% x (a+b+c+d)	e
Allowable Bond Premium	<u>f</u>
<b>TOTAL COST</b>	a+b+c+d+e+f

- b. Credit for work deleted shall be computed as outlined in 7.2.2.3 a. through e., except the Contractor's share of overhead and profit percentage is seven percent.

- c. For added work performed by Subcontractors: Subcontractors shall compute their work as outlined in 7.2.2.3 a. through e. To the cost of that portion of the work (Change) that is performed by the Subcontractor, the Contractor shall add an Overhead and Profit Change of five percent plus the Allowable Bond Premium.
- d. For work deleted by a Subcontractor: Subcontractors shall compute their work as outlined in 7.2.2.3 a through e, except that the overhead and profit shall be seven percent and the Contractor's overhead and profit shall be five percent.

### **7.3 PAYMENT FOR CHANGES IN THE WORK**

- 7.3.1 All changes in the Work will be paid for in the manner indicated in Article 4, Paragraph 4.2, and the compensation thus provided shall be accepted by the Contractor as payment in full for the use of small tools, superintendent's services, premium on bond, and all other overhead expenses incurred in the prosecution of such work.
- 7.3.2 The Owner shall not be deemed to have agreed to any costs for additional work, to have agreed to additional time for completion, or to have agreed to any other change in the terms and conditions of the Contract Documents until Owner, Design Professional and Contractor have executed a Change Order to this Contract.

## **ARTICLE 8 -- TIME**

### **8.1 DEFINITIONS**

- 8.1.1 Contract Time is the period of time identified in the Contract Documents for Substantial Completion of the Work, including authorized adjustments made as part of Change Orders agreed to by the Owner, the Design Professional and the Contractor.
- 8.1.2 Date for commencement of the Work is the fifth calendar day following the date of mailing, by regular mail, of the Notice to Proceed, unless otherwise stated in the Contract.
- 8.1.3 Date of Substantial Completion is the date certified by the Design Professional and the Owner.

### **8.2 PROGRESS**

- 8.2.1 Time limits identified in the Contract Documents are of the essence of the Contract. The Contractor confirms that the Contract Time is a reasonable period of time for performing the Work.

### **8.3 HOLIDAYS**

- 8.3.1 New Year's Day, Robert E. Lee/Dr. Martin Luther King's Birthday, President's Birthday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day and the day thereafter, Christmas Eve and Christmas Day will be considered as being legal holidays; no other days will be considered unless declared by the Governor of the State of Arkansas through an Executive Order or Proclamation. No Design Professional clarifications, observations, or State inspections will be provided on legal holidays, Saturdays and Sundays, and no work shall be performed on these days except in an emergency or with written approval in advance by the Design Professional and Owner.

### **8.4 DELAYS**

- 8.4.1 Delays beyond the Contractor's control occasioned by an act or omission on the part of the Owner, strikes, fires, additions to the work, delays by any separate contractor employed by the Owner,



extremely abnormal weather conditions, or other delays beyond the Contractor's control may, if agreed to by Change Order by the Contractor, Owner and Design Professional entitle the Contractor to an extension of time in which to complete the work. While such delays may be just cause for an extension of the Contract Time, the Contractor shall not have a claim for damages for any such cause or delay.

## **ARTICLE 9 -- PAYMENTS AND COMPLETION**

### **9.1 CONTRACT SUM**

- 9.1.1 The Contractor shall accept the compensation, as herein provided, in full payment for furnishing all materials, equipment, labor, tools, and incidentals necessary to complete the Work and for performing all Work contemplated and embraced under the Contract; also for loss or damage arising from the nature of the Work, from the action of the elements or from any unforeseen difficulties which may be encountered during the prosecution of the Work until the final acceptance by the Design Professional and Owner and for all risks of every description connected with the prosecution of the Work, for all expenses incurred in consequence of the suspension or discontinuance of the Work as specified, for any infringement of patent, trademark, or copyright, and for completing the Work according to the Contract Documents. Neither the payment of any estimate nor of any retained percentage shall relieve the Contractor of any obligation to make good any defective work or material.
- 9.1.2 No moneys payable under Contract or any part thereof, except the estimate for the first month or period, shall become due and payable if the Owner so elects until the Contractor shall satisfy the said Owner that he has fully settled or paid for all materials and equipment used in or on the Work and labor done in connection therewith, and the Owner, if he so elects, may pay any or all such bills wholly or in part and deduct the amount or amounts so paid from any monthly or final estimate excepting the first estimate.
- 9.1.3 In the event the surety on any contract or payment bond given by the Contractor becomes insolvent, or is placed in the hands of a receiver, or has the right to do business in a state revoked as provided by law, the Owner may at its election withhold payment of any estimate filed or approved by the Design Professional until the Contractor shall give a good and sufficient bond in lieu of the bond so executed by such surety. Any and all subsequent bonds shall be filed with the Circuit Clerk of the County in which the Work is being performed.

### **9.2 SCHEDULE OF VALUES**

- 9.2.1 The Contractor shall submit to the Design Professional a schedule of values for each part of the Work. The schedule shall be a complete breakdown of labor and materials for the various parts of the Work including an allowance for profit and overhead. The total of these amounts shall equal the Contract Sum. The approved schedule of values shall be used as a basis for the monthly payments to the Contractor. In applying for the monthly payment, the Contractor shall show a detailed account of work accomplished in conformity with the schedule.

### **9.3 MEASUREMENT OF QUANTITIES**

- 9.3.1 The Contractor shall be paid for all Work performed under the Contract based on Design Professional computations of as-built quantities and the Contractor's Contract Sum. This payment shall be full compensation for furnishing all supplies, materials, tools, equipment, transportation, and labor required to do the Work; for all loss or damage, because of the nature of the Work, from the action of the elements or from any unforeseen obstruction or difficulty which may be encountered in the prosecution of the Work and for which payment is not specifically provided for all or any part of the Work; and for well and faithfully completing the Work in accordance with the Contract

Documents. The method of computation and payment for each item shall be as set forth in the Specifications or the Supplementary Conditions.

#### **9.4 REQUESTS FOR PAYMENT**

- 9.4.1 The Contractor may submit periodically, but not more often than once each month, a Request for Payment for work completed. When unit prices are specified in the Contract Documents, the Request for Payment shall be based on the quantities completed.
- 9.4.2 Unless otherwise provided in the Contract Documents, payments will be made on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site, and if approved in advance by the Owner, payments may similarly be made for materials or equipment suitably stored at some other location agreed upon in writing. Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner and the Design Professional to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest including applicable insurance and transportation to the site for those materials and equipment stored off the site.
- 9.4.3 The Contractor shall furnish the Design Professional all reasonable facilities and job tickets required for obtaining the necessary information relative to the progress and execution of the Work and the measurement of quantities. Each Request for Payment shall be computed from the work completed on all items listed in the approved schedule of values less 10 percent of the first 50 percent of the adjusted Contract Sum and less previous payments to the Contractor on the Contract.

#### **9.5 PERIODIC ESTIMATES FOR PAYMENT**

- 9.5.1 Unless otherwise stated in the Specifications or Supplementary Conditions, the Owner shall cause the Design Professional to prepare an Estimate for Payment to the Contractor each month. The Design Professional will make the estimate for the materials complete in place and the amount of work performed in accordance with the Contract between the twenty-fifth day of the month and the fifth day of the succeeding month.
- 9.5.2 From the total of the amount estimated to be paid, an amount equal to 10 percent of the total completed shall be retained from the monthly estimates. All sums withheld by the Owner and requested in a Final Pay Request prepared by the Contractor will be paid to the Contractor within 30 days after the Contract has been completed and the work approved by the Owner and the Design Professional. No retainage will be withheld on that amount of the progress payment pertaining to the cost of materials stored at the site or within a bonded warehouse.

#### **9.6 PAYMENT FOR INCREASED OR DECREASED QUANTITIES**

- 9.6.1 When alterations in the quantities of work not requiring Contract modifications are ordered and performed, the Contractor shall accept payment in full at the Contract Sum, for the actual quantities of work accomplished. No allowance will be made for anticipated profits. Increased or decreased work involving Contract modifications shall be paid for as stipulated in such Contract modifications

#### **9.7 DESIGN PROFESSIONAL'S ACTION ON A REQUEST FOR PAYMENT (See also 9.9)**

- 9.7.1 The Owner shall cause the Design Professional to, within five working days plus time required for transmittal from one party to another, act on a Request for Payment by the Contractor in one of the following:
- a. Approve the Request for Payment as submitted by the Contractor, and transmit same to the Owner.

- b. Approve an adjusted amount as the Design Professional will decide is due the Contractor informing the Contractor in writing of the reason for the adjusted amount, and transmit same to the Owner.
- c. Withhold the Request for Payment submitted by the Contractor informing the Contractor and the Owner in writing of the reason for withholding the request.

**9.8 OWNER'S ACTION ON A REQUEST FOR PAYMENT (See also 9.9)**

9.8.1 The Owner will, within ten working days plus transmittal time between the various state agencies involved, act on a Request for Payment after approval by the Design Professional by one of the following:

- a. Approve the Request for Payment as approved by the Design Professional, and forward the Pay Request to the Owner's Contract Administrator in Finance for review and approval prior to submission to Owner's Accounts Payable for payment.
- b. Approve payment of an adjusted amount as the Owner will decide is due the Contractor, informing the Contractor and the Design Professional in writing of the reason for the adjusted amount of payment.
- c. Withhold the Request for Payment informing the Contractor and the Design Professional in writing of the reason for withholding the payment.

**9.9 ARKANSAS STATE AGENCIES ACTION ON A REQUEST FOR PAYMENT**

9.9.1 The State shall process payments in accordance with Ark. Code Ann. §19-4-1411, or as modified by subsequent law, which establishes the time limits for the Design Professional, the Owner and the Department of Finance and Administration. It also authorizes the Chief Fiscal Officer of the State to investigate any complaints of late payments and assess penalties for late payment. Complaints shall be addresses to "Chief Fiscal Officer of the State: Department of Finance and Administration; 1509 West Seventh Street, Suite 401; Post Office Box 3278; Little Rock, AR 72203-3278.

**9.10 WITHHOLDING PAYMENT**

9.10.1 The Design Professional or the Owner may withhold payment for contested issues, including but not limited to, defective work on the project; evidence indicating the probable filing of claims by other parties against the Contractor related to the project; damage caused to another contractor; reasonable evidence that Work cannot be completed for the unpaid balance of the Contract Sum or within Contract Time or failure of the Contractor to make payments on materials, equipment or labor to subcontractors. It is the responsibility of the contesting party to notify the Contractor in writing that payment has been contested and the reasons why. The notification must be done within the timeframe specified for processing of payment under Ark. Code Ann. §19-4-1411.

**9.11 PAYMENT FOR UNCORRECTED WORK**

9.11.1 Should the Design Professional direct the Contractor not to correct work that has been damaged or that was not performed in accordance with the Contract Documents, an equitable deduction from the Contract Sum shall be made to compensate the Owner for the uncorrected work. The Design Professional shall determine the amount of the equitable deduction.

**9.12 PAYMENT FOR REJECTED MATERIALS AND WORK**

9.12.1 The removal of rejected Work and materials and the re-execution of acceptable work by the Contractor shall be at the expense of the Contractor. The Contractor shall pay the cost of replacing the work of other contractors destroyed or damaged by the removal of the rejected work or materials and the subsequent replacement with acceptable work.

**9.13 DATE OF SUBSTANTIAL COMPLETION**

9.13.1 A Certificate of Substantial Completion, which shall establish the Date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to work, and insurance and shall fix the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the Date of Substantial Completion, unless another timeframe is stated in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall not become effective until approved by the Owner and the Design Professional.

**9.14 FINAL COMPLETION AND PAYMENT BY OWNER**

9.14.1 The Contractor shall furnish a letter from the Design Professional attached to the Contractor's final estimate, which shall include all retainage withheld, certifying that the Design Professional has received and approved all guarantees, bonds, maintenance and operation manuals, air balance data, shop drawings, catalog data, and record documents specified in the Contract Documents.

9.14.2 Before final payment, the Contractor shall furnish to the Design Professional executed copies of the Release of Claims and Consent of the Performance and Payment Bond Surety for Final Payment. Items listed in this Section Nine (9) shall be submitted with and at the same time as the final estimate to the Design Professional and shall be promptly delivered by the Design Professional to the Owner. No final payment or release of retained amounts shall be made without complete compliance with this Section Nine (9), and approval by the Owner of the Final Pay Request, which shall include payment of all retained amounts,

9.14.3 Any claim by the Contractor to the Owner for interest on a delinquent final payment shall only be made pursuant to Ark. Code Ann. § 22-9-205.

**9.15 PARTIAL OCCUPANCY OR USE**

9.15.1 The Owner may occupy or use any completed or partially completed portion of the Work provided such use or occupancy is consented to by the insurer and authorized. The Contractor will prepare a list of items to be completed or corrected before partial acceptance. Upon receipt of the Contractor's list, the Design Professional will make an inspection to determine whether the Work or portion thereof is substantially complete. No portion of the work shall be considered substantially complete unless described in a Certificate of Substantial Completion Form approved by the Contractor, Owner and the Design Professional.

9.15.2 The Design Professional will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to Work and insurance, identify work items to be corrected or completed by the contractor and shall fixing the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the Date of Substantial Completion, unless another timeframe is stated in the Certificate of Substantial Completion. No retained amounts shall be paid until the Contractor, Design Professional and the Owner approve a Certificate of Substantial Completion for all of the Work unless specifically provided for by this contract, and all other conditions for final acceptance of this Work are met to the satisfaction of the Owner.

9.15.3 Instances where some of the Work is “sectioned” out and substantially completed, the retained amounts shall not be paid until the final Certificate of Substantial Completion of the entire Work is approved by the Contractor, Design Professional, and the Owner and all other conditions of this Section Nine (9) are met by the Contractor.

#### 9.16 FINAL INSPECTION

9.16.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents, laws, ordinances, or any public authority having jurisdiction shall be made at the appropriate time. The Contractor shall give the Design Professional timely notice of when and where tests and inspections shall be made so that the Design Professional may be present. The Contractor shall make arrangements for the testing and inspection with an independent testing laboratory.

9.16.2 The Contractor shall ensure that the final completed work is in accordance with the Contract Documents. Required certificates of testing and inspection shall be secured by the Contractor and delivered to the Design Professional, unless otherwise required by the Contract Documents.

#### 9.17 ASSIGNMENT OF WARRANTIES

9.17.1 All warranties of materials and workmanship running in favor of the Contractor shall be transferred and assigned to the Owner on completion of the Work and at such time as the Contractor receives final payment.

9.17.2 In case of warranties covering work performed by subcontractors, such warranties shall be addressed to and in favor of the Owner. The Contractor shall be responsible for delivery of such warranties to the Owner prior to final acceptance of the work.

9.17.3 Delivery of guarantees or warranties shall not relieve the Contractor from any obligation assumed under any provision of the Contract. All warranties shall be for one year from the date of Substantial Completion of the Project, unless extended otherwise.

#### 9.18 ACCEPTANCE AND FINAL PAYMENT

9.18.1 Upon receipt of written notice that the Work is ready for final inspection, the Design Professional together with the Owner will conduct such inspection and when the Design Professional determines the work is acceptable to the Design Professional and the Owner, the Design Professional shall certify his acceptance to the Owner. Final Payment shall be the Contract Sum plus approved Change Order additions less approved Change Order deductions and less previous payments made. The Contractor shall furnish evidence that he has fully paid all debts for labor, materials, and equipment incurred in connection with the Work. The Owner, upon approval by the Design Professional of all documentation to be provided by the contractor in accordance with this Section 9, and approval by the Design Professional, Contractor and Owner of the Certificate of Substantial Completion will accept the Work and release the Contractor, except as to the conditions of the Performance and Maintenance Bond, any legal rights of the Owner, required guarantees and correction of faulty work after Final Payment, and shall authorize payment of the Contractor's final Request for Payment. The Contractor must allow sufficient time between the time of completion of the work and approval of the final Request for Payment for the Design Professional to assemble and check the necessary data.

9.18.2 Acceptance of final payment by the Contractor shall constitute waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the final Request for Payment. Any claims for interest on delinquent payments shall be made pursuant to Ark. Code Ann. § 22-9-205.

## **ARTICLE 10 -- PROTECTION OF PERSONS AND PROPERTY**

### **10.1 GENERAL**

- 10.1.1 The Contractor shall at all times exercise precaution for the safety of employees on the Project and of the public, and shall comply with all applicable provisions of federal, state and municipal safety laws and applicable building and construction codes. The Contractor shall provide and maintain passageways, guard fences, lights, and other facilities for protection required by all applicable laws. All machinery, equipment, and other physical hazards shall be guarded in accordance with all federal, state or municipal laws or regulations.
- 10.1.2 The Work, from commencement to completion, and until written acceptance by the Design Professional, and the Owner or to such earlier date or dates when the Owner may take possession and control in accordance with Section Nine (9) of these General Conditions, shall be under the charge and control of the Contractor and during such period of control by the Contractor, all risks in connection therewith shall be borne by the Contractor. The Contractor shall make good and fully repair all damages to the Project by reason of the Contractor's negligence, and make good on all injuries to persons caused by any casualty or cause by reason of the Contractor's negligence. The Contractor shall adequately protect adjacent Property as provided by law and the Contract Documents. The Contractor shall hold the Owner harmless from any and all claims for injuries to persons or for damage to property during the control by the Contractor of the project or any part thereof.
- 10.1.3 The Contractor shall at all times so conduct the Work as to ensure the least possible obstruction to traffic, to the general public, and the residents in the vicinity of the Work, and to ensure the protection of persons and property. No road, street, or highway shall be closed to the public except with the permission of the Owner and proper governmental authority. Fire hydrants on or adjacent to the Work shall be kept accessible to firefighting equipment at all times. The local fire department shall be notified of the temporary closing of any street.

## **ARTICLE 11 -- INSURANCE AND BONDS**

### **11.1 CONTRACTOR'S LIABILITY INSURANCE**

- 11.1.1 The Contractor shall secure and maintain in force during this Contract such insurance as is specified within the Contract Documents, from an insurance company authorized to write the prescribed insurance in the jurisdiction where the Project is located as will protect the Contractor, his subcontractors, and the Owner from claims for bodily injury, death, or property damage which may arise from operations under this Contract. The Contractor shall not commence work under this Contract until he has obtained all the insurance required, has filed the Certificate of Insurance with the Owner, and the certificate has been approved by the Owner. Each insurance policy shall contain a clause providing that it shall not be canceled by the insurance company without written notice to the Owner of intention to cancel.
- 11.1.2 Workman's Compensation and Employer's Liability Insurance in statutory limits shall be secured and maintained as required by the laws of the State of Arkansas. This insurance shall cover all employees who have performed any of the obligations assumed by the Contractor under these Contract Documents including Employer's Liability Insurance. This insurance shall protect the Contractor against any and all claims resulting from injuries, sickness, disease, or death to employees engaged in work under this Contract.
- 11.1.3 Comprehensive General Liability Insurance, including automobile and truck liability. Prior to blasting, the Contractor shall furnish Certificate of Insurance, which shall certify that damage caused by blasting is within the coverage of his Comprehensive General Liability Insurance to the

full limits thereof. Hired and non owned automobile insurance for automobiles and trucks shall include hired and non owned automobile coverage.

- 11.1.4 Contractor's Protective Liability Insurance: The Contractor shall indemnify and save harmless the Owner from and against all losses and all suits, claims, demands, judgments, actions, and payments of every description and nature brought or recovered against him by reason of any omission or act of the Contractor, his agents, or employees in the execution of the Work or in the guarding of it. The Contractor shall secure and maintain protective liability insurance in the name of the Owner and the Contractor covering them from contingent liability under this Contract.
- 11.1.5 Builder's Risk and Fire Insurance: The Contractor shall procure and maintain during the life of this Contract Builder's Risk Insurance fire, lightning, extended coverage, vandalism, and property theft on the insurable portion of the Project on a 100 percent completed value basis against damage to the equipment, structures, or material. The Owner and the Contractor, as their interests may appear, shall be named as the Insured.
- 11.1.6 Proof of Insurance: The Contractor shall maintain the insurance coverage required by this contract (**see Supplemental Conditions for required coverage**) throughout the term of this contract, and shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies. Such certificates shall also contain substantially the following statement: "The insurance covered by this certificate will not be canceled, or materially altered except after 15 days prior written notice has been received by the Owner."

## 11.2 BONDS

- 11.2.1 Performance and Payment Bond: The Contractor shall, at the time of execution of the Contract, furnish a bond covering faithful performance of the Contract and the payment of obligations. The Performance and Payment bonds, and any amendments thereto, shall be filed with the circuit clerk office in the County Courthouse of the county where the work shall be performed. For any increases to the contract amount, scope of work, time for completion or other terms relating to the Change Order, the Contractor may be required by Owner to furnish an amendment to the Bond agreement in which the Surety has agreed to amend the Performance and Payment Bond to reflect such revisions.

## ARTICLE 12 -- UNCOVERING AND CORRECTION OF WORK

### 12.1 EXAMINATION OF COMPLETED WORK

- 12.1.1 If any portion of the work should be covered contrary to the request of the Owner, Design Professional, or Inspector or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Owner, Design Professional, or Inspector, be uncovered for his observation and replaced at the Contractor's expense.

### 12.2 DEFECTIVE WORK

- 12.2.1 Defective work, whether through the use of defective materials, the result of poor workmanship, or any other cause, shall be removed within ten days after notice is given by the Owner or Design Professional. The Work and affected materials and equipment shall be removed and replaced as necessary to comply with the Contract Documents without additional cost to the Owner. The fact that the defective work may have been previously overlooked by the Design Professional shall not constitute acceptance.

### 12.3 REJECTED MATERIALS

- 12.3.1 Materials which do not conform to the requirements of the Contract Documents, are not equal to samples approved by the Design Professional, or are in any way unsuited or unsatisfactory for the

purpose for which intended, shall be rejected. Defective materials shall be removed within ten days after notice by the Design Professional. The materials shall be replaced with new materials as necessary to comply with the Contract Documents at no additional cost to the Owner. The fact that the defective material may have been previously overlooked by the Design Professional shall not constitute acceptance.

12.3.2 Should the Contractor fail to remove and replace rejected material within the specified ten days after written notice to do so, the Owner may remove and replace the material and deduct the cost from the Contract Sum.

#### **12.4 CORRECTION OF FAULTY WORK AFTER FINAL PAYMENT**

12.4.1 The approval of the final Contractor's Request for Payment by the Design Professional and the making of the final payment by the Owner to the Contractor shall not relieve the Contractor of responsibility to correct faulty materials or workmanship promptly after receipt of written notice from the Owner. The Owner shall give such notice of faulty materials or workmanship promptly, after discovery of the condition. If the Contractor fails to correct the defects, promptly, after receipt of written notice from Owner, the Owner may have the work corrected at the Contractor's expense.

### **ARTICLE 13 -- MISCELLANEOUS PROVISIONS**

#### **13.1 GOVERNING LAW**

13.1.1 The Contract shall be governed by the laws and regulations of the STATE OF ARKANSAS. Venue for any administrative action or judicial proceedings shall be Pulaski County, Arkansas. Nothing in these General Conditions shall be construed to waive the sovereign immunity of the STATE OF ARKANSAS or any entities thereof.

13.1.2 The Contractor shall give all notices and comply with all federal, state, and local laws, ordinances, and regulations in any manner affecting the conduct of the Work. The Contractor shall indemnify and save harmless the Owner against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree whether by himself or his employees.

13.1.3 The Contractor shall comply with the laws of the local, state, and federal government regarding wages and hours of labor.

#### **13.2 WRITTEN NOTICE**

13.2.1 Consider as served when delivered in person or sent by certified or registered mail to the individual, firm, or corporation or to the last business address of such known to him who serves the notice.

13.2.2 The written Notice to Proceed with the Work shall be issued by the Design Professional after the execution of the Contract by the Owner. The Contractor shall begin and prosecute the Work and uninterruptedly in a manner that will complete the Work within the time limits stated in the Contract.

#### **13.3 TESTS AND INSPECTIONS**

13.3.1 All materials and each and every part of the Work shall be subject at all times to inspection by the Owner, Design Professional, or the Inspector. The Contractor shall be held to the intent of the Contract Documents in regard to quality of materials, equipment, and workmanship, and the diligent execution of the Contract. The inspection may extend to and include plant, shop, or factory inspection of material furnished. The Contractor agrees to allow Federal or State inspectors, acting in an official capacity, to have access to the job site.



13.3.2 The Owner, Design Professional, and Inspectors shall be allowed access to all parts of the Work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection for ascertaining if the Work as performed is in accordance with the requirements and the Contract Documents.

13.3.3 Inspectors shall only have authority to suspend any work in a life threatening situation which is being improperly done, subject to the final decision of the Owner or Design Professional. Inspectors shall have no authority to permit deviations, or to relax provisions of the Contract Documents without the written permission or instruction of the Owner and the Design Professional, or delay the Contractor by failing to work with reasonable promptness.

#### 13.4 **VERBAL AGREEMENTS**

13.4.1 No verbal objection, order, claim, or notice by any of the parties involved to the other parties shall affect or modify any of the terms or obligations contained in the Contract Documents. None of the terms or provisions of the Contract Documents shall be considered waived or modified unless the waiver or modification thereof is in writing, and agreed upon by the parties in the form of a Change Order approved by the Owner, Design Professional and the Contractor and no evidence shall be introduced in any proceeding of any other waiver or modification.

### **ARTICLE 14 -- TERMINATION OR SUSPENSION OF THE CONTRACT**

#### 14.1 **SUSPENSION OF WORK**

14.1.1 The work or any portion thereof may be suspended at any time by the Owner provided that the Owner gives the Contractor written notice of the suspension. The notice shall set forth the date on which the work is to be suspended and the date on which the work is to be resumed. The Contractor shall resume the work upon written notice from the Owner within ten days after the date set forth in the notice of suspension.

14.1.2 The Owner will have the authority to suspend the work, wholly or in part, for such period of time as deemed necessary. The suspension may be due to unsuitable weather, or such other conditions as are considered unfavorable for the proper prosecution of the work, or the failure on the part of the Contractor to fulfill the provisions of the Contract. Failure to supply material, equipment, or workmanship meeting the requirements of the Contract Documents shall be just cause for suspension of the Work. The Contractor shall not have the right to suspend operations without the Design Professional or Owner's permission.

#### 14.2 **TERMINATION BY OWNER FOR CAUSE**

14.2.1 The Owner will have the right to terminate the Contract upon giving ten days written notice of the termination to the Contractor and the Contractor's surety, in the event of any default by the Contractor and upon written notice from the Design Professional to the Owner that sufficient cause exists to justify such action. In the event of termination of the Contract, the Owner may take possession of the Work and of all materials, tools, and equipment and construction equipment and machinery thereon and may finish the work by whatever method he may select. If the Owner does not elect to use his own forces, the surety shall furnish a competent licensed contractor within 10 working days from the written notice to the surety.

14.2.2 It shall be considered a default by the Contractor whenever he shall become insolvent; declare bankruptcy assigns assets for the benefit of his creditors; fails to provide qualified superintendence, proper materials, competent subcontractors, competent workmen; fails to make prompt payments for labor, materials, or equipment; disregards or violates provisions of the Contract Documents; disregards the Owner's or the Design Professional's instructions; fails to prosecute the Work according to the approved schedule of completion, including extensions thereof as provided for by

approved Change Orders; and fails to start the Work on the date established in the Notice to Proceed.

## **ARTICLE 15 – ALTERNATIVE DISPUTE RESOLUTION**

### **15.1 MEDIATION**

15.1.1 In the event of any dispute regarding the Contractor, Architect, Engineer, and/or Owner (hereinafter referred to as party/parties for this section only) under this Agreement, the party shall notify the appropriate Owner's Administrator in writing. The Owner's Administrator or his designee will then attempt to negotiate a settlement of the dispute between the parties.

15.1.2 If the Owner's Administrator, or designee, determines he is unable to negotiate a settlement between the parties, the parties may participate in mediation. A request for mediation must be made in writing to the Owner and the parties shall agree upon the location of the mediation. A Mediator mutually agreed upon by the parties shall conduct the mediation process. Mediation shall be voluntary, non-binding and all proceedings in connection with such shall be subject to this Agreement and applicable provisions of Arkansas law. Any mediation fees shall be borne equally between the parties. The parties shall coordinate mediation and the Owner shall notify the University of Arkansas System Office of any mediation prior to it taking place. The Owner's Administrator or his designee may view any and all mediation proceedings. Any settlements arising out of the mediation process must be approved by the University of Arkansas System Office.

15.1.3 Notwithstanding anything to the contrary contained herein, if any dispute arises between the Parties, whether or not it requires at any time the use of dispute resolution procedures described above, in no event, nor for any reason, shall the Contractor, Architect, or Engineer interrupt the provision of services/performance to the Owner, or perform any other action that prevents, slows down, or reduces, in any way, the provisions of the Agreement unless: (a) authority to do so is granted by the Owner or (b) the Agreement has been terminated by the Owner. Nothing in these contract documents, including the use of mediation, shall be construed to waive the sovereign immunity of the State of Arkansas or any entities thereof.

**END OF DOCUMENT**

**SECTION 00 80 00**

**SUPPLEMENTARY GENERAL CONDITIONS**

**MODIFICATIONS TO GENERAL CONDITIONS-**

**ARTICLE 11 - INSURANCE AND BONDS**

1 Subparagraph 11.1.1, add the following sentence:

The amount of such insurance shall be not less than the following or any limits required by law.

2 Subparagraph 11.1.2, add the following clause:

11.1.2.2 Worker's Compensation:

- A. State: Statutory
- B. Applicable Federal: Statutory
- C. Employer's Liability: \$ 100,000.00 per Accident  
\$ 500,000.00 Disease, Policy Limit  
\$ 100,000.00 Disease, each Employee

3 Subparagraph 11.1.3, add the following clause:

11.1.3.2 Comprehensive General Liability

- General Aggregate: \$ 1,000,000.00
- Completed Operations to be maintained for one year after final payment: \$ 1,000,000.00 Aggregate
- Personal Injury \$ 1,000,000.00 Each Occurrence
- Each Occurrence Limit \$ 1,000,000.00 Each Occurrence
- Automobile Liability (including owned, non-owned, and hired vehicles)  
Combined Single Limit \$ 1,000,000.00
- Contractual Liability (Builders Risk) Full value of the Contract
- Umbrella Excess Liability \$ 1,000,000.00

4 Subparagraph 11.1.4, add the following clause:

- Owner's and Contractor's Protection Liability \$ 1,000,000.00 Combined  
Single Limit

END OF DOCUMENT

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23 74 15 - Packaged Rooftop Air Conditioning Units (50 Tons and larger)  
23 81 01 - Terminal Heat Transfer Units

#### DIVISION 26 ELECTRICAL

26 05 00 - Common Work Results for Electrical  
26 05 02 - Equipment Wiring Systems  
26 05 13 - Medium Voltage Cable  
26 05 19 - Low-Voltage Electrical Power Connectors and Cable  
26 05 26 - Grounding and Bonding for Electrical Systems  
26 05 29 - Hangers and Supports for Electrical Systems  
26 05 33 - Raceway and Boxes for Electrical Systems  
26 05 48 - Vibration and Seismic Controls for Electrical Systems  
26 05 53 - Identification for Electrical Systems  
26 12 19 - Pad-Mounted Distribution Transformers  
26 22 13 - Low-Voltage Transformers  
26 24 16 - Panelboards  
26 26 00 - Low-Voltage Electrical Distribution  
26 27 26 - Wiring Devices  
26 28 16 - Enclosed Switches and Circuit Breakers  
26 29 13 - Enclosed Motor Controllers  
26 41 13 - Lightning Protection Systems  
26 50 00 - Lighting

#### DIVISION 27 COMMUNICATIONS

27 00 00 - Computer System Category 6

#### DIVISION 28 ELECTRONIC SAFETY AND SECURITY

28 31 00 - Fire Detection and Alarm (Addressable)

#### DIVISION 31 EARTHWORK

31 10 00 – Site Preparation  
31 23 10 – Grading  
31 23 15 – Excavation  
31 23 16 – Fill and Backfill  
31 23 17 – Trenching for Site Utilities  
31 31 10 – Soil Treatment for Termite Control

#### DIVISION 32 - EXTERIOR IMPROVEMENTS

32 12 16 – Bituminous Concrete Paving  
32 13 10 – Aggregate Base Course  
32 13 13 – Portland Cement Concrete Paving  
32 26 10 – Water Distribution System  
32 26 20 – Sanitary Sewer Collection System  
32 27 10 – Storm Drainage System  
32 84 23 – Landscape Sprinkler System  
32 92 00 - Sodding  
32 93 00 – Trees, Plants and Groundcover





## SECTION 01 10 00

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Scope of Work
- B. Work by Others.
- C. Contractor Use of Site and Premises.
- D. Work Sequence.

##### 1.02 SCOPE OF WORK

- A. Contractor shall provide all work, supervision, labor, materials, transportation, scaffolding, clean up and any other services necessary to perform the construction of this project, complete in every detail, within the limits shown on the construction documents.

##### 1.03 WORK BY OTHERS

- A. The Contractor shall thoroughly familiarize himself with all work to be performed by others, its interface with this Contract, its affect on the scheduling of this Contract and its impact on the Contractor's use of the site.
- B. The Owner will be utilizing his own Work forces to accomplish work not included in this contract.

##### 1.04 CONTRACTOR USE OF SITE AND PREMISES

- A. Comply with pertinent provisions of the General Conditions included in this project manual.
- B. Clean Up During Construction: During the process of work, keep the project clear of all rubbish. Keep all streets adjacent to the project free of dirt, gravel, concrete and other materials transported to and from the project.
- C. Drainage: Prevent mud and debris from getting into the sewers and or streets during the period of construction. Contractor is responsible for cleaning any permanent piping in places that may become clogged. Under no conditions shall such water used in flushing concrete or other cement mixes be deposited in or about sanitary sewer lines or storm sewer lines.
- D. Rubbish containers: Suitable containers with covers are to be provided for all refuse from meals eaten on the job site and such containers shall be removed from the job site at least once in every 72 hour period. One of these containers is to be placed beside each drinking water facility to receive discarded paper cups. All bottles, cans, paper and garbage of every description are to be constantly picked up and placed in the covered containers. All workmen are to be advised of the contents of this paragraph and nothing short of their full cooperation is considered reasonable.

##### 1.05 WORK SEQUENCE

- A. Construct work in sequence to accommodate the work of others. During the construction period, coordinate construction schedule and operations with the Owners Representative and Architect.
- B. All work to be completed by date established in a notice to proceed.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**

**SECTION 01 20 00**

**ALLOWANCES**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Allowances to be included in the bid:
  - 1. Interior Signage and Directories
  - 2. Secure Entrance System

1.2 ALLOWANCES

- A. Cost to be included in the Bid: Provide a \$24,000 allowance for interior signage and Directories.
- B. Cost to be included in the bid: Provide a \$20,000 allowance for a secure entrance system utilizing magnet locks, motion sensors and key pads, magnetic strip card or FOB.

**PART 2 PRODUCTS – Not Used**

**PART 3 EXECUTION – Not Used**

**End of Section**

## SECTION 01 23 00

### ALTERNATES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Submission procedures.
- B. Documentation of changes to Contract Sum/Price.

##### 1.02 RELATED SECTIONS

- A. Section 00 41 00 - Bid Form.

##### 1.03 REQUIREMENTS

- A. Alternates quoted will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

##### 1.04 SELECTION AND AWARD OF ALTERNATES

- A. Indicate variation of Bid Price for Alternates described below and list on Bid Form Document or any supplement to it, which requests a difference in Bid Price by adding to or deducting from the base bid price.
- B. Bids will be evaluated on base bid price and alternates. After determination of preferred bidder, consideration will be given to Alternates and Bid Price adjustments.

##### 1.05 SCHEDULE OF ALTERNATES

- A. Add Alternate No. 1: **Conference Room Ceiling:** Installation of a suspended modular sound absorbing acoustical ceiling panel system. Refer to Sheet A16.01
- B. Add Alternate No. 2: **Corridor 113 Ceiling:** Installation of Acoustic Ceiling Baffles in Corridor 113. Refer to Sheet A16.01

#### PART 2 PRODUCTS

Not Used

#### PART 3 EXECUTION

Not Used

**END OF SECTION**

## SECTION 01 30 00

### COORDINATION AND MEETINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Coordination.
- B. Site Mobilization Conference.
- C. Progress Meetings.
- D. Preinstallation Conference

##### 1.02 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirement characteristics of operating equipment to be used during the project are compatible with utilities being provided.
- C. Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Completion.
- D. After substantial completion, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

##### 1.03 SITE MOBILIZATION CONFERENCE

- A. The Architect will schedule a conference at the Project site prior to Contractor occupancy.
- B. Attendance Required: Owner, Architect, Special Consultants, Contractor and major Subcontractors.
- C. Agenda:
  - 1. Use of premises by Owner and Contractor.
  - 2. Owner's requirements.
  - 3. Security procedures.
  - 4. Schedules.
  - 5. Procedures for maintaining record documents.

##### 1.04 PROGRESS MEETINGS

- A. Schedule meetings throughout progress of the Work at maximum bi-weekly intervals.
- B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect as appropriate to agenda topics for each meeting.

- C. Agenda:
1. Review minutes of previous meetings.
  2. Review of Work progress.
  3. Field observations, problems, and decisions.
  4. Identification of problems which impede planned progress.
  5. Review of submittals schedule and status of submittals.
  6. Review of off-site fabrication and delivery schedules.
  7. Planned progress during succeeding work period.
  8. Coordination of projected progress.
  9. Maintenance of quality and work standards.
  10. Effect of proposed changes on progress schedule and coordination.
  11. Other business relating to Work.

**1.05 PREINSTALLATION CONFERENCE**

- A. When required in individual specification sections, convene a preinstallation conference at work site prior to commencing work of the section.
- B. Require attendance of parties directly involved or affected by the work of the specific section.
- C. Notify Architect seven days in advance of meeting date.
- D. Review conditions of installation, preparation and installation procedures and coordination with related work.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**

**SECTION 01 32 16**  
**PROGRESS SCHEDULE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Format.
- B. Content.
- C. Revisions to Schedules.
- D. Submittals.
- E. Distribution

**1.02 RELATED SECTIONS**

- A. Section 01 10 00 - Summary of Work.
- B. Section 01 33 00 - Submittals: Shop drawings, product data, and samples.

**1.03 FORMAT**

- A. Submit schedule for entire construction project.
- B. Prepare Schedule as a horizontal bar chart with separate bar for each major portion of Work or operation, identifying first work day of each week.
- C. Sequence of Listings: The chronological order of the start of each item of Work.
- D. Scale and Spacing: To provide space for notations and revisions.
- E. Sheet Size: Minimum 22 x 34 inches.

**1.04 CONTENT**

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification Section number.
- C. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules to define critical portions of the entire Schedule. Such as completion of foundation and slab work, completion of roof structure, date building is to be completely enclosed and secure.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

- F. Provide separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products, and dates reviewed submittals will be required from Architect/Engineer. Indicate decision data for selection of finishes.
- G. Indicate delivery dates for Owner furnished products or dates for Owner's own subcontractors are to start and finish their portion of work.

**1.05 REVISIONS TO SCHEDULES**

- A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
- C. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect, including the effect of changes on schedules of separate contractors.

**1.06 SUBMITTALS**

- A. Submit initial Schedule within 10 working days after date of Notice to Proceed. After review, resubmit required revised data within 5 working days.
- B. Submit revised Progress Schedules with every Application for Payment.
- C. Submit three copies of which one will be retained by the Architect, one by the owner and one by contractor.

**1.07 DISTRIBUTION**

- A. Distribute copies of reviewed Schedules to project site file, Subcontractors, suppliers, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in Schedules.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**



## SECTION 01 33 00

### SUBMITTALS AND SUBSTITUTIONS

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Submittal Procedures.
- B. Proposed Products List.
- C. Substitutions
- D. Shop Drawings.
- E. Product Data.
- F. Samples.
- G. Manufacturers' Instructions.
- H. Manufacturers' Certificates.

##### **1.02 RELATED SECTIONS**

- A. Section 01 70 00 - Contract Closeout: Contract warranty and closeout submittals.

##### **1.03 SUBMITTAL PROCEDURES**

- A. Transmit each submittal to the Architect with acceptable transmittal form indicating dates and quantities of each submittal.
- B. Identify Project, Contractor, Sub Contractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate on each submittal.
- C. Contractor shall apply Contractor's stamp or Cover Sheet, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- D. Schedule submittals to expedite the Project, and deliver to the Architect's office. Coordinate submission of related items.
- E. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- F. Provide space for Contractor and Architect/Engineer review stamps.
- G. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- H. Contractor will distribute copies of reviewed submittals to concerned parties and instruct parties to promptly report any inability to comply with provisions.

##### **1.04 PROPOSED PRODUCT LIST**

- A. Within 14 days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

#### **1.05 SUBSTITUTIONS**

- A. These specifications are intended to establish a minimum desired quality or performance level, or other minimum dimensions and capacities, which will provide the best product available at the best price. When a brand and/or model is designated, and a bidder offers other than the designated brand and/or model, ***the other than designated-brand and/or model***, must be listed; specifications and descriptive literature provided; and, if requested, a sample made available for testing. ***Other than designated brands and/or models*** approved as equal to designated projects shall receive equal consideration. ***Bidders please note:*** that in some cases, prior approval of materials and/or equipment must be obtained from SCM Architects before the bid, in order to obtain the desired color, size, visual appearance, performance, etc.. ***Verify*** this requirement in the technical specification respective divisions. ***The other than designated-brand and/or model*** that requires approval before the bid, must be submitted in writing to SCM Architects at least 7 days before the bid date. Product information and samples of the product must accompany submission.

#### **1.06 SHOP DRAWINGS**

- A. Submit electronically in PDF Format or Submit in the form of one reproducible transparency and two blueline prints or six blueline prints.
- B. If a reproducible is submitted, after review, Contractor shall reproduce and distribute copies as required.

#### **1.07 PRODUCT DATA**

- A. Submit electronically in PDF Format or Submit six copies of each required document to the Architect.
- B. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. After review, the Contractor will distribute in accordance with Article on Procedures above and provide copies for Record Documents at Contract Closeout.

#### **1.08 SAMPLES**

- A. If requested by the Architect or required herein, submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer's selection if colors have not been selected. If colors have been selected, submit selected color only.
- C. Include identification on each sample, with full Project information.
- D. Submit the number of samples specified in individual specification Sections; one of which will be retained by Architect/Engineer.
- E. Reviewed samples which may be used in the Work are indicated in individual specification Sections.

#### **1.09 MANUFACTURER'S INSTRUCTIONS**

- A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, adjusting and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

**1.10 MANUFACTURER'S CERTIFICATES**

- A. When specified in individual specification Sections, submit manufacturers' certificate to Architect/Engineer for review, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not used

**END OF SECTION**

## **SECTION 01 40 00**

### **QUALITY CONTROL**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Quality Assurance and Control of Installation.
- B. References.
- C. Mock-ups
- D. Field Samples.
- E. Inspection and Testing Laboratory Services
- F. Manufacturer's Field Services

##### **1.02 RELATED SECTIONS**

- A. Section 01 33 00 - Submittals: Submission of Manufacturers' Instructions and Certificates.
- B. Section 01 60 00 – Material and Equipment: Requirements for material and product quality.

##### **1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect and Owners Representative before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

##### **1.04 REFERENCES**

- A. Conform to reference standard by date of issue current on date of Contract Documents.
- B. Obtain copies of standards when required by Contract Documents.
- C. Maintain copy at project site during submittals, planning and progress of the specific work, until substantial completion.

- D. Should specified reference standards conflict with Contract Documents, request clarification for Architect and Owners Representative before proceeding.
- E. Neither the contractual relationships, duties or responsibilities of the parties in Contract nor those of the Architect shall be altered from the Contract documents by mention or inference otherwise in any reference document.

**1.05 MOCK-UPS**

- A. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals and finishes.
- B. Accepted mock-ups shall be a comparison standard for the remaining work.
- C. Where mock-up has been accepted by Architect and is specified in individual Sections to be removed, remove mock-up and clear area when directed to do so.

**1.06 FIELD SAMPLES**

- A. Install field samples at the site as required by individual specifications Sections for review.
- B. When samples are accepted by the Architect and Owners Representative, they shall represent the quality level required for the actual Work.
- C. Where field sample is specified in individual Sections to be removed, clear area after work represented by field sample has been accepted by Architect and Owner's Representative.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used.

**END OF SECTION**

## SECTION 01 50 00

### CONSTRUCTION FACILITIES, TEMPORARY CONTROLS, TEMPORARY UTILITIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, telephone and internet service, water and sanitary facilities.
- B. Temporary Controls: Chain Link Fencing and Barriers, protection for the public, protection of the Work, protection of existing surfaces and security.
- C. Construction Facilities: Parking and access to the site, progress cleaning, and construction field office.
- D. Removal of temporary utilities construction facilities and controls.

##### 1.02 RELATED SECTIONS

- A. Section 01 10 00 - Summary of Work.

##### 1.03 TEMPORARY ELECTRICITY

- A. Contractor to provide electrical service to access electricity required for construction.
- B. Contractor to pay the cost of energy used. Exercise measures to conserve energy.
- C. Contractor to furnish extension cords and temporary power locations as required for construction operations.

##### 1.04 TEMPORARY LIGHTING

- A. Contractor shall provide and maintain temporary lighting required for construction operations.

##### 1.05 TEMPORARY HEAT

- A. Provide and pay for heat devices and heat if required to maintain specified conditions for construction operations.

##### 1.06 TELEPHONE

- A. Provide, maintain and pay for telephone service to construction field office.

##### 1.07 TEMPORARY WATER SERVICE

- A. Contractor to provide suitable quality water service required for construction operations.
- B. Contractor to pay cost of water used. Exercise measures to conserve water.

##### 1.08 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures.
- B. Contractor shall pay cost of temporary sanitary facilities and service.

## **1.09 PROTECTION OF INSTALLED WORK**

- A. Protect installed Work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills and soffits of openings.
- D. Protect finished floors, stairs and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

## **1.10 PARKING AND ACCESS TO THE SITE**

- A. Parking and access to the site to be coordinated with owner's representative.

## **1.11 SECURITY**

- A. Provide security and facilities to protect Work and stored materials from unauthorized entry, vandalism, or theft.

## **1.12 PROGRESS CLEANING**

- A. Clean Up During Construction: During the process of work, keep the project sites clear of all rubbish. Keep all campus streets adjacent to the project free of dirt, gravel, concrete and other materials transported to and from the project.
- B. Rubbish Containers: Suitable containers with covers shall be provided for all refuse from meals eaten on the job site and such containers shall be emptied at least once in every 72 hour period. One container is to be placed beside each drinking water facility to receive discarded paper cups. All bottles, cans, paper and garbage of every description are to be continually picked up and placed in the covered containers. all workmen are to be advised of the contents of this paragraph and nothing short of their full cooperation is considered reasonable.
- C. Contractor shall remove waste materials, debris and rubbish from site and dispose off-site in accordance with all applicable codes and ordinances.

## **1.13 CONSTRUCTION FIELD OFFICE**

- A. Contractor shall maintain a temporary construction field office. This field office should be large enough to contain a telephone, internet service, plan table, record contract documents and conference table large enough for 10 people for progress meetings. The construction field office should be heated and air conditioned.

## **PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**  
Not Used

**END OF SECTION**



## SECTION 01 57 23

### TEMPORARY STORM WATER POLLUTION CONTROL

#### PART 1 GENERAL

##### 1.01 SUMMARY OF WORK

- A. Work shall consist of temporary and permanent storm water pollution prevention measures through the use of berms, sediment basins, sediment dams, fiberglass roving, filter fabric, silt fences, brush barriers, baled straw erosion checks, temporary flexible pipe slope drains and temporary seeding.
- B. Temporary storm water pollution prevention measures shall be performed promptly when problem conditions exist or when storm water pollution problems are anticipated in certain areas to minimize soil erosion and siltation. Temporary measures shall be properly maintained until permanent control measures are functioning properly.
- C. The Contractor shall comply with all Federal, State and local laws and regulations concerning controlling pollution of the environment. He shall take all necessary precautions to prevent pollution of streams, lakes, ponds and reservoirs with fuel, oils, bitumens, chemicals, soil sedimentation or other harmful materials, and to prevent pollution of the atmosphere from particulate gaseous matter.

##### 1.02 RELATED SECTIONS

- A. Section 31 00 00 - Earthwork.
- B. Section 31 10 00 - Site Clearing.
- C. Section 31 23 33 - Trenching and Backfilling.
- D. Section 31 25 00 - Erosion and Sedimentation Control.

- 1.03** At the Preconstruction Conference, or prior to the start of applicable construction, the Contractor shall submit his schedule for the accomplishment of temporary and permanent storm water pollution control work as applicable for clearing and grubbing, trenching and backfill to the Owner and Engineer. The location of the project, nature of the soil, topographic features and proximity to watercourses shall be considered when imposing such limitations.

#### PART 2 MATERIALS

##### 2.01 STRAW BALES

- A. Straw shall be the threshed plant residue of oats, wheat, barley, rye or rice from which the grain has been removed.

##### 2.02 FENCE OR WIRE FABRIC

- A. The fence fabric shall be a commercial grade of woven wire fence fabric. The wire fabric shall be a welded wire fabric.

##### 2.03 FILTER FABRIC OR SILT FENCING

- A. Nonwoven polypropylene or polyester fabric.
- B. Manufacturer: Typar 3401, Trevira S1115, or equal.

##### 2.04 ACCESSORIES

- A. Wood or steel stakes. If using steel stakes (rebar), stakes shall have safety caps meeting OSHA requirements.
- B. Rectangular hay bales shall be secured with twine or nylon rope.

- C. Filter fabric shall be supported by steel or wooden posts and backed with a woven wire fabric for support.

### **PART 3 EXECUTION**

#### **3.01 PERMITTING**

- A. A Storm Water Pollution Prevention Plan **is** required since the area to be disturbed is **more than** one acre.

**END OF SECTION**

**SECTION 01 60 00  
MATERIAL AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Products.
- B. Transportation and Handling.
- C. Storage and Protection.

**1.02 RELATED SECTIONS**

- A. Section 01 40 00 - Quality Control: Product quality monitoring.

**1.03 PRODUCTS**

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacturer, for similar components.

**1.04 TRANSPORTATION AND HANDLING**

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

**1.05 STORAGE AND PROTECTION**

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated products, place on sloped supports, above ground.
- C. Provide off-site storage and protection when site does not permit on-site storage or protection.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

**END OF SECTION**

**SECTION 01 70 00**  
**CONTRACT CLOSEOUT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Closeout Procedures.
- B. Final Cleaning.
- C. Project Record Documents.
- D. Operation and Maintenance Data
- E. Warranties.

**1.02 RELATED SECTIONS**

- A. Section 01 33 00 – Submittals.
- B. Section 01 50 00 – Construction Facilities, Temporary Controls and Temporary Utilities: Progress cleaning.

**1.03 CLOSEOUT PROCEDURES**

- A. Submit written certification that the Contract Documents and all punch lists have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect and Owner's Final inspection.
- B. Provide submittals to the Architect that are required by governing or other authorities.
- C. Submit final Application for Payment, after receiving letter from Architect as outlined in Article 9 of the General Conditions identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Comply with pertinent provisions of the General Conditions of the Contract contained within this project manual.

**1.04 FINAL CLEANING**

- A. Execute final cleaning prior to final inspection.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances.
- C. Clean debris from roofs, gutters, downspouts, and drainage systems.
- D. Clean site; sweep paved areas, rake clean landscaped and lawn areas.
- E. Remove waste and surplus materials, rubbish, and construction facilities from the site and dispose in accordance with all applicable codes and ordinances.

## **1.05 PROJECT RECORD DOCUMENTS**

- A. The Contractor will maintain on site, one set of the following record documents; record actual revisions to the Work:
  - 1. Contract Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other Modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
  - 6. Test results of concrete breaks
- B. Store Record Documents separate from documents used for construction.
- C. Contractor shall record information on said record documents concurrent with construction progress.
- D. Specifications: Legibly mark in red pencil and record at each Product section description of actual Products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and Modifications.
- E. Record Documents and Shop Drawings: Legibly mark in red pencil each item to record actual construction including:
  - 1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 2. Field changes of dimension and detail.
  - 3. Details not on original Contract Drawings.
  - 4. Exact locations of compaction tests and concrete cylinder breaks.
- F. Submit documents to Architect with final Application for Payment.

## **1.06 OPERATION AND MAINTENANCE DATA**

- A. Submit two sets prior to final inspection, bound in 8-1/2 x 11 inch text pages.
- B. Prepare binder covers with printed title "MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified.
- E. Part 1: Directory, listing names, addresses, and telephone numbers of Architect\Engineer, Contractor, Subcontractors, and major equipment suppliers.
- F. Part 2: Maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
  - 1. Significant design criteria.
  - 2. Maintenance instructions for systems.
  - 3. Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

- G. Part 3: Project documents and certificates, including the following:
  - 1. Shop drawings and product data.
  - 2. Certificates.
  - 3. Photocopies of warranties and bonds.

**1.07 WARRANTIES**

- A. Provide duplicate notarized copies.
- B. The Contractor shall execute and assemble documents from subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in a suitable binder with durable cover.
- D. Submit prior to final Application for Payment.

**PART 2 PRODUCTS**

Not used

**PART 3 EXECUTION**

Not used

**END OF SECTION**

## **SECTION 02 01 00**

### **GEOTECHNICAL INVESTIGATION**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. The following geotechnical investigation for this project, dated June 3, 2024, was provided to the Owner by Grubbs, Hoskyn, Barton and Wyatt, LLC dba UES, 1 Trigon Place, Little Rock, Arkansas 72209 (501) 455-2536.

##### **1.02 RELATED SECTIONS**

- A. Section 01 40 00 - Quality Requirements.
- B. Section 31 10 00 - Site Preparation.
- C. Section 31 23 10 - Grading.
- C. Section 31 23 15 - Excavating.
- D. Section 31 23 16 - Fill and Backfill.
- E. Section 31 23 17 Trenching for Site Utilities.
- F. Section 32 13 13 - Portland Cement Concrete Paving.
- G. Section 03 30 00 - Cast In Place Concrete

##### **1.03 EXPLANATION**

- A. The information contained in this section is included for the contractor's information only. No warranties are made or implied as to the accuracy of the information contained therein.
- B. The Contractor shall verify all on-site conditions.

##### **1.04 SOILS AND FOUNDATION INVESTIGATION**



August 7, 2024  
Job No. A24184.00055

SCM Architects  
1400 Kirk Road, Suite 220  
Little Rock, Arkansas 72223

Attn: Mr. John Connell, AIA  
Principal

**RESULTS of GEOTECHNICAL INVESTIGATION  
ALTERNATE SITE - FOREST HEALTH RESEARCH CENTER  
UNIVERSITY of ARKANSAS at MONTICELLO  
MONTICELLO, ARKANSAS**

**INTRODUCTION**

Submitted herewith are the final results of the geotechnical investigation performed for the proposed Forest Health Research Center planned at the University of Arkansas at Monticello campus in Monticello, Arkansas. These services were authorized on behalf of SCM Architects by Mr. John Connell on April 3, 2024. This geotechnical study was performed in accordance with our initial proposal of April 2, 2024 and the supplemental proposal for an alternate site of April 19, 2024. The initial proposal was for a site to the north of the current project site. The subject site of this report was selected for final design. An interim report with results of field studies and preliminary foundation design recommendations was provided on June 3, 2024. The boring logs for the initial site have been provided in a separate submittal.

We understand that the proposed research center will be a single-story wood and steel building with plan dimensions of approximately 75 ft by 245 feet. Maximum column loads are expected to be on the order of 150 kips. Site grading information has not been provided. However, the building finish floor is expected to be 1.5 to 2.5 higher than existing grades.

The purposes of this geotechnical investigation were to explore subsurface conditions at the selected site and to develop recommendations to guide design and construction of foundations and floor slabs. The results of the field and laboratory studies are discussed in the following report sections. Subsequent report sections provide recommendations for design and construction.



## **SUBSURFACE EXPLORATION**

Subsurface conditions at the selected Forest Health Research Center site were explored by drilling five (5) sample borings (Borings A through E) to 25- to 30-ft depth. In addition, one (1) boring drilled for the initial site being considered (Boring 7) has been included for this study. The site vicinity is shown on Plate 1. The approximate boring locations are shown on the Plan of Borings, Plate 2. Boring logs, presenting descriptions of the subsurface strata encountered and results of field and completed laboratory tests, are included as Plates 3 through 8. A key to the terms and symbols used on the logs is presented as Plate 9. A generalized subsurface profile is provided in Appendix A. It should be noted that surface elevations have been assumed.

The borings were drilled with a truck-mounted SIMCO 2800 (Boring C) and track-mounted CME-55 (remaining borings) rotary-drilling rigs using dry-auger drilling procedures. Samples were typically obtained using a 2-inch-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer dropped 30 inches, in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 inches of an 18-inch total drive, or portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column.

Selected, representative undisturbed samples of cohesive soils were obtained using a 3-in.-diameter thin-walled tube hydraulically advanced into the soil. Undrained shear strength of the cohesive soils was estimated in the field using a calibrated hand penetrometer. Estimated shear strength values are plotted on the log forms, in tons per sq ft, as circles enclosing an "x".

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger drilling procedures to facilitate groundwater observations. Observations regarding groundwater are noted in the lower-right portion of each log and are discussed in subsequent sections of this report.

## **LABORATORY TESTING**

To evaluate pertinent physical and engineering characteristics of the foundation and subgrade soil, laboratory tests consisting of natural water content determinations and classification tests were performed on selected representative samples. A total of 46 natural water content determinations were performed to develop a profile of *in-situ* soil water contents for each boring. The results of



these tests are plotted on the logs as solid circles, in accordance with the scale and symbols shown in the legend located in the upper-right corner.

To verify field classification and to evaluate soil plasticity, 13 liquid and plastic (Atterberg) limit determinations and 14 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as small pluses inter-connected with a dashed line using the water content scale. The percent of soil passing the No. 200 Sieve is noted in the "Minus No. 200" column on the log forms. Classification test results, as well as soil classification by the Unified Soil Classification System and AASHTO Classification System, are summarized in Appendix B.

Soil shear strength was estimated in the field using hand penetrometer and SPT results. In addition, laboratory strength testing included three (3) unconsolidated-undrained triaxial compression tests. Undrained shear strength (cohesion) determined from the results of the compression tests is plotted at the appropriate depth, in tons per sq ft, as an open triangle. Unit dry weight and natural water content were also determined as a part of the strength test. These data are also shown on the appropriate log.

## **GENERAL SITE and SUBSURFACE CONDITIONS**

### **Site Conditions**

The selected site for the Forest Health Research Center is located on the northwest corner of the intersection of Fine Arts Lane and Lake Shore Drive. The Fine Arts Center building is immediately to the west of this site. The site is presently open with a short, landscaped grass cover. A drainage ditch extends north to south along Lake Shore Drive. Underground utilities are present on the site. The site terrain is generally flat, with a gentle fall from the east and south. Site surface drainage is considered poor to fair. The site was not accessible to rubber-tired equipment at the time of the field studies (April 2024) and following rain events.

### **Site Geology**

Geologically, the project locale is in the mapped exposure of the Tertiary Period Jackson Group. The Jackson Group contains a lower marine unit and an upper lacustrine unit. The formation is comprised of variable sequences of clayey sand and clay with interbedded sand, silt, and silty clay units. The Jackson also includes crossbedded sands and lignite beds in the lower marine unit. The thickness of the Jackson Group is reported to be about 300 feet.

### **Seismic Conditions**

The Drew County, Arkansas site is located in Seismic Zone 1, defined by the Arkansas Building Authority (2005) as the zone of low seismic potential. Based on the site geology, the



average soil conditions revealed by the borings, and our experience in the area, a Seismic Site Class D (stiff soil profile) is considered fitting with respect to the criteria of IBC 2021 and ASCE 7, Chapter 20. The liquefaction potential of the predominantly clayey soils encountered within the exploration depths of the borings is considered negligible.

### Subsurface Conditions

The stratigraphy encountered in the borings may be generalized into the following primary strata.

- Stratum I: The surficial soils are comprised of very soft to stiff brown, red, tan, reddish tan, reddish brown, and gray fine sandy clay with interbedded silty fine sand pockets. The predominant fine sandy clay extends to 8 to 13 ft below existing grades. The fine sandy clay exhibits low to medium plasticity. However, the potential for shrink-swell activity is considered low due to the high sand content and relatively high present soil water content levels. Soil shear strength is low to moderate, and compressibility is high to moderate.
- Stratum II: A localized stratum of medium dense brownish red and gray silty fine sand is below the fine sandy clay at 8 ft and extends to approximately 13-ft depth (see Boring C). The silty fine sand has medium relative density and low compressibility.
- Stratum III: The basal stratum encountered below the fine sandy clay and localized silty fine sand is firm to stiff tan, reddish tan, brown, gray, brownish gray, and dark gray clay with silty fine sand partings and seams. The clay has a blocky structure at depth. The basal clay units have medium to high plasticity. The shrink-swell potential of the Stratum III clay is considered low due to the depth of the stratum and the present soil water contents. The clay has low to moderate shear strength and moderate compressibility with low compressibility below about 13- to 23-ft depth.

To aid in visualizing subsurface conditions, a generalized subsurface profile is presented in Appendix A. It should be recognized that the stratigraphy illustrated by the profile has been inferred between discrete boring locations and that surface elevations have been assumed based on available topographic information. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profile should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater was encountered at 6.5 to 15 ft in April and May 2024. In addition, shallow perched groundwater could be present in the near-surface soils, particularly during wet seasons of the year. Groundwater levels will vary with seasonal precipitation and surface runoff and infiltration.



## **ANALYSES and RECOMMENDATIONS**

### **Foundation Design**

Foundations for Forest Health Research building must satisfy two (2) basic and independent design criteria. First, foundations must have an acceptable factor of safety against bearing failure under maximum design loads. Secondly, movement of foundations due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structure or equipment operational requirements. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

The presence of weak, compressible surface and near-surface soils are of significant consequence to the selection of the most appropriate foundation system for the alternate site. Based on the subsurface conditions encountered in the borings and the anticipated moderate structural loads, we recommend that foundation loads be supported on an intermediate foundation system comprised of footings supported on a bearing stratum improved by rammed aggregate piers. Recommendations for foundations and an at-grade floor slab are discussed in the following report sections.

### **Footings Supported on Rammed Aggregate Piers**

The zone of weak and highly-compressible surface and near-surface soils extends to 6 to 8 ft below existing grades. To provide adequate bearing capacity and mitigate the settlement potential, we recommend the use of rammed aggregate piers in conjunction with conventional footings. The Geopier™ system is effective for rammed aggregate pier use and is recommended for this project. With the use of rammed aggregate piers, the foundation soils are reinforced by installing rammed aggregate pier elements below load-bearing foundations. Settlement of floor slab areas can be reduced, and subgrade support increased by supporting slabs on a subgrade/bearing stratum improved by rammed aggregate piers.

Geopier elements are constructed by drilling 24- to 30-in.-diameter holes and ramming thin lifts of well-graded aggregate within the holes to form very stiff, high-density aggregate piers. The drilled holes would be expected to extend 8 to 12 ft below footing bottoms, extending through the very soft, firm, and stiff sandy clay units just into the underlying firm to stiff clay. We recommend that rammed aggregate pier length be adjusted to the extent possible to limit penetration into the clay to less than one (1) Geopier element diameter.

The first lift of aggregate in rammed aggregate piers forms a bulb below the bottoms of the piers, thereby prestressing and prestraining the soils to an approximate depth equal to one (1) pier



diameter. Subsequent lifts are typically about 12-in. thick. Ramming takes place with a high-energy beveled tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in the surrounding soil thereby further stiffening the stabilized the composite soil mass. The result of Geopier installation is a strengthening and stiffening of subsurface soils that may then support relatively high bearing pressure spread footings.

Based on the results of the alternate site borings, a net allowable composite bearing pressure of 4000 lbs per sq ft is expected for the soil conditions at the alternate site in conjunction with rammed aggregate pier improvement. Design is typically based on total settlement of about 1.0 inch and differential settlement less than 0.5 inch.

Uplift resistance can be provided by designing the Geopiers with embedded anchors. Information from Geopier Foundation Company indicates that individual Geopiers can resist 20 to 30 kips of tensile load, depending on the length of the Geopier.

For resistance to sliding, an ultimate passive resistance value of 300 lbs per sq ft may be assumed for the footing lateral resistance from the stable on-site soils and compacted select fill below 1.5-ft depth. An ultimate composite coefficient of sliding value of 0.4 may be assumed for concrete on the composite soil/rammed aggregate pier bearing stratum. An appropriate factor of safety must be included in analysis of sliding.

Geopier™ design and construction is proprietary and provided by contractors licensed by Geopier Foundation Company, Inc. Specific design, construction, and cost information must be obtained from Geopier Foundation Company. The concept for rammed aggregate pier construction is illustrated in the sketches provided in Appendix C.

Continuous footings over rammed aggregate piers should have a minimum width of 30 in. and individual footings a minimum dimension of 48 inches. A minimum footing depth of 2 ft below final grade is recommended. Where footing excavations encounter highly-plastic clay (i.e., soils with a PI in excess of 25), footings should be undercut at least 2 ft below the plan footing bottom elevation and backfilled with low-plasticity select fill.

### Floor Slabs

Slab-on-grade construction is recommended for the building floor slabs. Given the anticipated 1.5- to 2.5-ft of fill across the site and the zone of weak and compressible soils extending to 6 to 8 ft, we recommend that the weak soils in the floor slab areas be improved by installation of rammed aggregate piers on a regularly-spaced grid. Rammed aggregate pier elements should be spaced on the order of 8 to 10 ft in each direction.



To facilitate development of uniform slab subgrade support, promote construction over the unstable surface soils, and to limit development of weak surface soil zones between the tops of rammed aggregate pier elements, a load transfer platform is recommended below the floor slab and over the tops of rammed aggregate piers. The load transfer platform may be constructed initially by undercutting, raising grades, or a combination of these. This should consist of placing an initial layer of heavy geotextile over the subgrade and placing at least 18 in. of crushed stone aggregate base (ARDOT Class 7) in a single lift. The initial lift should be static rolled to a stable density. The final 6 in. of crushed stone base should be placed over the initial lift and compacted to project specifications. At least 2 ft of crushed stone base will be required to provide stability over the weak on-site subgrade and to provide protection for the underlying geotextile when installing rammed aggregate piers.

The concept for the load transfer platform is provided in Appendix D. Information on the subgrade support geotextile is also included in Appendix D. The plan grades of the load transfer platform may require adjustment to avoid conflicts with underground utility lines planned in the building area.

Select fill may be placed over the load transfer platform. Low-plasticity select fill placed to achieve design floor grade should comply with the recommendations discussed in the Site Grading section of this report. We also recommend that the slab be supported on a 4- to 6-in.-thick clean crushed stone layer placed above the load transfer platform on a properly prepared subgrade. The granular layer should be densified with vibrating equipment prior to floor slab construction. Impervious sheeting should be placed between the slab and the granular course to act as a vapor retarder.

#### Site Grading and Subgrade Preparation

Site preparation will require stripping the zone of organic-containing soils. A stripping depth of about of 3 to 6 in. is expected. Where a load transfer platform is planned at existing grades, stripping should be limited to removal of heavy organic zones. Care must be taken to limit disturbance of the subgrade.

After stripping and performing any cut, and prior to placing any fill, all subgrade should be evaluated by the Geotechnical Engineer. The results of the borings indicate that the weak and unstable soil zone extends to 6- to 8-ft depth or more. A load transfer platform has been recommended in the building area to limit undercut depth and provide continuous support between rammed aggregate pier elements.





The on-site soils are not recommended for use as select fill or backfill due to high *in-situ* water content and widely variable medium to high plasticity. The on-site soils may be used in landscaped areas away from plan buildings and pavement areas. Imported borrow for fill or backfill should consist of low-plasticity clayey sand (SC), sandy clay (CL), or clayey gravel (GC) with a liquid limit less than 40 and a maximum plasticity index (PI) of 18, or an approved alternate. Where highly-plastic clay or sandy clay is undercut in footing or floor slab areas, the undercut backfill should have a PI in the range of 5 to 18. Fill and backfill should have a maximum particle size of about 3 inches and must be free of organic materials and debris. All fill and backfill should be approved by the Geotechnical Engineer.

Fill and backfill should be placed in nominal 6- to 8-in.-thick lifts. Fill, backfill, and recompacted soils should be compacted to at least 95 percent of the maximum Modified Proctor (ASTM D1557) dry density within a water content range of 2 percent below to 3 percent above the optimum value. Each lift of fill or backfill should be properly compacted, tested and approved prior to placing subsequent lifts.

## **CONSTRUCTION CONSIDERATIONS**

### **Groundwater Control**

Positive surface and subsurface drainage should be established at the start of construction, maintained during the work, and incorporated into final design to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until the foundations and floor slabs are completed. Subgrade soils that become saturated by ponding water or runoff should be excavated to suitable material.

Groundwater was encountered at 6.5 to 15 ft in April and May 2024. Excavations for rammed aggregate pier construction could encounter groundwater. Limited seepage into shallow excavations could occur, particularly during wet seasons of the year, due to the development of shallow perched water. Limited seepage can typically be controlled by a sump-and-pump system. For areas where steady seepage of shallow groundwater is encountered, the seepage should be directed to positive discharge by French drains or blanket drains.

### **Foundations**

All footing excavations and undercuts should be observed by the Geotechnical Engineer to verify suitable bearing and adequate undercut. Footing excavations should be clean, with all loose spoil and debris removed from the footing excavation bottoms and the tops of the rammed aggregate





piers. Temporary casing could be required for rammed aggregate pier construction. Concrete should be placed in footing excavations expeditiously following final clean up and approval to limit changes in foundation conditions. Footing excavations should be clean and dry at the time of concrete placement. Where footing excavations will be left open for extended periods, the bearing stratum should be protected with a thin layer of seal concrete.

Installation of all rammed aggregate piers should be observed by the Geotechnical Engineer. A modulus load test program should be included in the rammed aggregate pier construction scope of work. The load test results should be reviewed by the Geotechnical Engineer to verify compliance with design assumptions.

## **CLOSURE**

Site preparation, grading work, and all foundation construction should be monitored by the Architect or a designated representative thereof. Subsurface conditions significantly at variance with those encountered in the borings utilized for this study should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following attachments are included and complete this submittal.

Plate 1	Site Vicinity
Plate 2	Plan of Borings
Plates 3 through 8	Alternative Site Boring Logs
Plate 9	Key to Terms and Symbols
Appendix A	Generalized Subsurface Profile
Appendix B	Classification Test Results
Appendix C	Concept of Rammed Aggregate Piers
Appendix D	Concept of Load Transfer Platform

\* \* \* \*



We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance during final design or construction, please call on us.

Sincerely,

**GRUBBS, HOSKYN,  
BARTON & WYATT, LLC**

Vellela M. Scott, P.E.  
Senior Project Engineer

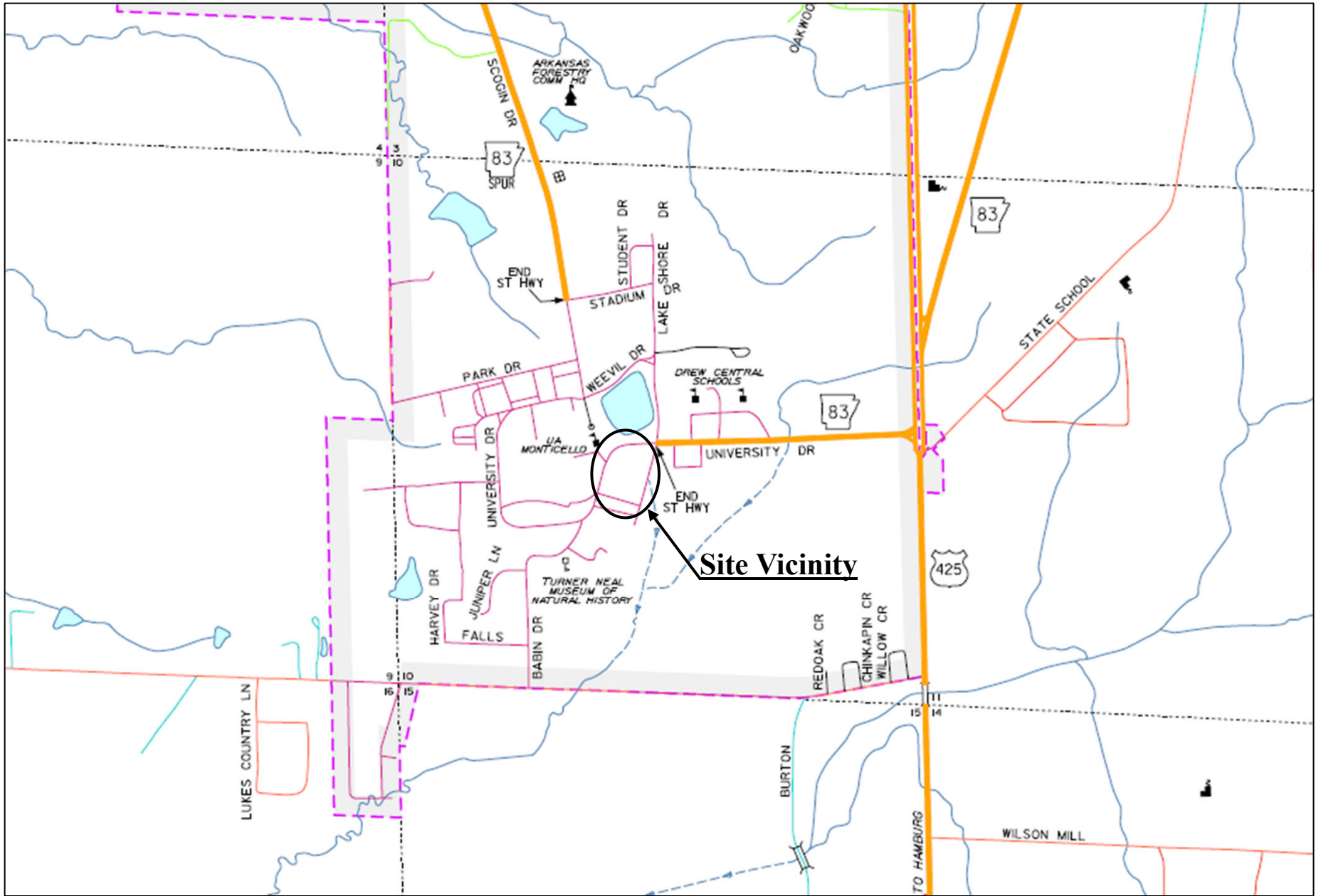
Mark E. Wyatt, P.E.  
President



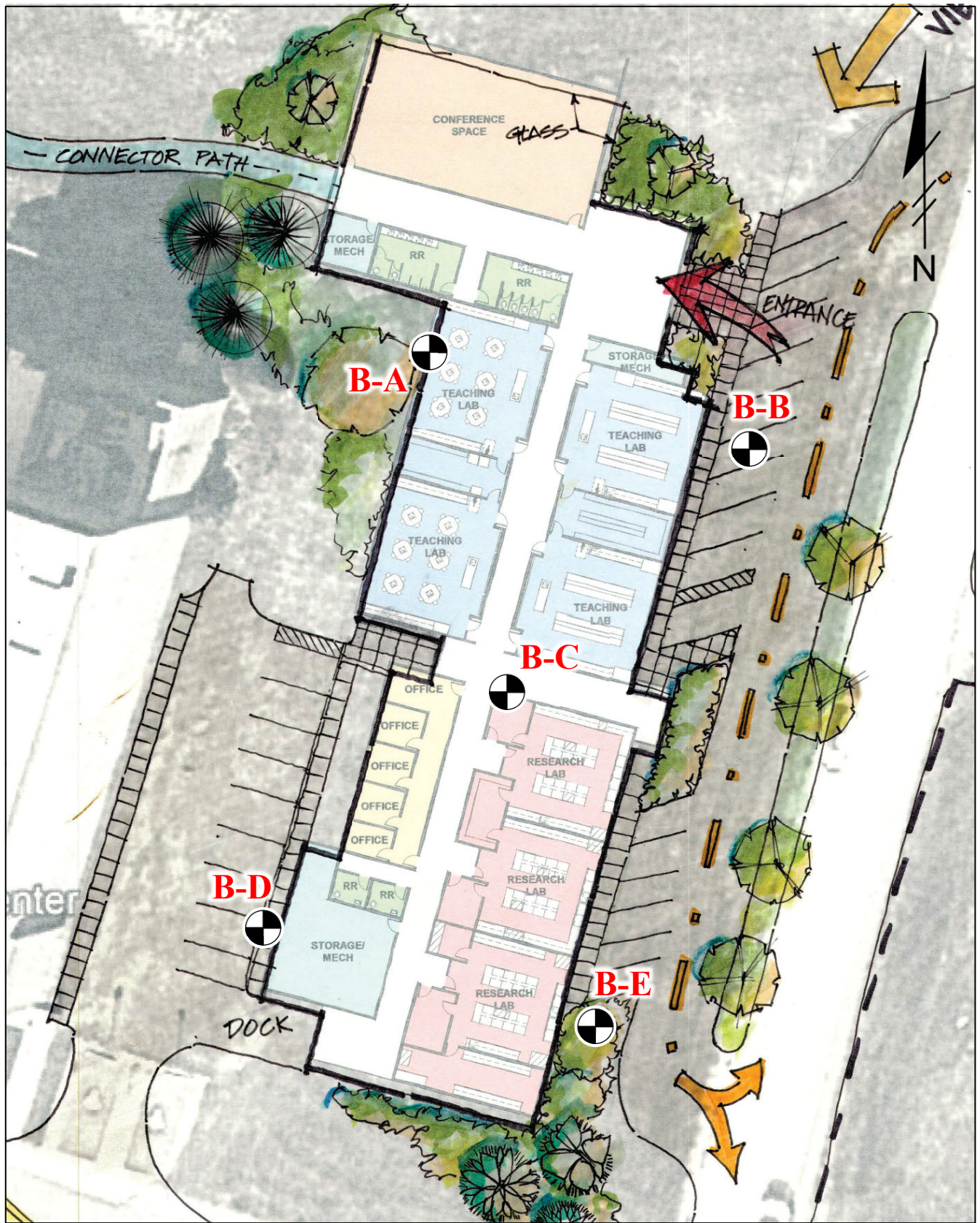
VMS/MEW:jw

Copies submitted:   SCM Architects  
                          Attn: Mr. John Connell, AIA           (1-email)

                          Engineering Consultants, Inc.  
                          Attn: Mr. Frank Allison, P.E.           (1-email)  
                          Attn: Mr. Alex Font, P.E.               (1-email)







Note: Base drawing received on 05-31-24

15 0 15 30 ft



**Grubbs, Hoskyn,  
Barton & Wyatt, LLC**  
CONSULTING ENGINEERS

A UES Company

**PLAN of BORINGS**  
**UAM Forest Health Research Center**  
**Monticello, Arkansas**

Scale: As Shown

Job No. A24184.00055

Plate 2



**Grubbs, Hoskyn,  
Barton & Wyatt, Inc.**  
Consulting Engineers

# LOG OF BORING NO. A

UAM Forest Health Research Center  
Monticello, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Building Location

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT				- No. 200 %	
						0.2	0.4	0.6	0.8		1.0
			SURF. EL:								
			Firm brown and reddish tan fine sandy clay w/rootlets	9							
			Firm gray and reddish brown fine sandy clay	7							
5			- stiff with trace fine gravel below 4 ft	11							66
			Stiff gray, tan, and red fine sandy clay		105						52
10			- with silty fine sand pockets and partings below 8 ft	11							
			Stiff tan and gray clay w/silty fine sand partings and seams	13							
15											
				15							
20											
			Stiff dark gray clay w/silty fine sand partings	16							
25											
30											

COMPLETION DEPTH: 25.0 ft  
DATE: 5-22-24

DEPTH TO WATER  
IN BORING: 15 ft

DATE: 5/22/2024

LGBNEW\_A24184.00055.GPJ\_5-30-24



**Grubbs, Hoskyn,  
Barton & Wyatt, Inc.**  
Consulting Engineers

## LOG OF BORING NO. B

UAM Forest Health Research Center  
Monticello, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Building Location

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %					
						PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT						
			SURF. EL:			0.2	0.4	0.6	0.8	1.0	1.2	1.4		
						10	20	30	40	50	60	70		
			Firm grayish brown and reddish tan fine sandy clay, silty w/ferrous nodules and stains	8			●							
			Firm tan and gray fine sandy clay	7			●	+					66	
5			Very soft to soft gray, tan, and reddish tan fine sandy clay w/occasional ferrous nodules and stains - firm at 6 to 8 ft - with a little fine to coarse gravel below 6 ft - stiff below 8 ft	4			●							
				8			●							
10				12			●	+	+					40
15			Firm tan, brownish gray, and reddish tan clay w/silty fine sand partings and seams											
20				8					●					
25			Stiff brown clay w/occasional silty fine sand partings	16					●					
30														

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COMPLETION DEPTH: 25.0 ft  
DATE: 5-22-24

DEPTH TO WATER  
IN BORING: 6.5 ft

DATE: 5/22/2024



**Grubbs, Hoskyn,  
Barton & Wyatt, Inc.**  
Consulting Engineers

# LOG OF BORING NO. C

UAM Forest Health Research Center  
Monticello, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Building Location

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %				
						PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT					
			SURF. EL:			0.2	0.4	0.6	0.8	1.0	1.2	1.4	
						10	20	30	40	50	60	70	
			Firm brown fine sandy clay	9			20		30				69
			- gray, tan, and reddish tan below 2 ft	7			20						
5			Firm gray and reddish brown fine sandy clay	9			20						
			- stiff with a little fine to coarse gravel below 6 ft	101			20		50		60	70	66
			Medium dense brownish red and gray silty fine sand w/clay pockets	21			20						42
15			Firm tan and reddish tan clay w/silty fine sand partings	8					40				
			- brown and reddish tan below 18 ft	9					40				
20			- stiff below 23 ft	15					40				
25			- dark gray below 28 ft	12					40				
30													

COMPLETION DEPTH: 30.0 ft  
DATE: 4-26-24

DEPTH TO WATER  
IN BORING: 12 ft

DATE: 4/26/2024

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**Grubbs, Hoskyn,  
Barton & Wyatt, Inc.**  
Consulting Engineers

# LOG OF BORING NO. D

UAM Forest Health Research Center  
Monticello, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Building Location

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %				
						PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT					
			SURF. EL:			0.2	0.4	0.6	0.8	1.0	1.2	1.4	
						10	20	30	40	50	60	70	
			Firm brown fine sandy clay	8									
			Soft gray, red, and tan fine sandy clay w/ferrous nodules and stains	6									
5			Soft gray, red, and tan fine sandy clay w/trace fine to coarse gravel	5									
			- stiff to very stiff below 6 ft		100								60
10			Firm grayish tan clay w/silty fine sand partings and seams	7									
15			Firm brown clay w/occasional silty fine sand partings and ferrous stains	7									96
20				9									
25			Stiff dark gray clay	14									
30													

COMPLETION DEPTH: 25.0 ft  
DATE: 5-22-24

DEPTH TO WATER  
IN BORING: 13 ft

DATE: 5/22/2024

LGBNEW\_A24184.00055.GPJ\_5-30-24





**Grubbs, Hoskyn,  
Barton & Wyatt, Inc.**  
Consulting Engineers

# LOG OF BORING NO. E

UAM Forest Health Research Center  
Monticello, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Building Location

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT						- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	
			SURF. EL:			PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT		
						+	+	+	+	+	+	
			Soft brown fine sandy clay w/rootlets	6								
5			Very soft to soft gray, brown, and red fine sandy clay w/ferrous nodules and stains and a little fine to coarse gravel - soft at 4 to 6 ft - stiff at 6 to 8 ft - firm to stiff, brownish gray and reddish tan below 8 ft	4 5 10								47
10												
15			Stiff tan and reddish tan clay w/silty fine sand partings and seams	12								
20			Firm to stiff brown clay w/occasional silty fine sand partings - stiff below 23 ft	10 16								
25												
30												

COMPLETION DEPTH: 25.0 ft  
DATE: 5-22-24

DEPTH TO WATER  
IN BORING: 10 ft

DATE: 5/22/2024

LGBNEW\_A24184.00055.GPJ\_5-30-24



**Grubbs, Hoskyn,  
Barton & Wyatt, Inc.**  
Consulting Engineers

# LOG OF BORING NO. 7

UAM Forest Health Research Center  
Monticello, Arkansas

TYPE: Auger

LOCATION: See Plate 2 - Building

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %	
						0.2	0.4	0.6		0.8
SURF. EL:						PLASTIC LIMIT: 10 --- 20 --- 30 --- 40 --- 50 --- 60 --- 70 WATER CONTENT: 10 --- 20 --- 30 --- 40 --- 50 --- 60 --- 70 LIQUID LIMIT: 10 --- 20 --- 30 --- 40 --- 50 --- 60 --- 70				
			Stiff brown clay	12						
			Very soft to soft tan, reddish brown, and gray fine sandy clay w/trace fine gravel	4						47
5			Firm gray, red, and brown fine sandy clay w/trace fine gravel	9						
			- stiff with a little fine to coarse gravel below 6 ft							57
10			Stiff gray and red clay w/silty fine sand pockets and partings	12						
15			Firm grayish tan and reddish tan clay w/silty fine sand partings	8						
20			- stiff with silty fine sand seams and ferrous stains below 18 ft	17						
25				20						
30										

COMPLETION DEPTH: 25.0 ft  
DATE: 4-26-24

DEPTH TO WATER  
IN BORING: 12 ft

DATE: 4/26/2024

LGBNEW\_A24184.00055.GPJ\_5-23-24



# SYMBOLS AND TERMS USED ON BORING LOGS

## SOIL TYPES

(SHOWN IN SYMBOLS COLUMN)



Gravel



Sand



Silt



Clay

Predominant type shown heavy

## SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



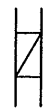
Shelby  
Tube



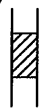
Rock  
Core



Split  
Spoon



No  
Recovery



Cutting

## TERMS DESCRIBING CONSISTENCY OR CONDITION

**COARSE GRAINED SOILS** (major portion retained on No. 200 sieve): Includes (1) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

**FINE GRAINED SOILS** (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

## TERMS CHARACTERIZING SOIL STRUCTURE

**SLICKENSIDED** - having inclined planes of weakness that are slick and glossy in appearance.

**FISSURED** - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

**LAMINATED** - composed of thin layers of varying color and texture.

**INTERBEDDED** - composed of alternate layers of different soil types.

**CALCAREOUS** - containing appreciable quantities of calcium carbonate.

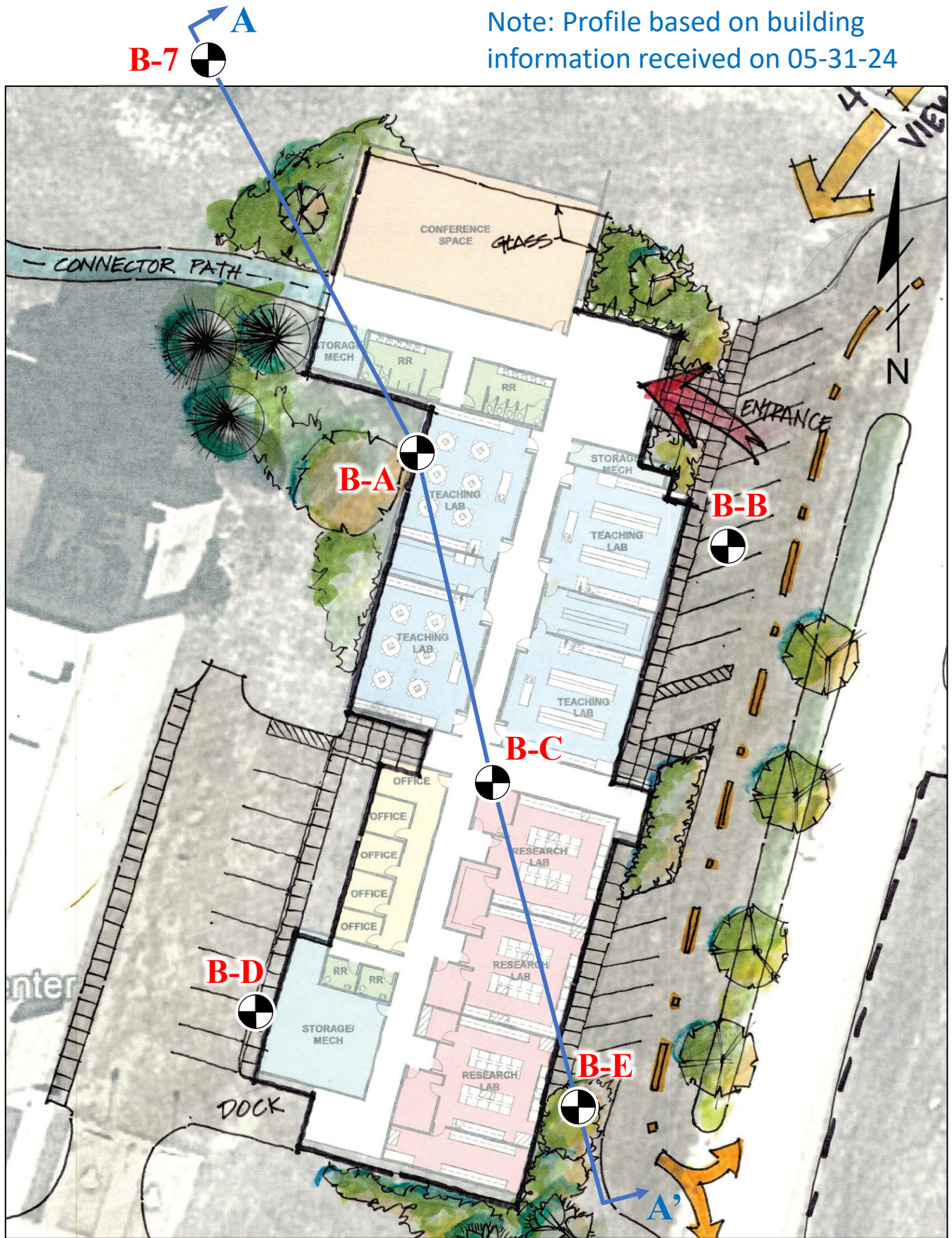
**WELL GRADED** - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.

**POORLY GRADED** - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

**APPENDIX A**

Note: Profile based on building information received on 05-31-24



**Grubbs, Hoskyn,  
Barton & Wyatt, LLC**  
CONSULTING ENGINEERS

A UES Company

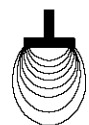
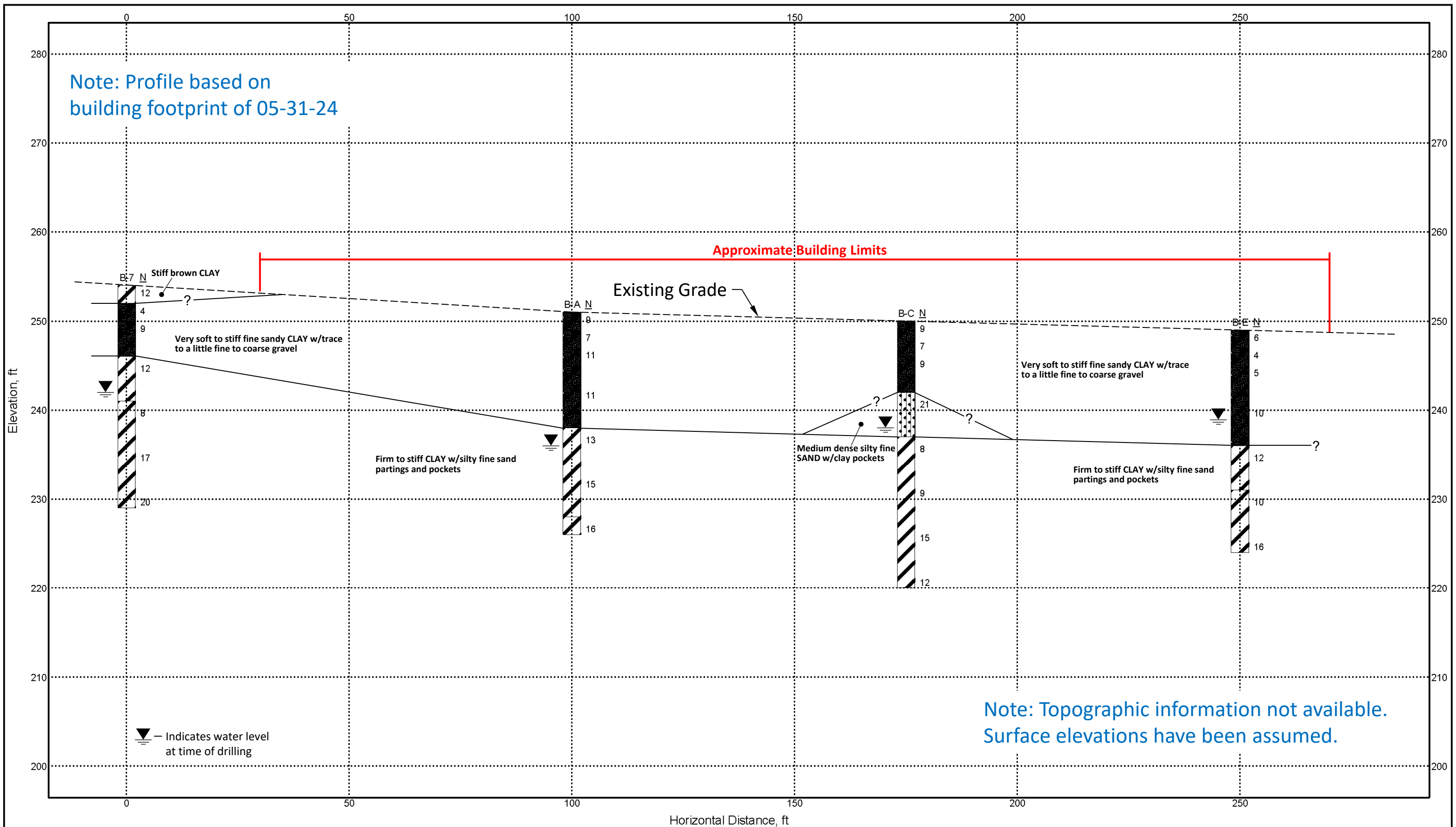
**PLAN of PROFILE A-A'**  
**UAM Forest Health Research Center**  
**Monticello, Arkansas**

Scale: As Shown

Job No. A24184.00055

Plate





**Grubbs, Hoskyn,  
Barton & Wyatt, LLC**

**NOTES:**  
 1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.  
 2. Ground surface approximate.

**SCALE:**  
 1" = 20' Horizontal  
 1" = 10' Vertical

**Generalized Subsurface Profile A-A'  
 UAM Forest Health Research Center  
 Monticello, Arkansas**

Project Number: A24184.00055

**APPENDIX B**

# SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: UAM Forest Health Research Center

LOCATION: Monticello, Arkansas

GHBW JOB NUMBER: A24184.00055

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			PERCENT RETAINED #4	PERCENT PASSING #200	USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				
A	4.5-5.5	23	45	21	24	6	66	CL	A-7-6
A	7-7.5	22	36	23	13	0	52	CL	A-6
B	2.5-3.5	18	30	18	12	1	66	CL	A-6
B	9-10	13	46	17	29	35	40	GC	A-2-7
C	0.5-1.5	21	35	19	16	1	69	CL	A-6
C	7-7.5	25	57	23	34	9	66	CH	A-7-6
C	9-10	24	---	---	---	0	42	SM	A-4
D	7-7.5	24	51	23	28	16	60	CH	A-7-6
D	14-15	36	60	23	37	0	96	CH	A-7-6
E	7-7.5	19	42	17	25	32	47	GC	A-7-6
7	2.5-3.5	19	36	23	13	18	47	SC	A-6
7	7-7.5	18	47	21	26	8	57	CL	A-7-6



# SUMMARY of CLASSIFICATION TEST RESULTS

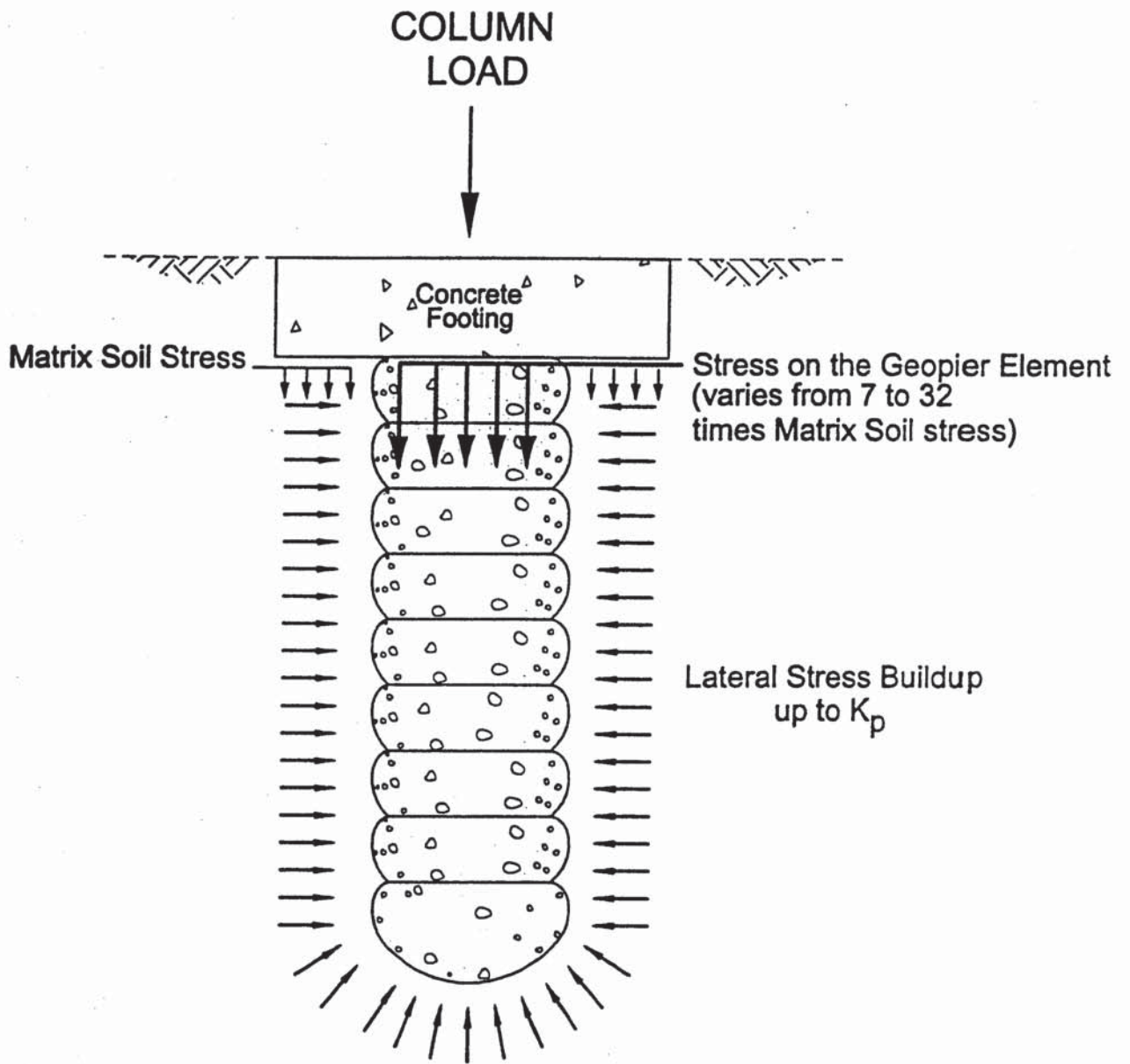
PROJECT: UAM Forest Health Research Center

LOCATION: Monticello, Arkansas

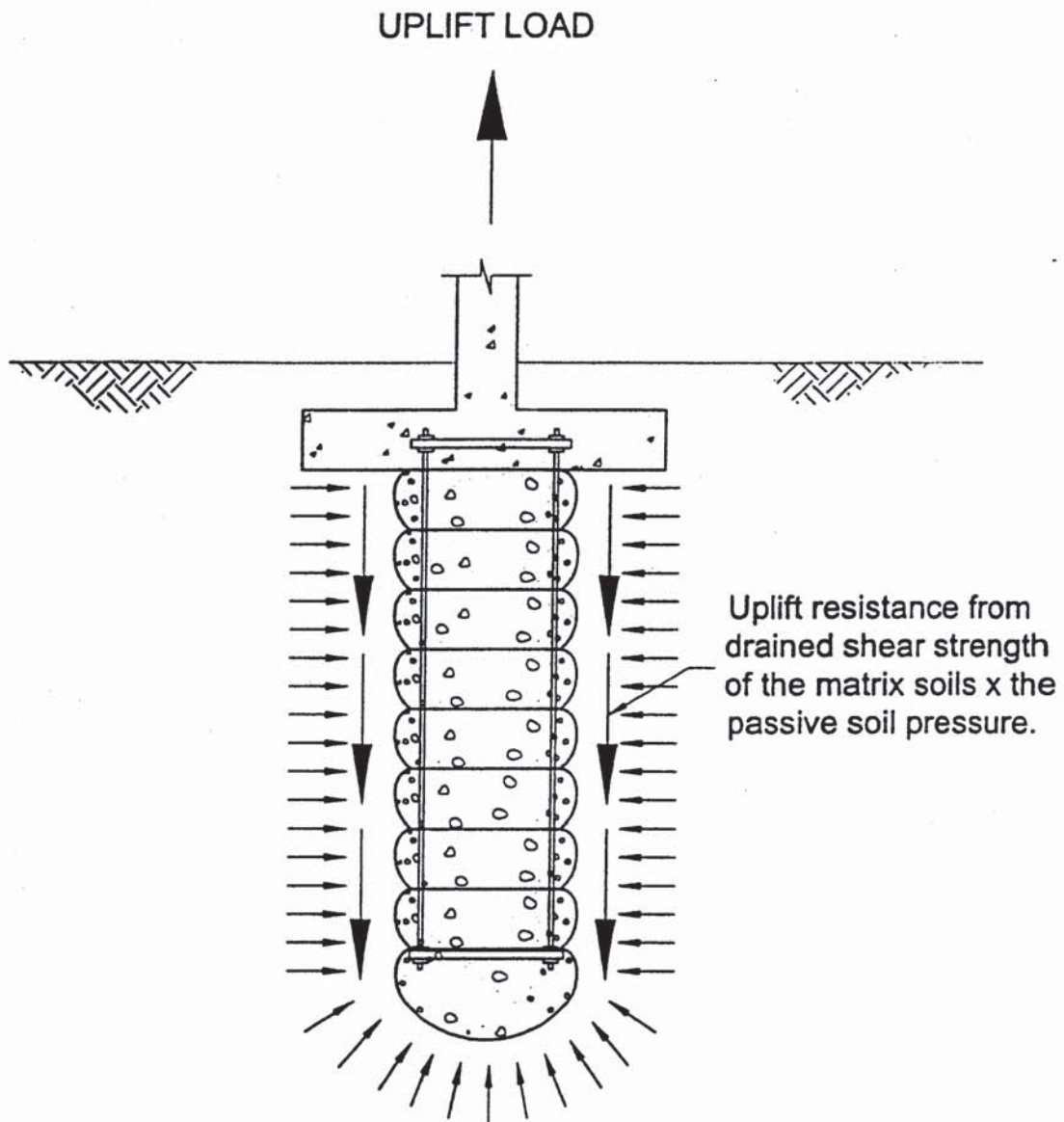
GHBW JOB NUMBER: A24184.00055

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			PERCENT RETAINED #4	PERCENT PASSING #200	USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				
A	4.5-5.5	23	45	21	24	6	66	CL	A-7-6
A	7-7.5	22	36	23	13	0	52	CL	A-6
B	2.5-3.5	18	30	18	12	1	66	CL	A-6
B	9-10	13	46	17	29	35	40	GC	A-2-7
C	0.5-1.5	21	35	19	16	1	69	CL	A-6
C	7-7.5	25	57	23	34	9	66	CH	A-7-6
C	9-10	24	---	---	---	0	42	SM	A-4
D	7-7.5	24	51	23	28	16	60	CH	A-7-6
D	14-15	36	60	23	37	0	96	CH	A-7-6
E	7-7.5	19	42	17	25	32	47	GC	A-7-6
7	2.5-3.5	19	36	23	13	18	47	SC	A-6
7	7-7.5	18	47	21	26	8	57	CL	A-7-6

## **APPENDIX C**



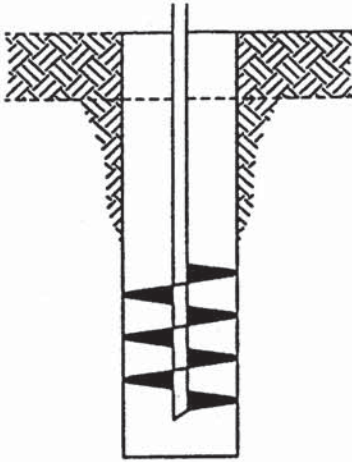
**Figure 2.1.1. Geopier Load Support**



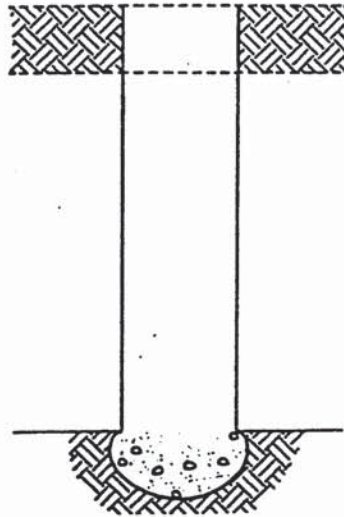
**Figure 4.4.1. Uplift Load Resistance**

## CONSTRUCTION

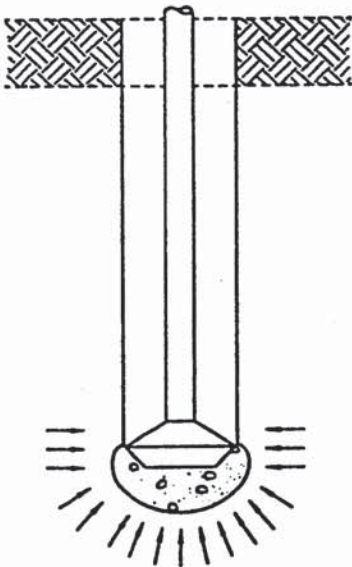
Construction Process (without casing):



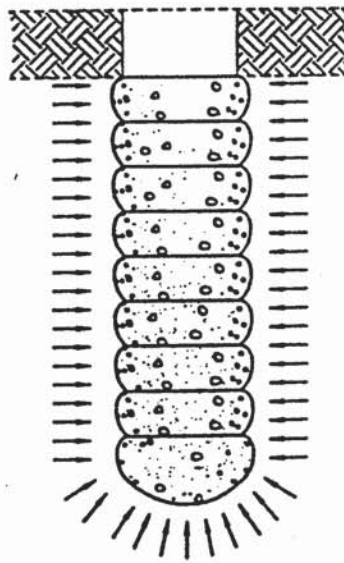
1. Excavate Cavity



2. Place single lift well-graded stone



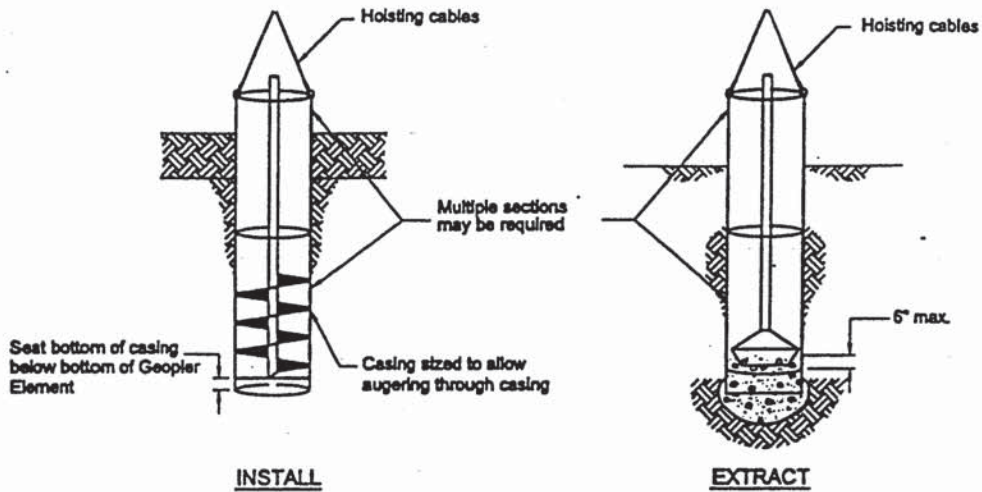
3. Form bottom bulb



4. Place thin lifts of aggregate and Ram with Beveled Tamper

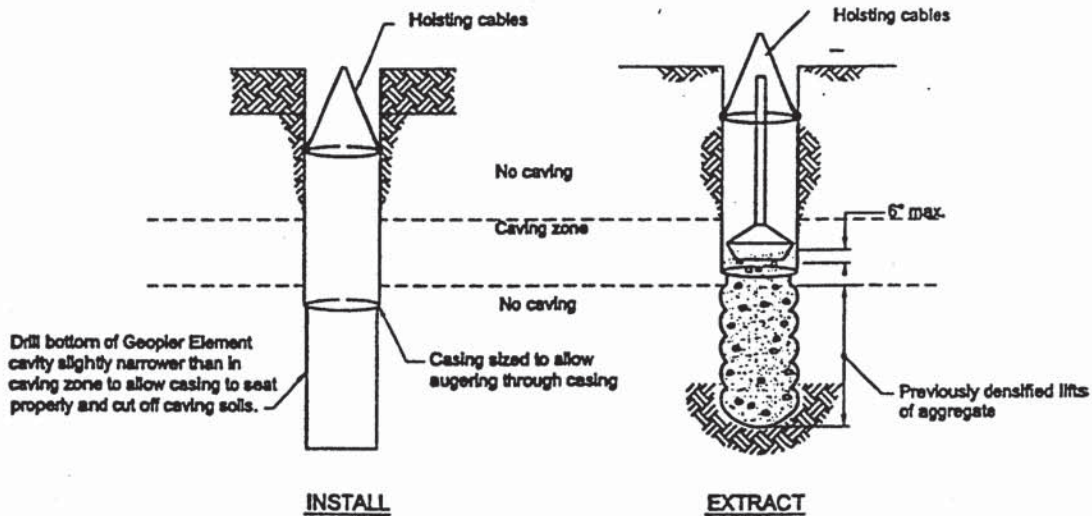
# CONSTRUCTION

## Construction Process (with casing):



### a) Caving soils present for full depth of Geopier Element.

**NOTE:** Place loose aggregate and extract casing such that bottom of casing is within 6-inches of top of loose lift of aggregate. Compact aggregate as with non-cased Geopier Elements. Repeat aggregate placement, casing extraction, and tamping on successive lifts.



### b) Caving soils confined by layers of stable soils.

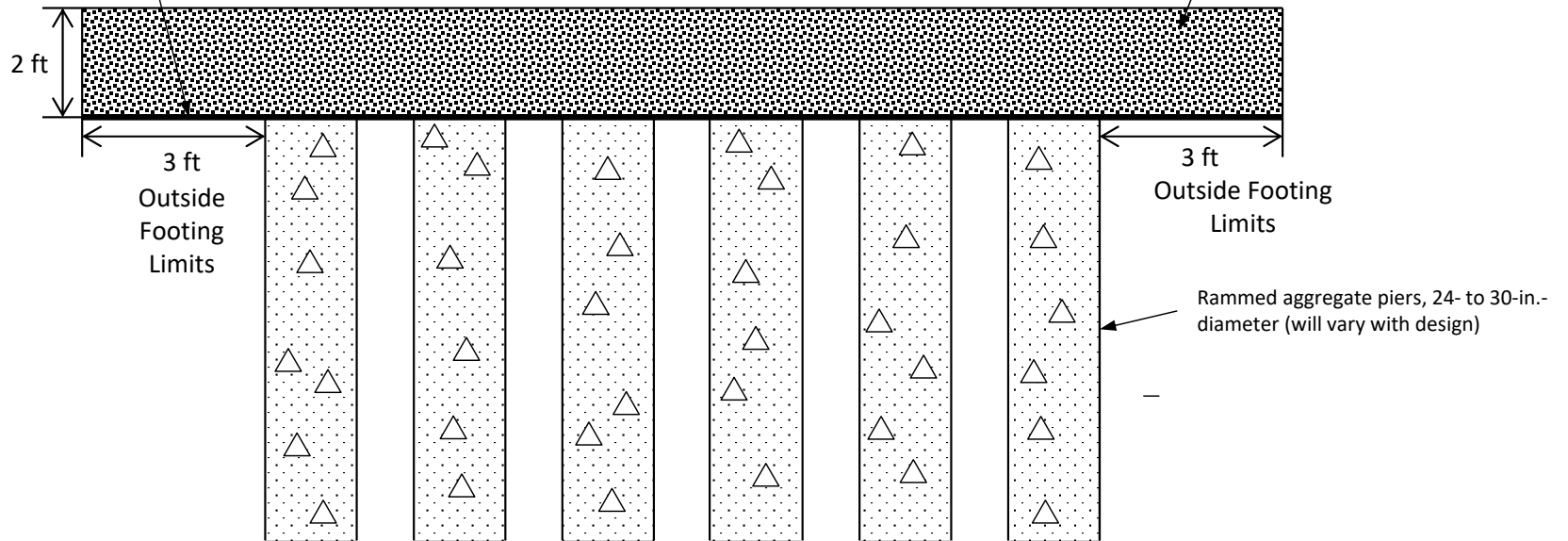
**APPENDIX D**

# CONCEPT DRAWING - FOR INFORMATION ONLY

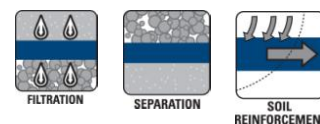
Woven Geotextile Subgrade Support Fabric  
 Mirafi HP 270 or approved alternate  
 One (1) full-width layer, wrapped at ends  
 Min. 24-in. overlap at all joints

Uniform subgrade for placement  
 of clean stone capillary layer and  
 slab construction or for placing  
 select fill

ARDOT Class 7 base or  
 Approved Alternative







## Mirafi<sup>®</sup> HP270

Mirafi<sup>®</sup> HP270 geotextile is composed of high-tenacity polypropylene yarns, which are woven into a network such that the yarns retain their relative position. Mirafi<sup>®</sup> HP270 geotextile is inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Tensile Strength (at ultimate)	ASTM D4595	kN/m (lbs/ft)	38.5 (2640)	35.9 (2460)
Tensile Strength (at 2% strain)	ASTM D4595	kN/m (lbs/ft)	7.0 (480)	8.6 (588)
Tensile Strength (at 5% strain)	ASTM D4595	kN/m (lbs/ft)	17.7 (1212)	19.8 (1356)
Tensile Strength (at 10% strain)	ASTM D4595	kN/m (lbs/ft)	34.1 (2340)	35.2 (2412)
Factory Seam Strength	ASTM D4884	kN/m (lbs/ft)	18.4 (1250)	
Flow Rate	ASTM D4491	l/min/m <sup>2</sup> (gal/min/ft <sup>2</sup> )	2037 (50)	
Permeability	ASTM D4491	cm/sec	0.04	
Permittivity	ASTM D4491	sec <sup>-1</sup>	0.70	
Apparent Opening Size (AOS) <sup>1</sup>	ASTM D4751	mm (U.S. Sieve)	0.60 (30)	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	80	

<sup>1</sup> ASTM D 4751: AOS is a Maximum Opening Diameter Value

NOTE: To obtain Secant Modulus, divide tensile strength by the appropriate strain level (i.e. Secant Modulus at 5% = 1,212/0.05 = 24,240 lbs/ft)

Physical Properties	Test Method	Unit	Typical Value
Mass/Unit Area	ASTM D5261	g/m <sup>2</sup> (oz/yd <sup>2</sup> )	227 (6.7)
Roll Dimensions (width x length)	--	m (ft)	4.5 (15) x 91 (300)
Roll Area	--	m <sup>2</sup> (yd <sup>2</sup> )	418 (500)
Estimated Roll Weight	---	kg (lbs)	100 (220)

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Mirafi<sup>®</sup> is a registered trademark of Nicolon Corporation



September 18, 2024  
Job No. A24184.00055

SCM Architects  
1400 Kirk Road, Suite 220  
Little Rock, Arkansas 72223

Attn: Mr. John Connell, AIA  
Principal

**REF: SUPPLEMENTAL COMMENTS – PAVEMENT SECTIONS  
FOREST HEALTH RESEARCH CENTER  
UNIVERSITY of ARKANSAS at MONTICELLO  
MONTICELLO, ARKANSAS**

Mr. Connell,

Provided herein are recommendations for pavement sections for the new Forest Health Research Center planned at the University of Arkansas at Monticello campus in Monticello, Arkansas. We provided the report of the geotechnical investigation on August 7, 2024. This additional information was requested by Mr. Connell on September 17, 2024.

These pavement section alternatives have been developed based on the assumption of light traffic in parking areas and drives, with traffic limited to automobiles and light utility vehicles.

We recommend the following pavement sections .

Parking

- 2 in. Asphalt Concrete Hot Mix Surface Course (ARDOT Standard Specifications, Section 407,  $\frac{3}{8}$  inch,  $N_{max} = 115$ )
- 7 in. Crushed Stone Base (ARDOT Standard Specifications Section 303, Class 7) or approved equal

Drives

- 3 in. Asphalt Concrete Hot Mix Surface Course (ARDOT Standard Specifications, Section 407,  $\frac{3}{8}$  inch,  $N_{max} = 115$ )
- 8 in. Crushed Stone Base (ARDOT Standard Specifications Section 303, Class 7) or approved equal

We recommend that all subgrade be proof-rolled prior to placing base course. Depending on seasonal site conditions and the final grading plans, some undercut could be required to develop a stable subgrade. Consideration may be given to utilizing geotextiles and select granular fill to limit undercut amounts. This concept is illustrated on the attached sketch. The aggregate base of the pavement section should be compacted to a minimum of 98 percent of the AASHTO T 180 maximum dry density as per ARDOT criteria. Recommendations for subgrade preparation and site grading were discussed in our August 7, 2024 report.

Positive drainage must be incorporated into pavement design. The importance of positive drainage for satisfactory pavement performance cannot be overemphasized. Grades should direct



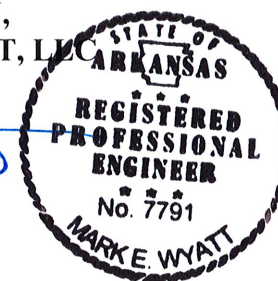
water off paved areas and ditches or storm drains should be used to develop positive flow away from pavement edges. Periodic maintenance of pavements should include sealing of all joints and cracks to prevent surface water infiltration.

We appreciate the opportunity to be of continued service to you during this phase of the project. Should you have any questions regarding this supplemental information, or if we may be of additional assistance during final design or construction, please call on us.

Sincerely,

**GRUBBS, HOSKYN,  
BARTON & WYATT, LLC**

Mark E. Wyatt, P.E.  
President

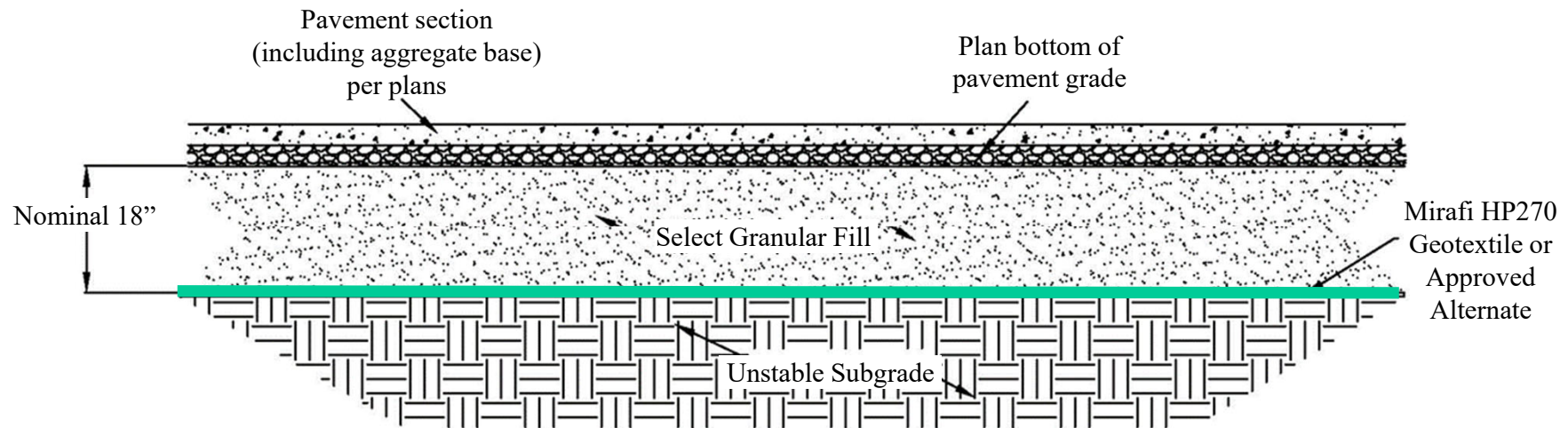


MEW:jw

Attachment

Copies submitted:   SCM Architects  
                          Attn: Mr. John Connell, AIA           (1-email)  
                          Attn: Mr. Tommy Wise-Ehlers       (1-email)

                          McClelland Consulting Engineers  
                          Attn: Mr. Dan Beranek, P.E.       (1-email)



Notes:

1. Stability of subgrade to be field verified by the Geotechnical Engineer.
2. Granular fill thickness may require field modification, either thickening or thinning. Unsuitable subgrade may warrant additional undercut.
3. Fill/backfill thickness can be attained by raising grade, undercut, or a combination of both.
4. Suitable select granular fill materials include ARDOT Class 7 base or approved alternates.
5. The surface of the select granular fill should be compacted to a stable density by static rolling as directed by the Geotechnical Engineer.
6. All select granular fill to be approved by the Geotechnical Engineer.

## SECTION 02 37 20

### SHORT AGGREGATE PIER FOUNDATION SYSTEMS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Design, furnishing and installation of aggregate pier foundations.

##### 1.02 RELATED SECTIONS

- A. Section 01 40 00 - Quality Control: Inspection of bearing surfaces.
- B. Section 02 01 000 – Geotechnical Investigation: Report and recommendations.
- C. Section 03 20 00 - Concrete Reinforcement: Reinforcement for grade beams and footings.
- D. Section 03 33 00 - Cast-In Place Concrete: Concrete for grade beams and footings.
- E. Section 31 23 16 - Excavation: Excavation to working level.

##### 1.03 REFERENCES

###### A. Design

1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from *IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.*
2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," By Evert C. Lawton and Nathaniel S. Fox. *Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments, ASCE, 2, 962-974.*

###### B. Modulus Load Testing

1. ASTM D-1143 – Pile Load Test Procedures
2. ASTM D-1194 – Spread Footing Load Test
3. ASTM D-3687 – Uplift Load Test

###### C. Materials and Inspection

1. ASTM D-1241 – Aggregate Quality
2. ASTM STP 399 – Dynamic Penetrometer Testing
3. ASTM D-422 – Gradation of Soils

- D. Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of the applicable document.

#### 1.04 QUALIFICATIONS

- A. Design and Installer of aggregate pier foundation system shall be licensed by Geopier Foundation Company, Inc. and shall have demonstrated experience in the construction of similar size and types of projects. They shall be approved by the Owner's Engineer. The Installer must be approved one week prior to bid opening.

#### 1.05 AGGREGATE PIER DESIGN

- A. The design submitted by the Aggregate Pier Installer shall consider the bearing capacity and settlement of all footings supported by aggregate piers, and shall be in accordance with acceptable engineering practice and these specifications. Total and differential settlement shall be considered. The design life of the structure shall be 100 years, unless specified by the Owner.
- B. Aggregate piers shall be designed in accordance with generally-accepted engineering practice and the method described in "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton, Nathaniel S. Fox, and Richard L. Handy, reprinted from *IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia*. The design shall meet the following criteria:
  - 1. Maximum Allowable Bearing Pressure for Aggregate Pier Improved Soil 4,000 psf
  - 2. Pier Capacity 64 kips
  - 3. Minimum Aggregate Pier Area Coverage (Spread Footings) 20%
  - 4. Estimated Total Long-Term Settlement for Footings  $\leq 1$  Inches
  - 5. Estimated Long Term Differential Settlement for Adjacent Footings  $\leq 0.5$  Inches
- C. The aggregate pier design shall include design spacing, subject to the maximum spacing criteria shown on the structural drawings. Any changes to the specified spacing criteria shall be subject to review and acceptance by the Geotechnical Engineer and Structural Engineer of Record.
- D. Aggregate Piers shall be designed to preclude bulging and excessive stresses in the column and to prevent detrimental deformations in the proposed structures being supported. Grouting of the aggregate piers is permitted.
- E. The results of the modulus tests shall confirm the Aggregate Pier Installer's design parameters for the aggregate piers. If the results of modulus testing do not confirm the aggregate pier design, the design shall be revised and additional modulus testing shall be performed.
- F. The Aggregate Pier Installer shall be responsible for all construction and post-construction damage related to work under this section.
- G. The Aggregate Pier Installer is responsible for protecting all existing structures and utilities to remain during aggregate pier installation. This includes protecting structures and utilities from excessive vibrations due to aggregate pier installation. The Aggregate Pier Installer shall modify installation procedures as necessary to protect structures and utilities from excessive vibrations due to aggregate pier installation.

## 1.06 CAPACITY AND SIZE OF THE AGGREGATE PIERS

- A. The **minimum** size and spacing **requirements** of the aggregate piers are described on the foundation drawings. Final size and spacing requirements shall be determined by the Aggregate Pier Engineer. The Installer shall be responsible for delivering a system that will support the structure, while controlling settlement in accordance with these specifications. The Engineer shall approve any modifications in size and spacing of the aggregate piers, unless such modifications result in a more conservative design, in which case the Installer may approve them. All Geopiers shall support load shown on plan and additional piers may be required if pier cannot reach desired strength.

## 1.07 CERTIFICATIONS AND SUBMITTALS

- A. The Aggregate Pier Installer shall submit 4 sets of detailed design calculations, construction drawings, and shop drawings for review and acceptance by the Geotechnical Engineer at least 3 weeks prior to the mobilization to the site. A detailed explanation of the design properties for bearing capacity, aggregate pier modulus, settlement and bulging calculations (for footings and slabs) shall be included with the design submittal. The Aggregate Pier Installer shall indicate the proposed modulus testing location(s). Additionally, the quality control test program for aggregate piers, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State of Arkansas. The submittal shall include proposed methods for removal of potential obstructions at aggregate pier locations.
- B. The Aggregate Pier Installer shall submit a notarized manufacturer's certification prior to start of work, stating that the aggregate and other materials used meet the requirement of this specification.
- C. Modulus Test Report – Within one week after completion of modulus testing on aggregate piers, the Aggregate Pier Installer shall submit to the Geotechnical Engineer a report summarizing the results of the modulus testing, and confirming that the test results indicate the aggregate pier design is appropriate. The report shall be prepared by a Professional Engineer registered in the state of Arkansas, experienced in the design of aggregate piers, and shall affirm that the aggregate pier design meets the performance criteria established herein. The submittal shall include a description of the installation equipment, installation records, complete test data, analysis of the test data, acceptance criteria, and recommended design parameters, based on the modulus test results. The report shall be stamped by a Professional Engineer licensed in the state of Arkansas and experience in aggregate pier design and testing.
- D. Daily Aggregate Pier Progress Reports – The Testing Agency shall furnish a complete and accurate record of aggregate pier installation to the General Contractor, Architect, and Geotechnical Engineer. The record shall indicate:
  - 1. Pier location, length, average lift thickness, volume and type of aggregate used;
  - 2. Volume of grout added to aggregate (if used);
  - 3. Densification forces used during aggregate pier installation;
  - 4. Final elevations of the base and top of piers;
  - 5. The type and size of the installation equipment used;
  - 6. General site conditions, weather, and soil and groundwater conditions observed;
  - 7. Any unanticipated or unusual subsurface conditions encountered during aggregate pier installation;
  - 8. The results of any Quality Control testing or deflection monitoring performed.

## 1.08 FIELD MEASUREMENTS

- A. Verify that field measurements and survey benchmarks are as indicated on Drawings.



- B. Accurately record the actual bearing depth of each pier on project record documents.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Aggregate:
  - 1. Aggregate used for piers constructed above the water table shall be Type I Grade B in accordance with ASTM D-1241-68, or shall be other graded aggregate selected by the Aggregate Pier Installer and successfully used in the load test. It shall be compacted to a densification and strength which will provide resistance to the dynamic penetrations test (ASTM STP 399) of a minimum average of 15 blows per 1.75 inch vertical movement.
  - 2. For aggregate used for piers constructed below the water table, the gradation shall be the same as Type I Gradation B, except that particles passing the No. 40 sieve shall be eliminated. Alternately, No. 57 stone or other stone selected by the Aggregate Pier Installer may be used. Dynamic penetration resistance testing is inappropriate for this material.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that site conditions will support equipment for aggregate pier operations.

### **3.02 PREPARATION**

- A. Notify Architect/Engineer 24 hours prior to aggregate pier installation.
- B. Protect structures near the Work from damage.

### **3.03 INSTALLATION**

- A. Layout aggregate piers based on grade beam locations.
- B. Excavate aggregate piers. Remove obstructions or relocate pier per engineers instructions.
- C. Clean cavity and bottom pier bulb. Maintain pier bulb free of water until stabilization verification test is performed.
- D. Allow for inspection of pier by Architect/Engineer and independent testing agency employed by the Contractor. Independent testing agency to perform bottom stabilization verification test throughout construction of pier per Geopier Foundation Company specifications.
- E. The aggregate piers shall be constructed by compacting aggregate in an excavated hole using special high-energy impact densification equipment. The aggregate piers shall be in a columnar-type configuration and shall be used to produce an intermediate foundation system for support of foundation loads. Vibratory stone column installation methods are not permitted.
- F. Aggregate piers improperly located shall be abandoned and replaced with new piers at no cost to the owner.

### **3.04 TOLERANCES**



- A. Maximum Variation of pier location within 6" of plan location.
- B. Top Elevation: Maximum 3 inches from elevation indicated.

### **3.05 FIELD QUALITY CONTROL**

- A. Field inspection and determination of acceptable bearing elevations will be performed by independent testing agency employed by Contractor under provisions of Section 01400. The testing agency representative shall immediately report any unusual conditions encountered during installation to the Owner, Architect, and Geotechnical Engineer. The quality control procedures shall include the preparation of aggregate pier progress reports completed during each day of installation.
- B. Accurately record the following on project record documents:
  - 1. Footing/structure and aggregate pier location, and any deviations from indicated locations.
  - 2. Volume of aggregate introduced into the hopper (number of buckets).
  - 3. Aggregate pier installation depth and bearing conditions of all piers.
  - 4. Number of lifts.
  - 5. Procedure to construct each lift.
  - 6. Time of mandrel raising and downward densification of each lift.
  - 7. Total pier installation time.
  - 8. Hydraulic pressures during installation (from installation or data record).
  - 9. Base diameter and height of the remaining aggregate cone formed after constructing each pier and extracting the mandrel out of the ground.
  - 10. Volume of aggregate used for pier construction (equal to the difference between the initial volume of aggregate introduced into the hopper and the volume of unused aggregate). Include volume of grout added to aggregate, if used.
  - 11. Planned and actual aggregate pier elevations at the top and bottom of the element (based on installation depth).
  - 12. Type and size of hammer equipment used.
  - 13. Aggregate description.
  - 14. Record of flow rates of water or compressed air pressure (if applicable).
  - 15. Documentation of any unusual conditions encountered.

### **3.06 SITE SUBGRADE PREPARATION**

- A. Prior to placing structural fill on the aggregate pier reinforced subgrade, the exposed subgrade soils and tops of aggregate pier elements shall be thoroughly compacted with a standard, hand-operated impact compactor or twin drum vibratory roller. Compaction shall be performed on the same day that structural fill is to be placed and shall extend over the entire subgrade to compact any loose surface soil and loose surface pier aggregate.

### **3.07 UTILITY EXCAVATIONS**

- A. The Contractor shall coordinate all excavations made subsequent to aggregate pier installations so that no excavation is made within a 1 Horizontal:1Vertical (1H:1V) line extending down from top edge of the aggregate pier, and at least 2.5 feet of horizontal distance remains between the edge of any installed aggregate pier and the excavation. Protection of completed aggregate pier elements is the responsibility of the Contractor and Aggregate Pier Installer. In the event that utility excavations are required within the above-defined distance from installed aggregate piers, the Contractor shall contact the Aggregate Pier Installer to develop construction solutions to minimize impacts on the installed aggregate piers such that the ground reinforcement and supported structures will perform as intended. Such construction modifications shall be submitted to the Geotechnical Engineer for review.

### **3.08 FOOTING SUBGRADE PREPARATION**

- A. Excavation for and subgrade surface compaction below all footings shall be the responsibility of the Contractor.
- B. Foundation excavations to expose the tops of aggregate pier elements shall be made in a workmanlike manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) prevent softening of the matrix soil between and around the aggregate piers before pouring structural concrete, and (2) achieving direct and firm contact between the undisturbed aggregate piers and the concrete footing.
- C. Recommended procedures for achieving these goals are to:
  - 1. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment).
  - 2. Compaction of surface soil and top of aggregate piers shall be prepared using several passes of a motorized impact compactor. Compaction shall be performed over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.
  - 3. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation.
  - 4. If same day placement of footing concrete is not possible, place a minimum 3-inch thick lean concrete seal ("mud mat") immediately after the footing is excavated and accepted or an alternative subsurface protection layer that may consist of a geotextile fabric and six inches of Crushed Stone to prevent softening or disturbance of the subgrade soils.
  - 5. Immediately before footing construction or placement of an alternate subgrade protection layer, the tops of all the aggregate pier elements exposed in each footing excavation shall be observed by the Geotechnical Engineer and recompacted as necessary with mechanical compaction equipment. The tops of any aggregate pier elements which may have been disturbed by footing excavation and related activity shall be recompacted to an unyielding surface and the soil between the aggregate piers compacted to a dry density equivalent to at least 95% of the maximum dry density per the modified Proctor method (ASTM D-1557) at no additional cost to the Owner.

### **3.09 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal – Remove excess soils, waste material, trash, and debris generated from aggregate pier installation, and legally dispose of it off Owner's property.

**END OF SECTION**

## SECTION 02 41 13

### SELECTIVE SITE DEMOLITION

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Labor and material that is necessary for the work associated with the removal of the existing facilities as shown on the Drawings.

##### 1.02 RELATED SECTION

- A. Section 31 00 00 - Earthwork.
- B. Section 31 10 00 - Site Clearing.

##### 1.03 SAFETY REQUIREMENTS

- A. Work shall be done in conformance with federal, state, and local rules and regulations pertaining to safety and as specified elsewhere in these Specifications.

##### 1.04 SALVAGE

- A. Salvageable piping, valves, and materials removed during demolition are the property of the Owner. Place on the site in an area designated by the Owner.

#### PART 2 PRODUCTS

Not Used.

#### PART 3 EXECUTION

##### 3.01 PREPARATION

- A. Make provisions to prevent the entrance of surface runoff from entering the area of excavation.
- B. Coordinate any disconnect and capping of services with Owner before starting demolition.
- C. Protect existing structures and underground utilities within the Work area from being damaged during demolition.

##### 3.02 DEMOLITION AND REMOVAL

- A. Excavate to the minimum extent necessary.
- B. Dispose of demolition debris at a site approved by the Owner. Otherwise, to the nearest state approved landfill permitted to receive waste.

##### 3.03 BACKFILLING

- A. Begin backfilling excavated areas after receiving approval from Engineer.
- B. Backfill in accordance with Section 31 23 33.
- C. Material excavated during demolition may be used as backfill.
- D. Import backfill as required.

**END OF SECTION**

## SECTION 03 01 30

### SITE CONCRETE WORK

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Cast-in-place concrete, including formwork.

##### 1.02 REFERENCES

- A. American Concrete Institute, Box 19150, Redford Station, Detroit, Michigan 48219 (latest revision).
  - 1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  - 2. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
  - 3. ACI 211.3: Standard Practice for Selecting Proportions for No-Slump Concrete.
  - 4. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete.
  - 5. ACI 304.2R: Placing Concrete by Pumping Method.
  - 6. ACI 304.3R: High Density Concrete: Measuring, Mixing, Transporting and Placing.
  - 7. ACI 304.4R: Placing Concrete with Belt Conveyors.
  - 8. ACI 305R: Hot Weather Concreting.
  - 9. ACI 306R: Cold Weather Concreting.
  - 10. ACI 309: Standard Practice for Consolidating of Concrete.
  - 11. ACI 309.1R: Behavior of Fresh Concrete During Vibration.
  - 12. ACI 309.2R: Identification and Control of Consolidation-Related Surface Defects in Formed Concrete.
  - 13. ACI 318: Building Code Requirements for Reinforced Concrete.
  - 14. ACI 347: Recommended Practice for Concrete Formwork.
- B. American Society of Testing for Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103 (latest revision).
  - 1. ASTM C31: Making and Curing Concrete Test Specimens in the Field.
  - 2. ASTM C33: Specification for Concrete Aggregates.
  - 3. ASTM C42: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  - 4. ASTM C143: Test for Slump of Portland Cement Concrete.
  - 5. ASTM C150: Specifications for Portland Cement.
  - 6. ASTM C172: Sampling Freshly Mixed Concrete.
  - 7. ASTM C173: Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  - 8. ASTM C231: Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
  - 9. ASTM C260: Specification for Air-Entraining Admixtures for Concrete.

10. ASTM C309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  11. ASTM C494: Specification for Chemical Admixtures for Concrete.
  12. ASTM E329: Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
- D. Local Codes and Ordinances: Wherever provisions of the Standard Building Code or the local current ordinances are more stringent than the above referenced Specifications and Standards, the local codes and ordinances shall govern.

### **1.03 SUBMITTALS**

- A. Submit the following in accordance with the Frontend Documents:
1. Product Data: Submit manufacturer's product data for reinforcement and forming accessories, patching compounds, curing compounds, and other materials.
  2. Shop Drawings: Submit for review prior to Installation, Shop Drawings of all reinforcing steel, including bar cutting lists, typical bar bend diagrams, construction of forms including jointing, reveals, and location and pattern of form tie placement.
  3. Design Mix: Prior to placement of concrete, the Contractor shall submit a design mix showing the proportions and compressive strength obtained from the concrete at 7 and 28 days. The design mix shall include a complete list of materials including type, brand, source, and amount of; cement, fly ash, ground slag, coarse aggregate, fine aggregate, water, air content and admixtures, if applicable. The mix design shall be submitted to the Engineer at least ten (10) days prior to the start of operations. Placement of concrete shall not begin until the mix design is approved in writing by the Engineer.

### **1.04 QUALITY ASSURANCE/ACCEPTANCE**

- A. Inspection: Engineer shall have access and rights to inspect batch plants, cement mills, and facilities of suppliers, manufacturers, and subcontractors providing products specified.
- B. Batch Plant:
1. Certification: Current certification that weighing scales have been tested and are within tolerances as set forth in National Bureau of Standards Handbook No. 44.
  2. Equipment: Semi-automatic or fully automatic.
- C. Evaluation and acceptance of concrete shall conform to ACI 318.
- D. The Contractor shall engage a testing laboratory acceptable to Owner and Engineer to perform material evaluation tests and to design concrete mixes. All testing shall be paid for by the Contractor.
- E. The mixing or alternate use of cement from different manufactures will not be permitted. The source of any materials shall not be changed without the written approval of the Engineer.
- F. If the cement furnished produces erratic results under field conditions incident to the placing of the concrete, or in regard to the strength of the finished product, or in the time of the initial or final set, the Contractor shall, without notice from the Engineer, cease the use of that source of cement.
- G. Should a change in sources be made, or admixtures added or deleted from the mix, a new design mix must be submitted to the Engineer for approval.
- H. The Contractor is responsible for product quality control during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of the

materials to produce an acceptable mix. The Contractor shall perform all applicable quality control sampling and testing required to ensure that the completed concrete complies with all requirements and specifications. The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and pay for testing.

- I. The Contractor shall be responsible for ensuring that all concrete cylinders, including those made for determination of quality acceptance, are properly cured while at the jobsite.
- J. Field Sampling and Testing:
  1. Field samples shall be made and cured in accordance with ASTM C31 for each concrete strength, at the rate of 4 test cylinders and one slump test for each 50 cubic yards of concrete from each days pour. Make air content check for each set of test cylinders in accordance with ASTM C173 or ASTM C231. Air content and slump shall be checked and recorded at both truck discharge and point of placement for pumped concrete from the first load each day and every 50 cubic yards thereafter.
  2. Test Cylinders: One at 7 days, two at 28 days, and reserve the remaining cylinder for testing after a longer period as required by the Engineer if the 28 day tests do not meet or exceed the required strength.
  3. The taking of samples from small pours of 10 cubic yards or less may be omitted at the discretion of the Engineer.
  4. Additional Test Slumps: Every 25 cubic yards, recording location for report.
  5. When early form removal is requested, field cure cylinders will be tested at 7 days or less to determine sufficient strength.
- K. Testing: Where average strength of any group of 3 cylinders falls below the minimum comprehensive strength, or an individual cylinder falls more than 500 psi below minimum compressive strength specified, the Contractor will be required to have a certified laboratory core the concrete and test it in accordance with ASTM C42. Specimens shall be selected by the Engineer from location in structure represented by test specimen or specimens which failed. At the discretion of the Engineer, Swiss hammer testing may or may not be used to aid in determination of acceptable concrete.
  1. Specimens shall be secured, prepared, and tested in accordance with ASTM C42, within a period of 60 days after placement of concrete.
  2. Concrete will be deemed approved meeting the strength requirements of this Section if it meets the strength requirements of ACI 318.
  3. The cost of cutting specimens from the structure, patching the resulting holes, and making laboratory analysis shall be at the sole expense of the Contractor.
  4. Holes from which the cored samples are taken shall be packed solid with no slump concrete proportioned in accordance with ACI 211. Patching shall have the same design strength as the specified concrete.
  5. Should laboratory analysis indicate that the proper concrete mix has not been used, all concrete poured where inappropriate mix was used shall be subject to rejection, before, during, or after the pour.
  6. If any of the specimens cut from the structure fail to meet the requirements of ACI 318, the Engineer shall have the right to require the defective concrete to be replaced, at the Contractors sole expense, and at no additional cost to the Owner.

- L. Sampling: In addition, the slump test specified in this Section, the Contractor shall keep a cone and rod apparatus on the Project site for random testing of batches. When concrete does not meet the specified slump requirements, and when directed by the Engineer, the Contractor will immediately perform a slump test in accordance with ASTM C143. Concrete not meeting the slump requirements shall be removed from the Project site.
- M. The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures.

## **PART 2 PRODUCTS**

### **2.01 CEMENT**

- A. Portland cement: ASTM C150 Type I.

### **2.02 WATER**

- A. Clean and free from oil, acid, alkali, salt, organic matter, or other deleterious substances.
- B. Potable.

### **2.03 CONCRETE AGGREGATES**

- A. General: Natural aggregates, well graded, free from deleterious coatings and organic materials conforming to ASTM C33 (latest revision).
  - 1. Import non-reactive aggregates if local aggregates are reactive. (Appendix XI-ASTM C33).
  - 2. Wash aggregates uniformly before use.
  - 3. Other aggregate gradations can be approved by Engineer.
- B. Fine Aggregates:
  - 1. Clean, sharp, natural or manufactured sand, free of loam, clay, lumps, or other detrimental materials and conforming to ASTM C33.
  - 2. Less than 2 percent passing the No. 200 sieve.
  - 3. Maximum size 1-1/2 inches.
- C. Course Aggregates:
  - 1. Natural gravel, crushed gravel, crushed stone, or combination of these materials.
  - 2. Less than 15 percent float or elongated particles (long dimension >5 times short dimension).
  - 3. Less than 0.5 percent passing the No. 200 sieve.

### **2.04 CONCRETE AIR-ENTRAINING ADMIXTURES**

- A. Manufacturer:
  - 1. Air-Mix or Perma-Air by the Euclid Chemical Co.
  - 2. Sealtight Air Entraining Admixture by W.R. Meadows of Texas.
  - 3. Master Builders, MB-VR.
  - 4. Or approved equal.
- B. ASTM C260; nontoxic after 30 days.
- C. Use only the specified non-corrosive non-chloride accelerator. Calcium chloride is not permitted.

- D. Provide for concrete exposed to freezing and thawing, required to be watertight or placed during cold weather. Air Content: 5 to 6 percent.

## **2.05 ADMIXTURES**

- A. Water-Reducing Admixture: Conforming to ASTM C494, Type A:
  - 1. Eucom WR-75 by the Euclid Chemical Company.
  - 2. Pozzolith 200N by Master Builder.
  - 3. Plastocrete 160 by Sika Chemical Corporation.
- B. Water-Reducing Retarding Admixture: Conforming to ASTM C494, Type D:
  - 1. Eucom Retarder-75 by the Euclid Chemical Company.
  - 2. Pozzolith 100XR by Master Builder.
  - 3. Plastiment by Sika Chemical Company.
- C. High-Range Water-Reducing Admixture (Superplasticizer): Conforming to ASTM C494, Type F or G:
  - 1. Eucom 37 by Euclid Chemical Company.
  - 2. Rheobuild 1000 by Master Builders.
  - 3. Sikament by Sika Chemical Company.
- D. Non-Corrosive Non-Chloride Accelerator Admixture: Conforming to ASTM C494 Type C or E:
  - 1. Accelguard 80 by Euclid Chemical Company.
  - 2. Or approved equal.
  - 3. Manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least 1 year's duration) using an acceptable accelerated corrosion test method using electrical potential measures.
- E. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.
- F. Certification: Submit written conformance to the requirements and chloride ion content of the admixture to Engineer prior to mix design review.

## **2.06 FORMS**

- A. Unexposed Finish Concrete: Plywood, lumber, metal or other acceptable material approved by the Engineer. Lumber shall be dressed on at least 2 edges and 2 sides for a tight fit if used.
- B. Form Coatings: Commercial formulation from coating compound with maximum VOC of 350 mg/l that will not bond, stain, or adversely affect concrete surfaces in contact with and will not impair succeeding treatments of concrete surfaces.
- C. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent deflection and spalling of concrete upon removal. Units provided shall not leave any metal closer than 1-1/2 inch to exposed surface. Provide ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

## **2.07 BONDING AGENT**

- A. Manufacturer: Sonnebond by Sonneborn; or approved equal.
- B. Submit product specifications and manufacturer's specific instructions for application on this Project for Engineer's approval.



- C. Product must meet Project requirements with regard to surface, pot life, set time, vertical or horizontal application, forming restrictions, or other stated requirements.

## **2.08 BOND BREAKER**

- A. Manufacturers:
  - 1. Williams Tilt-Up Compound, Williams Distributors Inc., Seattle, Washington.
  - 2. Silcoseal 77, Superior concrete Accessories, Franklin Park, Illinois.
  - 3. Or Equal.
- B. Nonstaining type.
- C. Provide positive bond prevention.
- D. Submit copies of manufacturer's data, recommendations, and instructions for specific use on this Project for review.

## **2.09 CURING COMPOUND**

- A. Liquid Membrane-Forming Curing Compound: ASTM C309, Type I, Class A. Moisture loss not more than 0.005 gr./sq. cm. applied at 200 square feet per gallon.
  - 1. Conspec, Conspec Cure & Seal.
  - 2. Sonneborn, Kure-N-Seal.
  - 3. Master Builders, MasterKure.
  - 4. Or approved equal.

## **2.10 BONDING AND REPAIR MATERIALS**

- A. Rewettable Bonding Compounds:
  - 1. Polyvinyl acetate type.
  - 2. Manufacturer:
    - a. Euco Weld by the Euclid Chemical Co.
    - b. Weldcrete by the Larsen Co.
    - c. Sonnocrete by Sonneborn.
    - d. Daraweld C by W. R. Grace.
  - 3. Use only in areas not subject to moisture.
- B. Non-Rewettable Bonding Compounds:
  - 1. Polymer modified type.
  - 2. Manufacturer:
    - a. Euco-Bond by the Euclid Chemical Co.
    - b. Or approved equal.
- C. Bonding Admixture:
  - 1. Latex, non-rewettable type.
  - 2. Manufacturer:
    - a. SBR Latex or Flex-Con by the Euclid Chemical Co.

- b. Daraweld C by W. R. Grace.
- D. Patching Mortar:
  - 1. Free flowing or gel consistency.
  - 2. Polymer modified cementitious mortar.
  - 3. Manufacturer:
    - a. Euco Thin Coat or Concrete Coat by the Euclid Chemical Co. for horizontal repairs.
    - b. Verticoat by the Euclid Chemical Co. for vertical or overhead repairs.
    - c. Sikatop 121 or 122 by the Sika Chemical Co. for horizontal repairs.
    - d. Sikatop 123 by the Sika Chemical Co. for vertical or overhead repairs.
- E. Underlayment Compound:
  - 1. Free-flowing, self-leveling, pumpable cementitious base compound.
  - 2. Manufacturer:
    - a. Flo-Top by the Euclid Chemical Co.
    - b. Or approved equal.
- F. Repair Topping:
  - 1. Self-leveling, polymer modified high strength topping.
  - 2. Manufacturer: Thin Top SL by the Euclid Chemical Co.

### **PART 3 EXECUTION**

#### **3.01 DESIGN OF CONCRETE MIX**

- A. Submit mix design on each class of concrete for review, include standard deviation analysis or trial mixture test data.
- B. Proportion mix design in accordance with ACI 318, Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures".
- C. If trial batches are used:
  - 1. Prepare mix design by independent testing laboratory.
  - 2. Achieve an average compressive strength 1200 psi higher than the specified strength, or 1400 psi for specified concrete strengths over 5000 psi.
  - 3. Certified copies of laboratory trial mix reports and cylinder tests shall be submitted to Engineer by the testing laboratory for approval.
- D. Do not place concrete prior to receipt of Engineer's written approval of mixes and cylinder test results.
- E. Design mix and perform tests to meet the requirements as specified.
- F. Slump: 2-4"
- G. Water/Cement Ratio:
  - 1. Watertight concrete exposed to fresh water and freeze/thaw: 0.50 max.
  - 2. Air entrained concrete exposed to fresh water: 0.50 max.

- H. Combined Aggregate Gradings:
  - 1. Aggregates for concrete shall be proportioned in accordance with "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete." ACI 211.1.
  - 2. Maximum aggregate size: Do not exceed one-fifth the narrowest dimension between sizes of forms or 3/4 of the clear space between reinforcing bars, 1-1/2 inch maximum.

### **3.02 MIXES**

- A. Strength: Concrete minimum strength at 28 days as noted on Drawings or as specified in other Sections.
- B. Mix Designs:
  - 1. Prepare design mixes for each type of concrete, in accordance with ACI 301 and ACI 318, except as otherwise specified.
- C. Conform to ACI 304 current edition for measuring, mixing, transporting and placing concrete.
- D. Concrete Mix Adjustments: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, and as approved by Engineer. Laboratory test data for revised mix design and strength results shall be submitted to and approved by Engineer prior to using in Work.

### **3.03 FORMS**

- A. Coordinate with other trades whose work may be located within or below concrete.
- B. Coordinate installation of joint materials and vapor retarders with placement of forms and reinforcing steel.
- C. Notify Engineer 1 full working day prior to erection of forms for inspection.
- D. Cleaning and Tightening:
  - 1. Clean forms thoroughly and adjacent surfaces to receive concrete.
  - 2. Remove chips, wood, sawdust, dirt or other debris immediately prior to concrete placement.
  - 3. Retighten forms after concrete placement to eliminate leaks.
- E. Design:
  - 1. Design, erect, support, brace, and maintain formwork in accordance with:
    - a. Building Codes Requirements for Reinforced Concrete (ACI 318).
    - b. Recommended Practice for Concrete Formwork (ACI 347).
    - c. Construction Industry Standards (OSHA 2207).
  - 2. Design formwork to be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials.
- F. Reuse of Forms: Do not reuse forms unless they are in new and undamaged condition.
- G. Chamfer exposed corners and edges 3/4 inch unless otherwise specified or shown on Drawing. Use wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Preparation of Form Surfaces: Coat the contact surfaces of forms with a form-coating compound where applicable prior to placement of reinforcement.

- I. Other Trades: Provide openings in concrete form work to accommodate Work of other trades. Determine size and location of openings, recesses, and chases for other trades providing such ties. Accurately place and securely support items built-in to form.
- J. Form Tolerances: Construct forms to sizes, shapes, lines, and dimensions shown, work in finished structures.
- K. Removal of Forms:
  - 1. Do not disturb forms until concrete is sufficiently strong to withstand possible injury.
  - 2. Do not remove shoring until member has acquired sufficient strength to support its weight and the load upon it.
  - 3. Do not remove forms until the concrete has attained 67 percent of 28 day strength or a minimum of 4 days. Use a method of form removal which will not cause overstressing of the concrete.

### **3.04 FORM TIES**

- A. Place in uniform patterns on exposed surfaces.
- B. Number and placement sufficient to withstand pressures and limit deflection of forms to acceptable limits.

### **3.05 PLACING CONCRETE - GENERAL**

- A. Do not place concrete without Engineer being present.
- B. Allow other trades reasonable time to complete portions of work which must be completed before concrete is placed.
- C. Notify Engineer at least 1 full working day in advance before starting to place concrete to permit inspection of forms, reinforcing, sleeves, conduits, boxes, inserts, or other work required to be installed in concrete.
- D. Review curing methods with Engineer and verify curing materials and equipment are at Project site.
- E. Placement shall conform to requirements and recommendations of ACI 304 and ACI 318, except as modified in these Specifications.
- F. Place concrete as soon as possible after leaving mixer in layers not over 1.5 feet deep:
  - 1. Without segregation or loss of ingredients.
  - 2. Without splashing forms or steel above.
- G. Do not use concrete truck chutes, pipes, finishing tools, etc., constructed of aluminum.
- H. Before depositing concrete:
  - 1. Remove debris from space to be occupied by concrete.
  - 2. Dampen:
    - a. Gravel fill beneath slabs on ground.
    - b. Sand where vapor barrier is specified.
    - c. Wood forms.
  - 3. Verify reinforcement is secured in position.
- I. Before placing concrete, clean and inspect form work, reinforcing steel, and items to be embedded or cast-in-place. Notify other trades prior to placement of concrete to permit the

installation of their Work. Coordinate the installation of joint materials and vapor barriers with placement of forms and reinforcing steel.

J. Conveying:

1. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of materials.
2. Conveying equipment shall be capable of providing a supply of concrete at the site of placement without interruptions sufficient to permit loss of plasticity between successive increments.
3. Provide equipment for chuting, pumping, and pneumatically conveying concrete of proper size and design to insure a practically continuous flow of concrete at the point of delivery and without segregation of the materials.
4. Keep open troughs and shuttes clean and free from coatings of hardened concrete.
5. Do not allow concrete to drop freely more than 10 feet. Equipment and methods used for conveying are subject to the approval of Engineer.

### **3.06 ADDITION OF WATER AT PROJECT SITE**

- A. Do not add water to concrete at Project site if slump is within specified range.
- B. With the Engineer's approval, add water to concrete arriving at Project site with a slump less than the specified range, provided it can be demonstrated that the specified water-cement ratio will not be exceeded.
- C. All concrete shall be 4000 psi at 28 days with a maximum cement water ratio of .45 unless noted otherwise on Design Drawings.

### **3.07 CONSOLIDATION AND VISUAL OBSERVATION**

- A. Concrete shall be consolidated with internal vibrators having a frequency of at least 800 vpm, with amplitude required to consolidate concrete in the section being placed.
- B. At least one standby vibrator in operable condition shall be at the placement site prior to and during placing concrete.
- C. Consolidation equipment and methods shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".
- D. Vibrator operator is required to see the concrete being consolidated to ensure good quality workmanship; or Contractor shall have a person actually observe the vibration of the concrete and will advise the vibrator operator of changes needed to assure complete consolidation.
- E. Do not use vibrators to transport concrete in forms.

### **3.08 PLACING CONCRETE IN HOT WEATHER**

- A. Comply with the requirements of ACI 305.
- B. Do not place concrete at times when temperature is forecast to exceed 100 degrees F within 12 hours after the concrete is placed.
- C. Fog spray forms, reinforcing steel, and subgrade just before placing concrete.
- D. Make every effort to maintain concrete temperature:
  1. Temperature of concrete shall be below 90 degrees F at time of placement, cool the ingredients before mixing by use of chilled water.
  2. Concrete batches with temperature in excess of 90 degrees F will be rejected.
- E. Place concrete promptly upon arrival at Project and vibrate immediately after placement.

- F. Do not add water to retemper.
- G. Consider placing concrete in late afternoon as opposed to early morning.
- H. Protect and cure exposed surfaces by one of the following:
  - 1. Continuous water curing.
  - 2. Moisture-cover curing.

### **3.09 PLACING CONCRETE IN COLD WEATHER (ACI 306R)**

- A. Preparation:
  - 1. Comply with the requirements of ACI 306.
  - 2. Additives for the sole purpose of providing freeze protection shall not be used.
  - 3. Arrangements for covering, insulating, housing, or steam heating newly-placed concrete shall be made in advance of placement and shall be adequate to maintain temperature and moisture conditions recommended.
- B. Placement:
  - 1. Surfaces to be in contact with concrete shall be free of snow, ice, and frost and shall be above 40 degrees F.
  - 2. Do not place concrete on frozen subgrade.
  - 3. Placement of insulating material, tarpaulins, or other movable coverings shall follow closely the placing of concrete so that only a few feet of concrete are exposed to outside air at anytime.
- C. Curing and Protection:
  - 1. Keep concrete continuously moist and covered and maintain concrete temperature at a minimum of 50 degrees F for 7 days; temperature shall be uniform throughout concrete. If high early strength concrete is used, this temperature requirement may be reduced to 3 days.
  - 2. It is recommended forms be left in place for the entire period of protection; use insulated blankets or other approved method on slab surfaces.
  - 3. Limit rapid temperature changes at end of protection period to avoid thermal cracking.

### **3.10 PATCHING - GENERAL**

- A. Prior to starting patching work, except as specified, obtain Engineer's approval of proposed patching techniques and mixes.

### **3.11 REPAIR OF DEFECTIVE AREAS**

- A. Definition: Concrete in place that does not conform to specified design strength, shapes, alignments, and elevations as shown on Drawings and contains surface defects.
- B. Evaluation and acceptance of concrete shall conform to ACI 318.
- C. With prior approval of Engineer, as to method and procedure, repair defective areas in conformance with ACI 301, Chapter 9, except that the specified bonding compound shall be used.
- D. Surface Repairs:
  - 1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner.

2. Honey-combed areas and rock pockets:
  - a. Repair immediately after removal of forms.
  - b. Prepare no-slump concrete mortar and test so that, when dry, patching mortar will match surrounding color and strength.
  - c. Cut out to solid concrete or minimum of 1-inch depth.
  - d. Make edges for cuts perpendicular to the concrete surface.
  - e. Thoroughly clean and dampen with water.
  - f. Apply bonding compound.
  - g. Compact no-slump concrete into patch, and finish to blend with adjacent finished concrete.
  - h. Cure in same manner as adjacent concrete.
3. High Areas: Grind after concrete has cured at least 14 days.
4. Low Areas:
  - a. Repair during or immediately after completion of surface finishing operations.
  - b. Cut out low areas and replace with fresh concrete of same type and class as original concrete.
  - c. Finish repaired areas to blend into adjacent concrete.
5. Defective Areas:
  - a. Cut out and replace with fresh concrete of same type and class as original concrete.
  - b. Finish repaired areas to blend into adjacent concrete.
6. Make structural repairs with prior approval of Engineer, as to method and procedure, using the specified epoxy adhesive or epoxy mortar. Where epoxy injection procedures must be used, use an approved low viscosity epoxy made by the manufacturers previously specified.
7. Level floors for subsequent finishes by use of specified underlayment material.
8. Where required, level exposed floors by use of the specified self-leveling repair topping.
9. Repair methods not specified above may be used, subject to approval of Engineer.

### **3.12 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS**

- A. Submit proposed blockouts for review in accordance with the Frontend Documents.

### **3.13 CONCRETE CURING**

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as specified herein.
  1. Provide moisture curing by keeping concrete surface continuously wet by covering with water, by water-fog spray, or by covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive

cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.

2. Provide moisture-cover curing by covering concrete surface with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Provide curing and sealing compound on interior slabs left exposed and to exterior slabs and walks, as follows:
  - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

C. Curing Formed Surfaces:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed.
2. If forms are removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces:

1. Cure unformed surfaces; i.e., slabs and other flat surfaces by application of appropriate curing compound.
2. Final cure concrete surfaces to receive finish flooring by moisture-retaining cover, unless otherwise directed by Engineer.

### 3.14 SURFACE FINISHES

A. As-Cast Finish:

1. For formed concrete surfaces not exposed-to-view in the finished work or by other construction, unless otherwise indicated.
2. This is concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth Form Finish:

1. For formed concrete surfaces exposed-to-view, or that will be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, i.e.; waterproofing, damp-proofing, painting or other similar system.
2. This is cast-in-place concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams.
3. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise specified or shown on Drawings.



- D. Float Finish: Apply float finish to slab surfaces to receive trowel finish and other finishes specified.
1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units.
  2. Check and level surface plane to tolerances of Ff 18 - Fl 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.
- E. Grout Cleandown Finish:
1. After repairing defects, saturate surface thoroughly and keep saturated during grouting operations.
  2. Use a grout consisting of 1 part cement, 1-1/2 to 2 parts of fine sand and sufficient water for a thick creamy consistency.
  3. Apply by brush, trowel or rubber float to completely fill air bubbles and holes.
  4. Float vigorously with a wood, sponge-rubber or cork float immediately after applying grout. Excess grout shall be scraped off with a sponge-rubber float.
  5. After grout has been allowed to stand undisturbed to allow some loss of plasticity, but not damp appearance, the surface should be rubbed with a clean, dry burlap to remove all excess grout. All air holes shall be filled but no visible film of grout shall remain after the rubbing.
- F. Trowel Finish: After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 20 - fl 17. Grind smooth surface defects which would telegraph through applied floor covering. Apply where exposed-to-view, and where slab surfaces are to be covered other than finish coating system.
- G. Non-Slip Broom Finish:
1. Finish concrete as specified, except only trowel the surface once.
  2. Finish surface by drawing fine-hair broom lightly across surface.
  3. Brooming:
    - a. Broom in same direction and parallel to expansion joints.
    - b. Inclined slab: Broom perpendicular to slope. Texture shall be as approved by the Engineer from sample panels.
    - c. Round Roof Slab: Broom surface in radial direction.
- H. Class 2, Rubbed Finish in accordance with Standard Specifications for Highway Construction, Section 802.20, Arkansas Department of Transportation, latest edition, and this Section:
1. After removal of forms, rubbing of concrete shall be started as soon as its condition will permit.
  2. Immediately before starting this Work, concrete shall be thoroughly saturated with water. Sufficient time shall have elapsed before wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set.

3. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone using a small amount of mortar on its face.
  4. Mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished.
  5. Rubbing shall be continued until form marks, projections, and irregularities have been removed, voids filled, and a uniform surface has been obtained.
  6. Paste produced from rubbing shall be left in place at this time.
  7. After concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. Rubbing shall be continued until the entire surface is smooth texture.
  8. Finish will not be acceptable if a uniform texture and color have not been achieved. Should the finish not be acceptable, the surface shall be given a sprayed finish or other approved finish that is satisfactory to the Engineer.
  9. After final rubbing is completed and the surface is dried, it shall be rubbed with burlap to remove loose power and left free from all unsound patches, paste, powder, and objectionable marks.
- I. Class 3, Textured Coating Finish in accordance with Standard Specifications for Highway Construction, Section 802.19, Arkansas Department of Transportation, latest edition, and this Section:
1. Material provided for textured coating finish shall be a commercial paint type texturing product produced specifically for this purpose, and shall consist of a synthetic non-alkyd resin containing mica, perlite, non-biodegradable fibers, and durable tinting pigments. The material shall be listed on the QPL. Material shall be approved by Engineer.
  2. Unless otherwise specified in the Contract, the color of the textured coating finish shall be concrete gray, equal or close to Shade 36622 of the Federal Color Standard 595 B. The exact shade shall be selected by the Owner.
  3. Surfaces to be coated shall be free of efflorescence, laitance, flaking, coatings, dirt, oil, and other foreign substances.
  4. The sprayed finish shall not be applied over surfaces cured with membrane curing compound until 30 days has elapsed from application of the membrane.
  5. Prior to application of the finish, the surfaces shall be free of moisture, as determined by sight and touch, and in a condition consistent with manufacturer's published recommendations.
  6. The finish shall be applied at a rate as recommended by the manufacturer and as approved by the Engineer.
  7. The finish shall be applied with heavy duty spray equipment capable of maintaining a constant pressure as necessary for proper application.
  8. Completed finish shall be tightly bonded to the structure and shall present a uniform appearance and texture equal to or better than the required for rubbed finish.
  9. If necessary, an additional coat or coats shall be applied to produce the desired surface texture and uniformity.
  10. Upon failure to adhere positively to the structure without chipping or cracking, or to attain the desired surface appearance, the coating shall be removed from the structure and the surface given a rubbed finish, or another approved finish satisfactory to the Engineer.

### **3.15 WATER LEAKAGE TESTS - WATER HOLDING STRUCTURES**

- A. Subject water holding structures to leakage tests after concrete has been cured and obtained its design strength and before backfill, brick facing, or other Work that will cover exposed faces of walls is begun.
- B. Fill basins to be subjected to leakage tests with water to normal liquid level line.
- C. After basin has been kept full for 48 hours, it will be assumed, for purposes of the test, that moisture absorption by the concrete in the basin is complete.
- D. Valves and gates to the structure shall then be closed, and the change in water surface measured for a 24-hour period.
- E. During test period, examine exposed portions of the structure and mark visible leaks or damp spots; such leaks or damp spots shall be later patched or corrected in a manner acceptable to Engineer.

### **3.16 MISCELLANEOUS ITEMS**

- A. Filling Holes:
  - 1. Fill in holes and openings left in concrete for the passage of Work by other trades after their Work is in place.
  - 2. Mix, place, and cure concrete to blend with in-place construction. Provide other miscellaneous concrete filling required to complete Work.
- B. Non-Shrink Grout Application: Grout base plates, equipment bases, clarifier base, and other location indicated with specified non-shrink grout. Provide non-metallic type where grout is exposed.

### **3.17 PROTECTION**

- A. No Work or walking on finished surfaces will be allowed for 16 hours after the concrete is placed.
- B. Provide plywood or other acceptable protective cover at all traffic areas throughout the job.
- C. Protect exposed concrete floors, steps, and walks from paint and other materials or equipment which may blemish or damage these surfaces.

**END OF SECTION**

## SECTION 03 11 00

### CONCRETE FORMS AND ACCESSORIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

##### 1.02 RELATED SECTIONS

- A. Section 03 20 00 - Concrete Reinforcement.
- B. Section 03 33 00 - Cast-in-Place Concrete.
- C. Section 03 39 00 - Concrete Curing.

##### 1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2002.
- C. ACI 347R - Guide to Formwork for Concrete; American Concrete Institute International; 2001.
- D. ASME A17.1 - Safety Code for Elevators and Escalators; The American Society of Mechanical Engineers; 2002.
- E. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.

##### 1.04 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

##### 1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 347R, ACI 301, and ACI 318.

##### 1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection and removal of formwork.

##### 1.07 COORDINATION

- A. Coordinate this Section with other Sections of work which require attachment of components of formwork.
- B. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

#### PART 2 PRODUCTS

##### 2.01 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor to produce the required shape, line and dimension of finished concrete.

## **2.02 PREFABRICATED FORMS**

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

## **2.03 FORMWORK ACCESSORIES**

- A. Form Ties: Removable type, galvanized metal, fixed length, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Form Release Agent: Colorless mineral oil that will not stain concrete or absorb moisture.
- C. Corners: Chamfered, wood strip type; 1 x 1 inch size; maximum possible lengths.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

### **3.02 EARTH FORMS**

- A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.
- B. Conform to concrete cover dimension requirements indicated on structural drawings when earth forms are used.

### **3.03 ERECTION - FORMWORK**

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Provide chamfer strips on external corners of beams, joists, columns, and all exposed concrete.
- G. Coordinate this section with other sections of work that require attachment of components to formwork.
- H. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

### **3.04 APPLICATION - FORM RELEASE AGENT**

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

### **3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS**

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

### **3.06 FORM CLEANING**

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
  - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
  - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

### **3.07 FORMWORK TOLERANCES**

- A. Construct formwork to maintain tolerances required by ACI 301.

### **3.08 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

### **3.09 FORM REMOVAL**

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

**END OF SECTION**

**SECTION 03 15 16**  
**SITE CONCRETE ACCESSORIES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Provide expansion, construction, and contraction joints as specified.

**1.02 RELATED SECTIONS**

- A. Section 03 01 30 - Site Concrete Work.

**1.03 REFERENCES**

- A. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM A36 - Specification for Structural Steel.
  - 2. ASTM D226 - Specification for Asphalt-Saturated Organic Felt used in Roofing and Waterproofing.
  - 3. ASTM D994 - Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
  - 4. ASTM D1190 - Specification for Concrete joint Sealer, Hot-Poured Elastic Type.
  - 5. ASTM D1751 - Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- B. Corp of Engineers, (U.S. Department of the Army) Pulaski Building, 20 Massachusetts Avenue, North West, Washington, D.C. 20314.
  - 1. CRD-C-572 - Polyvinylchloride Waterstops.
- C. Federal Specifications: SS-S-210A; Sealing Compound for Expansion Joints.

**PART 2 PRODUCTS**

**2.01 WATERSTOPS**

- A. Center bulb type extruded from an elastomeric plastic compound, the basic resin of virgin polyvinyl chloride (PVC).
- B. Size as recommended by manufacturer for each application or as shown on Drawing. Generally 6 inches for walls with a 12 inches thickness and 9 inches for walls thicker than 12 inches.
- C. Specific gravity approximately 1.37 and the shore durometer Type A hardness, approximately 80.
- D. Meet the performance requirements of the Corps of Engineers' Specification CRD-C-572.
- E. Constant thickness from the edge of the bulb to the outside edge.
- F. Have a number of parallel ribs or protrusions on each side of the center of the strip.
- G. Corrugated type or tapered waterstops are not acceptable.
- H. The minimum weight per foot for waterstop shall be 0.75 pound for 3/16-inch by 6-inch, 1.35 pounds for 3/8-inch by 6-inch, and 2.05 pounds for 3/8-inch by 9-inch.

- I. Manufacturers:
  - 1. Southern Metal and Plastic Products, Inc.
    - a. Type 11RCB for 4-inch by 3/16-inch.
    - b. Type 17RCB for 6-inch by 3/8-inch.
    - c. Type 18RCB for 9-inch by 3/8-inch.
  - 2. Vinylex Corporation.
    - a. Catalog No. RB6-38H for the 6-inch by 3/8-inch.
    - b. Catalog No. RB9-38H for the 9-inch by 3/8-inch.
  - 3. Greenstreak Plastic Products.
    - a. Style 732 for the 6-inch by 3/8-inch.
    - b. Style 735 for the 9-inch by 3/8-inch.
  - 4. Or approved equal.

## **2.02 BOND BREAKER TAPE FOR EXPANSION JOINTS**

- A. Where indicated, adhesive-backed glazed butyl or polyethylene tape that will satisfactorily adhere to the premolded joint material or concrete surface.
- B. Same width as joint.

## **2.03 PREMOLDED JOINT FILLER - BITUMINOUS TYPE**

- A. Bituminous type conforming to ASTM D994 or D1751, unless otherwise shown or specified.
- B. Use around pipe penetrations through existing walls.
- C. Manufacturers:
  - 1. Synko Flex Products Inc.; Synko Flex Preformed Plastic Adhesive Waterstop.
  - 2. American Colloid Co.; Waterstop RX.

## **2.04 BOND BREAKER**

- A. Bond breaker, except where a tape is specifically called for, shall be either bond breaker tape as specified or a bond prevention material, nonstaining type, as specified in Section 03 01 30.

## **2.05 CORK EXPANSION JOINT FILLER**

- A. Manufacturer: W.R. Meadows Sealtight, or equal.
- B. Seal joints with a pourable two-component cold-applied compound to depth as indicated on Drawings.

## **2.06 POURABLE JOINT FILLERS - RUBBER ASPHALT FILLER**

- A. Hot-pour type, conforming to ASTM D1190. Use primer recommended by the manufacturer.



## **2.07 COAL-TAR TAPE**

- A. Manufacturer's:
  - 1. Protecto Wrap 200, by Protecto Wrap Co., Denver, CO.
  - 2. Tapecoat CT, by Tapecoat Company, Inc., Evanston, IL.
  - 3. Or equal.

## **2.08 STEEL EXPANSION JOINT DOWELS**

- A. Smooth steel conforming to ASTM A36. Coating on bars with an approved, FUSION BONDED COATING.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF WATERSTOPS - GENERAL**

- A. Join waterstops at intersections so continuous seal is provided.
- B. Center waterstop on joint.
- C. Hold waterstop positively in correct position.
- D. If waterstop is damaged, repair in acceptable manner.
- E. Vibrate concrete to obtain impervious concrete in the vicinity of joints.
- F. In horizontal joints, fill areas below waterstop completely with concrete; make visual inspection of entire waterstop area during concrete placement.

### **3.02 WATERSTOPS IN CONSTRUCTION JOINTS**

- A. Horizontal Waterstops:
  - 1. Place immediately after the pour is completed and before concrete has begun to set.
  - 2. Puddle each side to level concrete and assure that waterstop is properly embedded.
  - 3. Where stops are spliced, lap at least 12 inches and secure together.
  - 4. After concrete has set to the point where the surface can be cut with a broom or a stream of water, cut off the surface to a rough finish with laitance removed and the concrete left clean.
- B. Vertical Waterstop: Place and secure in forms prior to placing concrete.

### **3.03 PLASTIC WATERSTOP**

- A. Install in accordance with details shown and manufacturer's instructions.
- B. Allow at least 10 minutes before pulling or straining the new splice.
- C. Finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80 percent of unspliced materials.

### **3.04 SPLICES AND JOINTS**

- A. Prior to use of the waterstop material in the field, submit a sample of a fabricated cross constructed of each size or shape of material to be used for approval.
- B. Fabricate samples so that the material and workmanship represent the fittings provided under this Section.

- C. Make field splices and joints in accordance with waterstop manufacturer's instructions using a thermostatically controlled heating iron.

### **3.05 JOINT PREPARATION - GENERAL**

- A. Accurately locate and construct joints to produce straight joints.
- B. Vertical or horizontal, except where walls intersect sloping floors.
- C. Do not commence concrete pour until after joint preparation has been inspected and approved by Engineer.

### **3.06 CONSTRUCTION JOINTS**

- A. Prior to placing abutting concrete, clean contact surface by sandblasting or other approved means to remove laitance and expose the aggregate.
- B. Remove concrete from exposed portion of reinforcing steel.
- C. Do not damage the waterstop, if one is present, during the cleaning process.
- D. Grout for horizontal construction joints shall be as specified in Section 03 01 30.
- E. Roughen surface of hardened concrete by one of the following methods:
  - 1. Sandblast foundation and reinforcing dowels after concrete has fully cured to remove laitance and spillage and to expose sound aggregate.
  - 2. Water blast the foundation and reinforcing dowels after concrete has partially cured to remove laitance and spillage and to expose sound aggregate.
  - 3. Green cut fresh concrete with high pressure water and hand tools to remove laitance and spillage from the foundation and reinforcing dowels, and to expose sound aggregate.

### **3.07 LOCATION**

- A. Joints as shown on the Drawings or approved by Engineer.

### **3.08 TIME BETWEEN POURS**

- A. At least 2 hours shall elapse after depositing concrete in long or high columns or heavy walls before depositing in beams, girders, or slabs supported thereon.
- B. For short columns and low height walls, 10 feet or less, wait at least 45 minutes prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.
- C. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed monolithically therewith.
- D. Where cold joints will result and this joint will be below the finished water surface, provide and install a waterstop in the joint.

### **3.09 EXPANSION JOINTS - GENERAL**

- A. Provide premolded joint filler of sufficient width to completely fill the joint space.
- B. If a waterstop is in the joint, accurately cut premolded joint filler to butt tightly against the waterstop and the side forms.
- C. At locations where joint sealant is to be applied, precut premolded joint filler the required depth.
- D. Form cavities for joint sealant with either precut, premolded joint filler or smooth, accurately-shaped material that can be removed.
- E. Thoroughly vibrated concrete along the joint form to produce a dense, smooth surface.

- F. Repair surface irregularities along the joint sealant cavity due to improper concrete consolidation or faulty form removal with an approved compound compatible with the joint sealant in a manner that is satisfactory to the sealant manufacturer.

### **3.10 INSTALLATION OF BITUMINOUS TYPE OR CLOSED CELL FOAM TYPE PREMOLDED JOINT FILLER**

- A. Drive nails at about 1 foot on centers through the filler to provide anchors into the concrete when it is placed.
- B. Place premolded joint filler in the forms in the proper position before concrete is poured.
- C. Install premolded joint filler in walks (to provide expansion and contraction joints at not more than 20-foot intervals), at changes in direction at intersections, and at each side of driveway entrances.

### **3.11 POURABLE JOINT FILLER - GENERAL**

- A. Install pourable joint fillers in accordance with the manufacturer's instructions.
- B. Thoroughly clean joints by sandblasting concrete surfaces of each side of joint from plastic waterstop to top of joint, dry the joint, and remove dust and foreign material; prime before pouring the filler.
- C. Avoid damaging waterstop by sandblasting operations.
- D. Primer compatible with filler material.

### **3.12 RUBBER ASPHALT JOINT FILLER**

- A. Heat rubber asphalt filler material in a double-walled boiler and place in the joint by means of a nozzle.
- B. Prevent spillage outside of the joint.
- C. Begin pouring joint filler at the bottom of the horizontal joint and proceed upwards in a manner that will preclude the possibility of trapping air in the joint.
- D. Use masking tape at each side of joint to assist in cleaning all spillage.

### **3.13 CONTROL JOINTS IN FLOOR SLABS**

- A. Form tongue-and-groove construction joints with keyway in bulkhead forms.
- B. Key horizontal joints the full length of the member.
- C. Key width shall occupy the interior one-third section, and depth of the key shall be 2 inches.

### **3.14 STEEL EXPANSION JOINT DOWELS**

- A. Install parallel to wall or slab face and in true horizontal position by securing tightly in forms with rigid ties.
- B. Orient dowels to permit joint movement.

**END OF SECTION**

## SECTION 03 20 00

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

##### 1.02 RELATED SECTIONS

- A. Section 32 13 13 - Concrete Paving.
- B. Section 03 11 00 - Concrete Forms and Accessories.
- C. Section 03 33 00 - Cast-in-Place Concrete.

##### 1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2002.
- C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 1994.
- D. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2001.
- E. ASTM A 184/A 184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2001.
- F. ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2001.
- G. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2001b.
- H. ASTM A 706/A 706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2001.
- I. ASTM A 775/A 775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2001.
- J. ASTM A 996/A 996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2001a.
- K. ASTM D 3963/D 3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy Coated Reinforcing Steel Bars; 2001.
- L. AWS D1.4 - Structural Welding Code - Reinforcing Steel; American Welding Society; 1998.
- M. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2001.
- N. CRSI (P1) - Placing Reinforcing Bars; Concrete Reinforcing Steel Institute; 1997.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

## **1.05 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with CRSI (DA4), CRSI (P1), ACI 301, ACI SP-66, ACI 318, and ASTM A 184/A 184M.

## **1.06 COORDINATION**

- A. Coordinate with placement of formwork, formed openings and other Work.

## **PART 2 PRODUCTS**

### **2.01 REINFORCEMENT**

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
  - 1. Deformed billet-steel bars.
  - 2. Unfinished.
- B. Stirrup Steel: ASTM A 82 steel wire, unfinished.
- C. Steel Welded Wire Reinforcement for first floor slab-on-grade: ASTM A 185, plain type.
  - 1. Coiled Rolls.
  - 2. Mesh Size: 6 x 6.
  - 3. Wire Gage: W1.4 X W1.4 minimum or larger as indicated on drawings.
- D. Steel Welded Wire Reinforcement for second floor composite floor slabs: ASTM A 185, plain type.
  - 1. Flat Sheets
  - 2. Mesh Size: 6 X 6
  - 3. Wire Gage: W2.1 X W2.1 minimum or larger as indicated on drawings.

### **2.02 REINFORCEMENT ACCESSORIES:**

- A. Tie Wire: Annealed, minimum 16 gage.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
- C. Provide stainless steel or plastic components for placement within 1-1/2 inches of weathering surfaces.

### **2.03 FABRICATION**

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice, ACI SP-66 - ACI Detailing Manual, and ACI 318.
- B. Locate reinforcing splices not indicated on drawings at point of minimum stress.

## **PART 3 EXECUTION**

### **3.01 PLACEMENT**

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as follows:
  - 1. Beams: 1 1/2 inch
  - 2. Supported Slabs and Joists: 3/4 inch.
  - 3. Column Ties: 1 1/2 inch.
  - 4. Walls (exposed to weather or backfill): 2 inch.
  - 5. Footings and Concrete Formed Against Earth: 3 inch.
  - 6. Slabs on Fill: 2 inch.

E. Conform to ACI 318 code for concrete cover over reinforcement.

**3.02 FIELD QUALITY CONTROL**

A. Independent testing agency, as specified in Section 01 40 00, will inspect installed reinforcement for conformance to contract documents before concrete placement.

**END OF SECTION**

## SECTION 03 20 01

### SITE CONCRETE REINFORCING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide reinforcing steel and welded wire fabric.
- B. Conform to "Placing Reinforcing Bars", Recommended Practices, Joint Effort of CRSI-WCRSI, prepared under the direction of the CRSI Committee on Engineering Practice.
- C. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for this inspection prior to casting concrete.

##### 1.02 RELATED SECTIONS

- A. Section 03 01 30 - Site Concrete Work.

##### 1.03 REFERENCES

- A. American Concrete Institute, 22400 West Seven Mile Road, Detroit, Michigan 48219.
  - 1. ACI-318 - Building Code Requirements for Reinforcing Concrete.
- B. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM A185 - Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
  - 2. ASTM A497 - Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
  - 3. ASTM A615 - Specification for Deformed and Plain Billet-Steel for Concrete Reinforcement.
- C. American Welding Society, 550 North West LeJeune Road, Miami, Florida 33126.
  - 1. AWS D1.4 - Structural Welding Code; Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute, 933 North Plum Grove Road, Schamburg, Illinois 60195.
  - 1. CRSI-MSP-1 - Manual of Standard Practice.

##### 1.04 SUBMITTALS

- A. Submit the following in accordance with the Frontend Documents:
  - 1. Bending lists.
  - 2. Placing drawings.
  - 3. Shop drawings.
- B. Shop Drawings:
  - 1. Bars for footings, including dowels, shall not be fabricated and shipped without prior review of Shop Drawings by the Engineer.
  - 2. Otherwise, Shop and Placing Drawings shall include reinforcing placing plans and details indicating size, location, arrangement, placing sequence, etc., and shall conform to ACI 315.

## **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Steel:
  - 1. Deliver with suitable hauling and handling equipment.
  - 2. Tag for easy identification.
  - 3. Store to prevent contact with the ground.
- B. Unloading, storing, and handling of bars shall conform to CRSI publication "Placing Reinforcing Bars".

## **PART 2 PRODUCTS**

### **2.01 DEFORMED REINFORCING BARS**

- A. Deformed billet-steel bars conforming to ASTM A615, Grade 60.

### **2.02 WELDED WIRE FABRIC**

- A. Conform to ASTM A185 or A497.

### **2.03 ACCESSORIES**

- A. Tie wire: 16-gage, black, soft-annealed wire.
- B. Bar supports: proper type for intended use.
- C. Bar supports in beams, columns, walls, and slabs exposed to view after stripping: Small rectangular concrete blocks of same color and strength of concrete that is being placed around them.
- D. Concrete supports: for reinforcing concrete placed on grade.
- E. Conform to requirements of "Placing Reinforcing Bars" published by CRSI.

## **PART 3 EXECUTION**

### **3.01 REINFORCING STEEL**

- A. Clean metal reinforcement of loose mill scale, oil, earth and other contaminants.
- B. Straightening and rebending reinforcing steel:
  - 1. Do not straighten or rebend metal reinforcement.
  - 2. Where construction access through reinforcing is a problem, use bundle or space bars instead of bending.
  - 3. Submit details and obtain Engineer's review prior to placing.
- C. Protection, spacing, and positioning of reinforcing steel: Conform to the current edition of the ACI Standard Building Code Requirements for Reinforced Concrete (ACI 318), reviewed placing drawings and design drawings.
- D. Location Tolerance: Conform to the current edition of "Placing Reinforcing Bars" published by Concrete Reinforcing Steel Institute and to the Details and Notes on the Drawings.
- E. Splicing:
  - 1. Conform to Drawings and current edition of ACI Code 318.
  - 2. Stagger splices in adjacent bars.



- F. Tying deformed reinforcing bars: Conform to current edition of "Placing Reinforcing Bars" published by Concrete Reinforcing Steel Institute and to details and notes on Drawings.
- G. Field Bending:
  - 1. Field bending of reinforcing steel bars is not permitted when rebending will later be required to straighten bars.
  - 2. Consult with Engineer prior to pouring if there is a need to work out a solution to prevent field bending.

### **3.02 REINFORCEMENT AROUND OPENINGS**

- A. Place an equivalent area of steel around pipe or opening and extend on each side sufficiently to develop bond in each bar.
- B. See Drawings for bar extension length each side of opening.
- C. Where welded wire fabric is used, provide extra reinforcement using fabric or deformed bars.

### **3.03 WELDING REINFORCEMENT**

- A. Welding shall not be permitted unless Contractor submits detailed Shop Drawings, qualifications, and radiographic nondestructive testing procedures for review by Engineer.
  - 1. Obtain results of this review prior to proceeding.
  - 2. Basis for submittals: Structural Welding Code, Reinforcing Steel, AWS D1.4, published by American Welding Society, and applicable portions of ACI 318, current edition.
  - 3. Test 10 percent of welds using radiographic, nondestructive testing procedures in accordance to the above referenced codes.

### **3.04 PLACING WELDED WIRE FABRIC**

- A. Conform to ACI 318 and to current Manual of Standard Practice, Welded Wire Fabric, by Wire Reinforcement Institute regarding placement, bends, laps, and other requirements.
- B. Placing:
  - 1. Extend fabric to within 2 inches of edges of slab.
  - 2. Lap splices at least 1-1/2 courses of fabric and a minimum of 6 inches.
  - 3. Tie laps and splices securely at ends and at least every 24 inches with 16-gage black annealed steel wire.
  - 4. Place welded wire fabric at the proper distance above bottom of slab.

**END OF SECTION**

## SECTION 03 33 00

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete footings.
- B. Concrete foundations.
- C. Concrete for floors over metal deck and slabs on grade.
- D. Control, expansion and contraction joint devices associated with concrete work.
- E. Miscellaneous Concrete elements including equipment pads, light pole bases, thrust blocks and elevator pit.

##### 1.02 RELATED SECTIONS

- A. Section 01 40 00 - Quality control: Testing program.
- B. Section 03 11 00 - Concrete Forms and Accessories: Forms and accessories for formwork.
- C. Section 03 20 00 - Concrete Reinforcement.
- D. Section 03 35 00 - Concrete Floor Finishing.
- E. Section 03 39 00 - Concrete Curing.
- F. Section 05 31 33 – Steel Roof Deck
- G. Section 07 90 00 - Joint Sealers.
- H. Section 32 13 13 - Cement Concrete Paving: Sidewalks, curbs and gutters.

##### 1.03 REFERENCES

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 1997).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 1996.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- E. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- F. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988.
- G. ACI 308 - Standard Practice for Curing Concrete; American Concrete Institute International; 2001.
- H. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2002.
- I. ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2001.
- J. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2001b.

- K. ASTM C 33 - Standard Specification for Concrete Aggregates; 2002a.
- L. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2001.
- M. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2000.
- N. ASTM C 143/C 143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2000.
- O. ASTM C 150 - Standard Specification for Portland Cement; 2002a.
- P. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete; 2003.
- Q. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2001.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2001.
- S. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 1999a.
- T. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2003.
- U. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2001.
- V. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2002.
- W. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 1998.
- X. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 1999.
- Y. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2001).

#### **1.04 SUBMITTALS**

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- C. Submit proposed mix design of each class of concrete to independent testing agency and Architect/Engineer for review and receive approval prior to commencement of Work.
- D. Independent testing agency shall submit results of concrete test results to Contractor and Architect/Engineer immediately following each test.

#### **1.05 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Acquire cement from same source and aggregate from same source for entire project.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.

#### **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Do not place concrete when base temperature is less than 40 degrees F., or when surface is wet or frozen.

## **PART 2 PRODUCTS**

### **2.01 FORMWORK**

- A. Comply with requirements of Section 03 11 00.

### **2.02 REINFORCEMENT**

- A. Comply with requirements of Section 03 20 00.

### **2.03 CONCRETE MATERIALS**

- A. Cement: ASTM C 150, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Fly Ash: ASTM C 618, Class C.
- D. Water: Clean and not detrimental to concrete.

### **2.04 ADMIXTURES**

- A. Air Entrainment Admixture: ASTM C 260.
- B. Chemical Admixtures: ASTM C 494/C 494M, only if approved in writing by the Structural Engineer and Architect.
  - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

### **2.05 CONCRETE ACCESSORIES**

- A. Vapor Retarder: 15 mil thick polyethylene film, type recommended for below grade application. Place under all interior concrete slabs on grade.
- B. Non-Shrink Grout: ASTM C 1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
  - 1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
  - 2. Minimum Compressive Strength at 28 Days: 7,000 psi.

### **2.06 JOINT DEVICES AND MATERIALS**

- A. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and full depth of slab less 1/2 inch.
- B. Joint Filler: Compressible asphalt mastic with felt facers, complying with ASTM D 994, 1/4 inch thick and 4 inches deep.
- C. Construction Joint Devices: Integral galvanized steel; formed to tongue and groove profile, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.
- D. Sealant and Primer: As specified in Section 07 90 00.

### **2.07 CONCRETE MIX DESIGN**

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Proportions of Concrete Mix Designs shall be determined by the procedures established in Section 5.3 of ACI 318-99.
- C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
  - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- D. **Concrete mix designs: Refer to the Structural Drawings for concrete strength requirements, mix designs and proportioning.**

- E. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- F. Mix designs may include (Type C) Fly Ash as a replacement for Portland cement up to a maximum amount of 20% of the total cementitious material. **Do not use Fly Ash containing concrete mix when the temperature during placement or curing is projected to fall below 60 Degrees Fahrenheit.**
- G. Use acceleration admixtures in cold weather only when approved in writing by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
- H. Use set retarding admixtures during hot weather only when approved in writing by Architect/Engineer.
- I. Add air entraining agent to normal weight concrete mix for work exposed to exterior.
- J. Air entrainment: Comply with Structural Drawings.

## **2.08 MIXING**

- A. Transit Mixers: Comply with ASTM C 94/C 94M.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

### **3.02 PREPARATION**

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.
- C. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- D. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- E. Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches and seal watertight by taping edges and ends.

### **3.03 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- E. Install vapor barrier under interior slabs on grade. Lap joints minimum 6 inches and seal watertight.
- F. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 12 inches and seal watertight.
- G. Separate slabs on grade from vertical surfaces with joint filler.
- H. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Conform to

Section 07 90 00 for finish joint sealer requirements.

- J. Install joint devices in accordance with manufacturer's instructions.
- K. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- L. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- M. Place concrete continuously between predetermined expansion, control, and construction joints.
- N. Do not interrupt successive placement; do not permit cold joints to occur.
- O. Saw cut joints within 24 hours after placing. Use 3/16 inch thick blade, depth of cut shall be at least 1/4 depth of slab thickness.
- P. Screed floors level, maintaining surface flatness of maximum 1/4 inch in 10 ft.

### **3.04 CONCRETE FINISHING**

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
  - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs: Finish to requirements of Section 03 35 00.

### **3.05 CURING AND PROTECTION**

- A. Comply with requirements of Section 03 39 00.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Comply with requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- D. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
  - 1. Normal concrete: Not less than 7 days.
  - 2. High early strength concrete: Not less than 4 days.

### **3.06 FIELD QUALITY CONTROL**

- A. Independent testing agency will perform field quality control tests, as specified in Section 01 40 00 – Quality Control.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 50 cu yd or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C 143/C 143M.

### **3.07 PATCHING**

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections in accordance with ACI 301.

### **3.08 DEFECTIVE CONCRETE**

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

**END OF SECTION**

## SECTION 03 35 00

### CONCRETE FLOOR FINISHING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Finishing slabs on grade and slabs over metal deck.

##### 1.02 RELATED SECTIONS

- A. Section 03 33 00 - Cast-in-Place Concrete: Prepare concrete floors ready to receive finish.
- B. Section 03 39 00 - Concrete Curing.
- C. Section 05 31 33 – Steel Roof Deck
- D. Section 07 90 00 - Joint Sealers.

##### 1.03 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- B. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 1996.
- C. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2001).

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data on sealer, including information on compatibility of different products and limitations.

##### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1R.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

##### 1.07 PROJECT CONDITIONS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

##### 1.08 ENVIRONMENTAL REQUIREMENTS

- A. Temporary Lighting: Minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.
- B. Temporary Heat: Ambient temperature of 50 degrees F minimum.
- C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

#### PART 2 PRODUCTS

##### 2.01 Not Used

#### PART 3 EXECUTION

##### 3.01 EXAMINATION



- A. Verify that floor surfaces are acceptable to receive the work of this section.

### **3.02 FLOOR FINISHING**

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1R.
- B. Steel trowel surfaces that will receive all finishes.
- C. Troweled Finish: Apply troweled finish to all interior monolithic slab surfaces. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/4" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

### **3.03 FLOOR SURFACE TREATMENT**

- A. Apply sealer to scheduled floor surfaces in accordance with manufacturer's instructions.

### **3.04 TOLERANCES**

- A. Measure flatness of slabs in accordance with ACI 302.1R and to achieve the following tolerances:
  - 1. Maximum Variation of Surface Flatness For Exposed Concrete Floors: 1/4 inch in 10 ft.
- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

**END OF SECTION**

## SECTION 03 36 20

### BURNISHED CONCRETE FLOOR FINISHES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Application of densifier and burnishing of concrete floor slabs.
- B. Related Requirements:
  - 1. Section 03 33 00 - Cast-In-Place Concrete Slabs (Interior). Concrete for interior slabs on grade.
  - 2. Section 03 35 00 – Concrete Floor Finishing

##### 1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM C779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
  - 2. ASTM C805 – Standard Test Method for Rebound Number of Hardened Concrete.
  - 3. ASTM C1028 – Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
  - 4. ASTM D3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
  - 5. ASTM F150(06)2018 – Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring.
  - 6. ASTM G23 – Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Withdrawn 2000).
- C. American National Standards Institute (ANSI):
  - 1. ANSI B101.1 – Test Method for Measuring Wet SCOF of Common Hard-Surface Floors.
  - 2. ANSI B101.3 – Test Method for Measuring Wet DCOF of Common Hard-Surface Floors.
- D. National Floor Safety Institute (NFSI):
  - 1. Certified as High Traction by the National Floor Safety Institute (NFSI), Phase 2 testing.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals and Substitutions : Procedures for Submittals.
- B. Submit to Architect specified in Section 01 33 00.
- C. Product Data:
  - 1. Densifier: Brand name, chemical composition, installation directions and certificates of compliance with required standards. Submit 30 days prior to first concrete placement.
  - 2. Burnishing Pads: Submit product data for burnishing pads prior to beginning burnishing operations to verify pad texture.
- D. Applicator Qualifications:
  - 1. Provide documentation showing densifier applicator is certified by the densifier manufacturer.
  - 2. Letter shall be from the product manufacturer stating that the installer is qualified and certified by the manufacturer to install the material to be used, citing the specific project and location.
  - 3. Provide list of a minimum of 5 projects performed within the last 3 years of similar type, size and

- complexity as this contract.
- 4. Submit 30 days prior to first concrete placement.

#### **1.4 QUALITY ASSURANCE**

- A. A technically qualified manufacturer's field representative of the densifier product shall be on site during the initial application of the densifier and occasional observations during remainder of the applications.

#### **1.5 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Dispense densifier material from factory numbered and sealed drums. Maintain record of drum numbers.

#### **1.6 ENVIRONMENTAL REQUIREMENTS**

- A. Limit and control damage from excessive dust caused by burnishing.
- B. Limit and control damage from moisture. Remove standing moisture from floor after densifier application.

#### **1.7 WARRANTY**

- A. Provide manufacturer's standard 20 year warranty for replacement of defective densifier products.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with project requirements, provide products as manufactured by the following to the extent as specified hereinafter for the specific product:
  - 1. Curecrete Distribution, Inc. 1203 Spring Creek Place, Springville, UT 84663-0551 Phone: (800) 998-5664, (801) 489-5663, Fax: (801) 489-3307, Email: [info@ashfordformula.com](mailto:info@ashfordformula.com), Web: [www.ashfordformula.com](http://www.ashfordformula.com)

#### **2.2 DENSIFIER PRODUCTS**

- A. Pre-Densifier Floor Cleaner: As recommended by densifier manufacturer.
- B. Densifier: Ashford Formula
- C. Sprayer: Manufacturer approved high volume, low pressure sprayer and sprayer tip.

#### **2.3 POLISHING PRODUCTS**

- A. Burnishing Pads: Pads as follows or equivalent as required to produce specified results:
  - 1. Diamond Impregnated Pads:
    - a. Twister Diamond Cleaning System Pads by HTC.
    - b. Diamond Polishing Pads by Norton.
    - c. SpinFlex Diamond Polishing Pads by CPS.
    - d. Scotch-Brite Diamond Floor Pads Plus by 3M.
    - e. [Optima pad system by VIC.](#)
  - 2. Hogs Hair Pads:
    - a. Niagra Super Hogs Hair Floor Pad 3700N by 3M.
    - b. Ultra Grizzly Bear by Norton.
    - c. Consolideck Heat Pad by Prosoco.

#### **2.4 EQUIPMENT**

- A. Scrubber Machines Equipment used for cleaning operations shall be Clark Encore Max38 or L38 with a

head pressure of 150 lbs. or similar equipment as required to produce the specified results.

- B. Burnishing Machine: High speed propane burnisher, with a min. 27 inch head generating pad speeds of 1,500 RPM or higher as verified with tachometer.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Install Densifier in accordance with manufacturers published instructions.
- B. Burnish floors as specified hereinafter after application of densifier.

#### **3.2 DENSIFIER APPLICATION**

1. Apply product immediately following the finishing operation, as soon as the surface is firm enough to walk on and before hairline checking and temperature cracking begin. Curecrete recommends application using a low-pressure, high-volume pump that will dispense material at 40-70 psi (276-483 Kpa) and roughly 3-5 gal (11-19 L) per minute. Keep the entire surface wet with Ashford Formula for 30 minutes, working it into the concrete surface with a soft-bristled broom.
2. As the Ashford Formula becomes slippery underfoot, lightly mist the surface with water. As it again becomes slippery underfoot, thoroughly flush the entire surface with water and squeegee it completely dry to remove all surface alkalis and/or Ashford Formula residue.
3. Newly placed concrete requires the normal hardening period. Allow 30 days for days for proper curing before applying paint or covering.

#### **3.3 BURNISHING PROCEDURE**

- A. Allow densifier to dry.
- B. Burnish at a slow movement pace using burnishing machine with 800 grit diamond impregnated or hogs hair burnishing pads.
- C. Continue burnishing operations until the specified gloss is attained. Achieve specified gloss not later than two weeks prior to Owner Possession and maintain specified gloss levels until Owner Possession.
- D. Provide final burnishing prior to Owner Possession to eliminate any scratches resulting from construction operations.

#### **3.4 FINISH REQUIREMENTS**

- A. Gloss: Final surface gloss shall be a Specified Overall Gloss Value (SOGV) from 30 to 55, and a Minimum Local Gloss Value (MLGV) of 30 as measured using a Horiba IG-320 Gloss Checker.

#### **3.5 FLOOR PROTECTION**

- A. Protect finished floor from construction traffic and weather until time of Owner Possession.
- B. Prohibit acids and acidic detergents to come in contact with slab.

#### **3.6 PRODUCT DISPOSAL**

- A. Upon completion of densifier application, dispose of excess material as required by local agency having jurisdiction.

- B. Certified applicator shall remove densifier product containers from job site immediately upon completion of treatment.

**END OF SECTION**

**SECTION 03 39 00**  
**CONCRETE CURING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Initial and final curing of horizontal concrete surfaces.

**1.02 RELATED SECTIONS**

- A. Section 03 33 00 - Cast-in-Place Concrete.

**1.03 REFERENCES**

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- B. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 1996.
- C. ACI 308 - Standard Practice for Curing Concrete; American Concrete Institute International; 2001.
- D. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete; 2003.
- E. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.
- F. ASTM D 2103 - Standard Specification for Polyethylene Film and Sheeting; 1997.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data on curing compounds, including compatibility of different products and limitations.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 301 and ACI 302.1R.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver curing materials in manufacturer's sealed packaging, including application instructions.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Interior Slabs: Membrane Curing Compound: ASTM C 309 Type 1 Clear or translucent, Class A.
- B. Exterior Elevated Concrete Slabs: Ashford Formula
- C. Polyethylene Film: ASTM D 2103, 6 mil thick, clear.
- D. Water: Potable, not detrimental to concrete.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to be cured.

**3.02 EXECUTION - HORIZONTAL SURFACES**

- A. Cure floor surfaces in accordance with ACI 308 by one of the following methods.

1. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 7 days.
2. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
3. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges; maintain water coverage over entire floor area under sheets for not less than 7 days.

### **3.03 PROTECTION OF FINISHED WORK**

- A. When using curing compound, do not permit traffic over unprotected floor surface until curing compound has dried completely.

**END OF SECTION**

**SECTION 03 47 00**  
**SITE CAST CONCRETE**

**PART 1. GENERAL**

**1.01 WORK INCLUDED**

- A. Cast-in-place concrete, including formwork.

**1.02 REFERENCES**

- A. American Concrete Institute, Box 19150, Redford Station, Detroit, Michigan 48219 (latest revision).
1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  2. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
  3. ACI 211.3: Standard Practice for Selecting Proportions for No-Slump Concrete.
  4. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete.
  5. ACI 304.2R: Placing Concrete by Pumping Method.
  6. ACI 304.3R: High Density Concrete: Measuring, Mixing, Transporting and Placing.
  7. ACI 304.4R: Placing Concrete with Belt Conveyors.
  8. ACI 305R: Hot Weather Concreting.
  9. ACI 306R: Cold Weather Concreting.
  10. ACI 309: Standard Practice for Consolidating of Concrete.
  11. ACI 309.1R: Behavior of Fresh Concrete During Vibration.
  12. ACI 309.2R: Identification and Control of Consolidation-Related Surface Defects in Formed Concrete.
  13. ACI 318: Building Code Requirements for Reinforced Concrete.
  14. ACI 347: Recommended Practice for Concrete Formwork.
- B. American Society of Testing for Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103 (latest revision).
1. ASTM C31: Making and Curing Concrete Test Specimens in the Field.
  2. ASTM C33: Specification for Concrete Aggregates.
  3. ASTM C42: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  4. ASTM C143: Test for Slump of Portland Cement Concrete.
  5. ASTM C150: Specifications for Portland Cement.
  6. ASTM C172: Sampling Freshly Mixed Concrete.
  7. ASTM C173: Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  8. ASTM C231: Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
  9. ASTM C260: Specification for Air-Entraining Admixtures for Concrete.



10. ASTM C309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  11. ASTM C494: Specification for Chemical Admixtures for Concrete.
  12. ASTM E329: Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
- D. Local Codes and Ordinances: Wherever provisions of the Standard Building Code or the local current ordinances are more stringent than the above referenced Specifications and Standards, the local codes and ordinances shall govern.

### **1.03 SUBMITTALS**

- A. Submit the following:
1. Product Data: Submit manufacturer's product data for reinforcement and forming accessories, patching compounds, curing compounds, and other materials.
  2. Shop Drawings: Submit for review prior to Installation, Shop Drawings of all reinforcing steel, including bar cutting lists, typical bar bend diagrams, construction of forms including jointing, reveals, and location and pattern of form tie placement.
  3. Design Mix: Prior to placement of concrete, the Contractor shall submit a design mix showing the proportions and compressive strength obtained from the concrete at 7 and 28 days. The design mix shall include a complete list of materials including type, brand, source, and amount of; cement, fly ash, ground slag, coarse aggregate, fine aggregate, water, air content and admixtures, if applicable. The mix design shall be submitted to the Engineer at least ten (10) days prior to the start of operations. Placement of concrete shall not begin until the mix design is approved in writing by the Engineer.

### **1.04 QUALITY ASSURANCE/ACCEPTANCE**

- A. Inspection: Engineer shall have access and rights to inspect batch plants, cement mills, and facilities of suppliers, manufacturers, and subcontractors providing products specified.
- B. Batch Plant:
1. Certification: Current certification that weighing scales have been tested and are within tolerances as set forth in National Bureau of Standards Handbook No. 44.
  2. Equipment: Semi-automatic or fully automatic.
- C. Evaluation and acceptance of concrete shall conform to ACI 318.
- D. The Contractor shall engage a testing laboratory acceptable to Owner and Engineer to perform material evaluation tests and to design concrete mixes. All testing shall be paid for by the Contractor.
- E. The mixing or alternate use of cement from different manufacturers will not be permitted. The source of any materials shall not be changed without the written approval of the Engineer.
- F. If the cement furnished produces erratic results under field conditions incident to the placing of the concrete, or in regard to the strength of the finished product, or in the time of the initial or final set, the Contractor shall, without notice from the Engineer, cease the use of that source of cement.
- G. Should a change in sources be made, or admixtures added or deleted from the mix, a new design mix must be submitted to the Engineer for approval.
- H. The Contractor is responsible for product quality control during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of the

materials to produce an acceptable mix. The Contractor shall perform all applicable quality control sampling and testing required to ensure that the completed concrete complies with all requirements and specifications. The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and pay for testing.

- I. The Contractor shall be responsible for ensuring that all concrete cylinders, including those made for determination of quality acceptance, are properly cured while at the jobsite.
- J. Field Sampling and Testing:
  1. Field samples shall be made and cured in accordance with ASTM C31 for each concrete strength, at the rate of 4 test cylinders and one slump test for each 50 cubic yards of concrete from each days pour. Make air content check for each set of test cylinders in accordance with ASTM C173 or ASTM C231. Air content and slump shall be checked and recorded at both truck discharge and point of placement for pumped concrete from the first load each day and every 50 cubic yards thereafter.
  2. Test Cylinders: One at 7 days, two at 28 days, and reserve the remaining cylinder for testing after a longer period as required by the Engineer if the 28 day tests do not meet or exceed the required strength.
  3. The taking of samples from small pours of 10 cubic yards or less may be omitted at the discretion of the Engineer.
  4. Additional Test Slumps: Every 25 cubic yards, recording location for report.
  5. When early form removal is requested, field cure cylinders will be tested at 7 days or less to determine sufficient strength.
- K. Testing: Where average strength of any group of 3 cylinders falls below the minimum comprehensive strength, or an individual cylinder falls more than 500 psi below minimum compressive strength specified, the Contractor will be required to have a certified laboratory core the concrete and test it in accordance with ASTM C42. Specimens shall be selected by the Engineer from location in structure represented by test specimen or specimens which failed. At the discretion of the Engineer, Swiss hammer testing may or may not be used to aid in determination of acceptable concrete.
  1. Specimens shall be secured, prepared, and tested in accordance with ASTM C42, within a period of 60 days after placement of concrete.
  2. Concrete will be deemed approved meeting the strength requirements of this Section if it meets the strength requirements of ACI 318.
  3. The cost of cutting specimens from the structure, patching the resulting holes, and making laboratory analysis shall be at the sole expense of the Contractor.
  4. Holes from which the cored samples are taken shall be packed solid with no slump concrete proportioned in accordance with ACI 211. Patching shall have the same design strength as the specified concrete.
  5. Should laboratory analysis indicate that the proper concrete mix has not been used, all concrete poured where inappropriate mix was used shall be subject to rejection, before, during, or after the pour.
  6. If any of the specimens cut from the structure fail to meet the requirements of ACI 318, the Engineer shall have the right to require the defective concrete to be replaced, at the Contractors sole expense, and at no additional cost to the Owner.

- L. Sampling: In addition, the slump test specified in this Section, the Contractor shall keep a cone and rod apparatus on the Project site for random testing of batches. When concrete does not meet the specified slump requirements, and when directed by the Engineer, the Contractor will immediately perform a slump test in accordance with ASTM C143. Concrete not meeting the slump requirements shall be removed from the Project site.
- M. The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures.

## **PART 2 PRODUCTS**

### **2.01 CEMENT**

- A. Portland cement: ASTM C150 Type I.

### **2.02 WATER**

- A. Clean and free from oil, acid, alkali, salt, organic matter, or other deleterious substances.
- B. Potable.

### **2.03 CONCRETE AGGREGATES**

- A. General: Natural aggregates, well graded, free from deleterious coatings and organic materials conforming to ASTM C33 (latest revision).
  - 1. Import non-reactive aggregates if local aggregates are reactive. (Appendix XI-ASTM C33).
  - 2. Wash aggregates uniformly before use.
  - 3. Other aggregate gradations can be approved by Engineer.
- B. Fine Aggregates:
  - 1. Clean, sharp, natural or manufactured sand, free of loam, clay, lumps, or other detrimental materials and conforming to ASTM C33.
  - 2. Less than 2 percent passing the No. 200 sieve.
  - 3. Maximum size 1-1/2 inches.
- C. Course Aggregates:
  - 1. Natural gravel, crushed gravel, crushed stone, or combination of these materials.
  - 2. Less than 15 percent float or elongated particles (long dimension >5 times short dimension).
  - 3. Less than 0.5 percent passing the No. 200 sieve.

### **2.04 CONCRETE AIR-ENTRAINING ADMIXTURES**

- A. Manufacturer:
  - 1. Air-Mix or Perma-Air by the Euclid Chemical Co.
  - 2. Sealtight Air Entraining Admixture by W.R. Meadows of Texas.
  - 3. Master Builders, MB-VR.
  - 4. Or approved equal.
- B. ASTM C260; nontoxic after 30 days.
- C. Use only the specified non-corrosive non-chloride accelerator. Calcium chloride is not permitted.

- D. Provide for concrete exposed to freezing and thawing, required to be watertight or placed during cold weather. Air Content: 5 to 6 percent.

## **2.05 ADMIXTURES**

- A. Water-Reducing Admixture: Conforming to ASTM C494, Type A:
  - 1. Eucom WR-75 by the Euclid Chemical Company.
  - 2. Pozzolith 200N by Master Builder.
  - 3. Plastocrete 160 by Sika Chemical Corporation.
- B. Water-Reducing Retarding Admixture: Conforming to ASTM C494, Type D:
  - 1. Eucom Retarder-75 by the Euclid Chemical Company.
  - 2. Pozzolith 100XR by Master Builder.
  - 3. Plastiment by Sika Chemical Company.
- C. High-Range Water-Reducing Admixture (Superplasticizer): Conforming to ASTM C494, Type F or G:
  - 1. Eucom 37 by Euclid Chemical Company.
  - 2. Rheobuild 1000 by Master Builders.
  - 3. Sikament by Sika Chemical Company.
- D. Non-Corrosive Non-Chloride Accelerator Admixture: Conforming to ASTM C494 Type C or E:
  - 1. Accelguard 80 by Euclid Chemical Company.
  - 2. Or approved equal.
  - 3. Manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least 1 year's duration) using an acceptable accelerated corrosion test method using electrical potential measures.
- E. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.
- F. Certification: Submit written conformance to the requirements and chloride ion content of the admixture to Engineer prior to mix design review.

## **2.06 FORMS**

- A. Unexposed Finish Concrete: Plywood, lumber, metal or other acceptable material approved by the Engineer. Lumber shall be dressed on at least 2 edges and 2 sides for a tight fit if used.
- B. Form Coatings: Commercial formulation from coating compound with maximum VOC of 350 mg/l that will not bond, stain, or adversely affect concrete surfaces in contact with and will not impair succeeding treatments of concrete surfaces.
- C. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent deflection and spalling of concrete upon removal. Units provided shall not leave any metal closer than 1-1/2 inch to exposed surface. Provide ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

## **2.07 BONDING AGENT**

- A. Manufacturer: Sonnebond by Sonneborn; or approved equal.
- B. Submit product specifications and manufacturer's specific instructions for application on this Project for Engineer's approval.

- C. Product must meet Project requirements with regard to surface, pot life, set time, vertical or horizontal application, forming restrictions, or other stated requirements.

## **2.08 BOND BREAKER**

- A. Manufacturers:
  - 1. Williams Tilt-Up Compound, Williams Distributors Inc., Seattle, Washington.
  - 2. Silcoseal 77, Superior concrete Accessories, Franklin Park, Illinois.
  - 3. Or Equal.
- B. Nonstaining type.
- C. Provide positive bond prevention.
- D. Submit copies of manufacturer's data, recommendations, and instructions for specific use on this Project for review.

## **2.09 CURING COMPOUND**

- A. Liquid Membrane-Forming Curing Compound: ASTM C309, Type I, Class A. Moisture loss not more than 0.005 gr./sq. cm. applied at 200 square feet per gallon.
  - 1. Conspec, Conspec Cure & Seal.
  - 2. Sonneborn, Kure-N-Seal.
  - 3. Master Builders, MasterKure.
  - 4. Or approved equal.

## **2.10 BONDING AND REPAIR MATERIALS**

- A. Rewettable Bonding Compounds:
  - 1. Polyvinyl acetate type.
  - 2. Manufacturer:
    - a. Euco Weld by the Euclid Chemical Co.
    - b. Weldcrete by the Larsen Co.
    - c. Sonnocrete by Sonneborn.
    - d. Daraweld C by W. R. Grace.
  - 3. Use only in areas not subject to moisture.
- B. Non-Rewettable Bonding Compounds:
  - 1. Polymer modified type.
  - 2. Manufacturer:
    - a. Euco-Bond by the Euclid Chemical Co.
    - b. Or approved equal.

- C. Bonding Admixture:
  - 1. Latex, non-rewettable type.
  - 2. Manufacturer:
    - a. SBR Latex or Flex-Con by the Euclid Chemical Co.
    - b. Daraweld C by W. R. Grace.
- D. Patching Mortar:
  - 1. Free flowing or gel consistency.
  - 2. Polymer modified cementitious mortar.
  - 3. Manufacturer:
    - a. Euco Thin Coat or Concrete Coat by the Euclid Chemical Co. for horizontal repairs.
    - b. Verticoat by the Euclid Chemical Co. for vertical or overhead repairs.
    - c. Sikatop 121 or 122 by the Sika Chemical Co. for horizontal repairs.
    - d. Sikatop 123 by the Sika Chemical Co. for vertical or overhead repairs.
- E. Underlayment Compound:
  - 1. Free-flowing, self-leveling, pumpable cementitious base compound.
  - 2. Manufacturer:
    - a. Flo-Top by the Euclid Chemical Co.
    - b. Or approved equal.
- F. Repair Topping:
  - 1. Self-leveling, polymer modified high strength topping.
  - 2. Manufacturer: Thin Top SL by the Euclid Chemical Co.

### **PART 3 EXECUTION**

#### **3.01 DESIGN OF CONCRETE MIX**

- A. Submit mix design on each class of concrete for review, include standard deviation analysis or trial mixture test data.
- B. Proportion mix design in accordance with ACI 318-89, Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures".
- C. If trial batches are used:
  - 1. Prepare mix design by independent testing laboratory.
  - 2. Achieve an average compressive strength 1200 psi higher than the specified strength, or 1400 psi for specified concrete strengths over 5000 psi.
  - 3. Certified copies of laboratory trial mix reports and cylinder tests shall be submitted to Engineer by the testing laboratory for approval.
- D. Do not place concrete prior to receipt of Engineer's written approval of mixes and cylinder test results.
- E. Design mix and perform tests to meet the requirements as specified.
- F. Slump: 2-4"

- G. Water/Cement Ratio:
  - 1. Watertight concrete exposed to fresh water and freeze/thaw: 0.50 max.
  - 2. Air entrained concrete exposed to fresh water: 0.50 max.
- H. Combined Aggregate Gradings:
  - 1. Aggregates for concrete shall be proportioned in accordance with "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete." ACI 211.1.
  - 2. Maximum aggregate size: Do not exceed one-fifth the narrowest dimension between sizes of forms or 3/4 of the clear space between reinforcing bars, 1-1/2 inch maximum.

### **3.02 MIXES**

- A. Strength: Concrete minimum strength at 28 days shall be 4000 psi or as noted elsewhere.
- B. Mix Designs:
  - 1. Prepare design mixes for each type of concrete, in accordance with ACI 301 and ACI 318, except as otherwise specified.
- C. Conform to ACI 304 current edition for measuring, mixing, transporting and placing concrete.
- D. Concrete Mix Adjustments: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, and as approved by Engineer. Laboratory test data for revised mix design and strength results shall be submitted to and approved by Engineer prior to using in Work.

### **3.03 FORMS**

- A. Coordinate with other trades whose work may be located within or below concrete.
- B. Coordinate installation of joint materials and vapor retarders with placement of forms and reinforcing steel.
- C. Notify Engineer 1 full working day prior to erection of forms for inspection.
- D. Cleaning and Tightening:
  - 1. Clean forms thoroughly and adjacent surfaces to receive concrete.
  - 2. Remove chips, wood, sawdust, dirt or other debris immediately prior to concrete placement.
  - 3. Retighten forms after concrete placement to eliminate leaks.
- E. Design:
  - 1. Design, erect, support, brace, and maintain formwork in accordance with:
    - a. Building Codes Requirements for Reinforced Concrete (ACI 318).
    - b. Recommended Practice for Concrete Formwork (ACI 347).
    - c. Construction Industry Standards (OSHA 2207).
  - 2. Design formwork to be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials.
- F. Reuse of Forms: Do not reuse forms unless they are in new and undamaged condition.
- G. Chamfer exposed corners and edges 3/4 inch unless otherwise specified or shown on Drawing. Use wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Preparation of Form Surfaces: Coat the contact surfaces of forms with a form-coating compound where applicable prior to placement of reinforcement.

- I. Other Trades: Provide openings in concrete form work to accommodate Work of other trades. Determine size and location of openings, recesses, and chases for other trades providing such ties. Accurately place and securely support items built-in to form.
- J. Form Tolerances: Construct forms to sizes, shapes, lines, and dimensions shown, work in finished structures.
- K. Removal of Forms:
  - 1. Do not disturb forms until concrete is sufficiently strong to withstand possible injury.
  - 2. Do not remove shoring until member has acquired sufficient strength to support its weight and the load upon it.
  - 3. Do not remove forms until the concrete has attained 67 percent of 28 day strength or a minimum of 4 days. Use a method of form removal which will not cause overstressing of the concrete.

### **3.04 FORM TIES**

- A. Place in uniform patterns on exposed surfaces.
- B. Number and placement sufficient to withstand pressures and limit deflection of forms to acceptable limits.

### **3.05 PLACING CONCRETE - GENERAL**

- A. Do not place concrete without Engineer being present.
- B. Allow other trades reasonable time to complete portions of work which must be completed before concrete is placed.
- C. Notify Engineer at least 1 full working day in advance before starting to place concrete to permit inspection of forms, reinforcing, sleeves, conduits, boxes, inserts, or other work required to be installed in concrete.
- D. Review curing methods with Engineer and verify curing materials and equipment are at Project site.
- E. Placement shall conform to requirements and recommendations of ACI 304 and ACI 318, except as modified in these Specifications.
- F. Place concrete as soon as possible after leaving mixer in layers not over 1.5 feet deep:
  - 1. Without segregation or loss of ingredients.
  - 2. Without splashing forms or steel above.
- G. Do not use concrete truck chutes, pipes, finishing tools, etc., constructed of aluminum.
- H. Before depositing concrete:
  - 1. Remove debris from space to be occupied by concrete.
  - 2. Dampen:
    - a. Gravel fill beneath slabs on ground.
    - b. Sand where vapor barrier is specified.
    - c. Wood forms.
  - 3. Verify reinforcement is secured in position.
- I. Before placing concrete, clean and inspect form work, reinforcing steel, and items to be embedded or cast-in-place. Notify other trades prior to placement of concrete to permit the installation of their Work. Coordinate the installation of joint materials and vapor barriers with placement of forms and reinforcing steel.



J. Conveying:

1. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of materials.
2. Conveying equipment shall be capable of providing a supply of concrete at the site of placement without interruptions sufficient to permit loss of plasticity between successive increments.
3. Provide equipment for chuting, pumping, and pneumatically conveying concrete of proper size and design to insure a practically continuous flow of concrete at the point of delivery and without segregation of the materials.
4. Keep open troughs and chutes clean and free from coatings of hardened concrete.
5. Do not allow concrete to drop freely more than 10 feet. Equipment and methods used for conveying are subject to the approval of Engineer.

**3.06 ADDITION OF WATER AT PROJECT SITE**

- A. Do not add water to concrete at Project site if slump is within specified range.
- B. With the Engineer's approval, add water to concrete arriving at Project site with a slump less than the specified range, provided it can be demonstrated that the specified water-cement ratio will not be exceeded.
- C. All concrete shall be 4000 psi at 28 days with a maximum cement water ratio of .45 unless noted otherwise on Design Drawings.

**3.07 CONSOLIDATION AND VISUAL OBSERVATION**

- A. Concrete shall be consolidated with internal vibrators having a frequency of at least 800 vpm, with amplitude required to consolidate concrete in the section being placed.
- B. At least one standby vibrator in operable condition shall be at the placement site prior to and during placing concrete.
- C. Consolidation equipment and methods shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".
- D. Vibrator operator is required to see the concrete being consolidated to ensure good quality workmanship; or Contractor shall have a person actually observe the vibration of the concrete and will advise the vibrator operator of changes needed to assure complete consolidation.
- E. Do not use vibrators to transport concrete in forms.

**3.08 PLACING CONCRETE IN HOT WEATHER**

- A. Comply with the requirements of ACI 305.
- B. Fog spray forms, reinforcing steel, and subgrade just before placing concrete.
- C. Make every effort to maintain concrete temperature:
  1. Temperature of concrete shall be below 90 degrees F at time of placement, cool the ingredients before mixing by use of chilled water.
  2. Concrete batches with temperature in excess of 90 degrees F will be rejected.
  3. Coordinate timing and testing with Engineer and Construction Materials Testing when placing concrete on extreme weather days (above 90 degrees F).
  4. Cancel/reschedule concrete placement when it becomes impossible to maintain concrete temperatures below 90 degrees F.
- D. Place concrete promptly upon arrival at Project and vibrate immediately after placement.

- E. Protect and cure exposed surfaces by one of the following:
  - 1. Continuous water curing.
  - 2. Moisture-cover curing.

### **3.09 PLACING CONCRETE IN COLD WEATHER (ACI 306R)**

- A. Preparation:
  - 1. Comply with the requirements of ACI 306.
  - 2. Additives for the sole purpose of providing freeze protection shall not be used.
  - 3. Arrangements for covering, insulating, housing, or steam heating newly-placed concrete shall be made in advance of placement and shall be adequate to maintain temperature and moisture conditions recommended.
- B. Placement:
  - 1. Surfaces to be in contact with concrete shall be free of snow, ice, and frost and shall be above 40 degrees F.
  - 2. Do not place concrete on frozen subgrade.
  - 3. Placement of insulating material, tarpaulins, or other movable coverings shall follow closely the placing of concrete so that only a few feet of concrete are exposed to outside air at anytime.
- C. Curing and Protection:
  - 1. Keep concrete continuously moist and covered and maintain concrete temperature at a minimum of 50 degrees F for 7 days; temperature shall be uniform throughout concrete. If high early strength concrete is used, this temperature requirement may be reduced to 3 days.
  - 2. It is recommended forms be left in place for the entire period of protection; use insulated blankets or other approved method on slab surfaces.
  - 3. Limit rapid temperature changes at end of protection period to avoid thermal cracking.

### **3.10 PATCHING - GENERAL**

- A. Prior to starting patching work, except as specified, obtain Engineer's approval of proposed patching techniques and mixes.

### **3.11 REPAIR OF DEFECTIVE AREAS**

- A. Definition: Concrete in place that does not conform to specified design strength, shapes, alignments, and elevations as shown on Drawings and contains surface defects.
- B. Evaluation and acceptance of concrete shall conform to ACI 318.
- C. With prior approval of Engineer, as to method and procedure, repair defective areas in conformance with ACI 301, Chapter 9, except that the specified bonding compound shall be used.
- D. Surface Repairs:
  - 1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner.
  - 2. Honey-combed areas and rock pockets:
    - a. Repair immediately after removal of forms.
    - b. Prepare no-slump concrete mortar and test so that, when dry, patching mortar will match surrounding color and strength.

- c. Cut out to solid concrete or minimum of 1-inch depth.
  - d. Make edges for cuts perpendicular to the concrete surface.
  - e. Thoroughly clean and dampen with water.
  - f. Apply bonding compound.
  - g. Compact no-slump concrete into patch, and finish to blend with adjacent finished concrete.
  - h. Cure in same manner as adjacent concrete.
3. High Areas: Grind after concrete has cured at least 14 days.
  4. Low Areas:
    - a. Repair during or immediately after completion of surface finishing operations.
    - b. Cut out low areas and replace with fresh concrete of same type and class as original concrete.
    - c. Finish repaired areas to blend into adjacent concrete.
  5. Defective Areas:
    - a. Cut out and replace with fresh concrete of same type and class as original concrete.
    - b. Finish repaired areas to blend into adjacent concrete.
  6. Make structural repairs with prior approval of Engineer, as to method and procedure, using the specified epoxy adhesive or epoxy mortar. Where epoxy injection procedures must be used, use an approved low viscosity epoxy made by the manufacturers previously specified.
  7. Level floors for subsequent finishes by use of specified underlayment material.
  8. Where required, level exposed floors by use of the specified self-leveling repair topping.
  9. Repair methods not specified above may be used, subject to approval of Engineer.

### **3.12 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS**

- A. Submit proposed blockouts for review in accordance with Specifications.

### **3.13 CONCRETE CURING**

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for no less than 7 days. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as specified herein.
  1. Provide moisture curing by keeping concrete surface continuously wet by covering with water, by water-fog spray, or by covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide **coverage of** concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.
  2. Provide moisture-cover curing by covering concrete surface with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide curing and sealing compound on interior slabs left exposed and to exterior slabs and walks, as follows:
  - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
- C. Curing Formed Surfaces:
  1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed.
  2. If forms are removed, continue curing by methods specified above, as applicable.
- D. Curing Unformed Surfaces:
  1. Cure unformed surfaces; i.e., slabs and other flat surfaces by application of appropriate curing compound.
  2. Final cure concrete surfaces to receive finish flooring by moisture-retaining cover, unless otherwise directed by Engineer.

### **3.14 SURFACE FINISHES**

- A. As-Cast Finish:
  1. For formed concrete surfaces not exposed-to-view in the finished work or by other construction, unless otherwise indicated.
  2. This is concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
- B. Smooth Form Finish:
  1. For formed concrete surfaces exposed-to-view, or that will be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, i.e.; waterproofing, damp-proofing, painting or other similar system.
  2. This is cast-in-place concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams.
  3. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise specified or shown on Drawings.
- D. Float Finish: Apply float finish to slab surfaces to receive trowel finish and other finishes specified.
  1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units.

2. Check and level surface plane to tolerances of Ff 18 - Fl 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.
- E. Grout Cleandown Finish:
1. After repairing defects, saturate surface thoroughly and keep saturated during grouting operations.
  2. Use a grout consisting of 1 part cement, 1-1/2 to 2 parts of fine sand and sufficient water for a thick creamy consistency.
  3. Apply by brush, trowel or rubber float to completely fill air bubbles and holes.
  4. Float vigorously with a wood, sponge-rubber or cork float immediately after applying grout. Excess grout shall be scraped off with a sponge-rubber float.
  5. After grout has been allowed to stand undisturbed to allow some loss of plasticity, but not damp appearance, the surface should be rubbed with a clean, dry burlap to remove all excess grout. All air holes shall be filled but no visible film of grout shall remain after the rubbing.
- F. Trowel Finish: After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 20 - fl 17. Grind smooth surface defects which would telegraph through applied floor covering. Apply where exposed-to-view, and where slab surfaces are to be covered other than finish coating system.
- G. Non-Slip Broom Finish:
1. Finish concrete as specified, except only trowel the surface once.
  2. Finish surface by drawing fine-hair broom lightly across surface.
  3. Brooming:
    - a. Broom in same direction and parallel to expansion joints.
    - b. Inclined slab: Broom perpendicular to slope. Texture shall be as approved by the Engineer from sample panels.
  4. Provide this finish to sidewalks.
- H. Class 2, Rubbed Finish in accordance with Standard Specifications for Highway Construction, Section 802.20, Arkansas State Highway and Transportation Department, Edition (latest edition) and this Section:
1. After removal of forms, rubbing of concrete shall be start as soon as its condition will permit.
  2. Immediately before starting this Work, concrete shall be thoroughly saturated with water. Sufficient time shall have elapsed before wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set.
  3. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone using a small amount of mortar on its face.
  4. Mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished.
  5. Rubbing shall be continued until form marks, projections, and irregularities have been removed, voids filled, and a uniform surface has been obtained.
  6. Paste produced from rubbing shall be left in place at this time.

7. After concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. Rubbing shall be continued until the entire surface is smooth texture.
  8. Finish will not be acceptable if a uniform texture and color have not been achieved. Should the finish not be acceptable, the surface shall be given a sprayed finish or other approved finish that is satisfactory to the Engineer.
  9. After final rubbing is completed and the surface is dried, it shall be rubbed with burlap to remove loose power and left free from all unsound patches , paste, powder, and objectable marks.
  10. Apply this finish to exposed retaining wall surfaces.
- I. Class 3, Textured Coating Finish in accordance with Standard Specifications for Highway Construction, Section 802.19, Arkansas Department of Transportation, Edition (latest edition) and this Section:
1. Material provided for textured coating finish shall be a commercial paint type texturing product produced specifically for this purpose, and shall consist of a synthetic non-alkyd resin containing mica, perlite, non-biodegradable fibers, and durable tinting pigments. The material shall be listed on the QPL. Material shall be approved by Engineer.
  2. Unless otherwise specified in the Contract, the color of the textured coating finish shall be concrete gray, equal or close to Shade 36622 of the Federal Color Standard 595 B. The exact shade shall be selected by the Owner.
  3. Surfaces to be coated shall be free of efflorescence, laitance, flaking, coatings, dirt, oil, and other foreign substances.
  4. The sprayed finish shall not be applied over surfaces cured with membrane curing compound until 30 days has elapsed from application of the membrane.
  5. Prior to application of the finish, the surfaces shall be free of moisture, as determined by sight and touch, and in a condition consistent with manufacturer's published recommendations.
  6. The finish shall be applied at a rate as recommended by the manufacturer and as approved by the Engineer.
  7. The finish shall be applied with heavy duty spray equipment capable of maintaining a constant pressure as necessary for proper application.
  8. Completed finish shall be tightly bonded to the structure and shall present a uniform appearance and texture equal to or better than the required for rubbed finish.
  9. If necessary, an additional coat or coats shall be applied to produce the desired surface texture and uniformity.
  10. Upon failure to adhere positively to the structure without chipping or cracking, or to attain the desired surface appearance, the coating shall be removed from the structure and the surface given a rubbed finish, or another approved finish satisfactory to the Engineer.

### **3.15 WATER LEAKAGE TESTS - WATER HOLDING STRUCTURES**

- A. Subject water holding structures to leakage tests after concrete has been cured and obtained its design strength and before backfill, brick facing, or other Work that will cover exposed faces of walls is begun.
- B. Fill basins to be subjected to leakage tests with water to normal liquid level line.
- C. After basin has been kept full for 48 hours, it will be assumed, for purposes of the test, that moisture absorption by the concrete in the basin is complete.

- D. Valves and gates to the structure shall then be closed, and the change in water surface measured for a 24-hour period.
- E. During test period, examine exposed portions of the structure and mark visible leaks or damp spots; such leaks or damp spots shall be later patched or corrected in a manner acceptable to Engineer.

### **3.16 MISCELLANEOUS ITEMS**

- A. Filling Holes:
  - 1. Fill in holes and openings left in concrete for the passage of Work by other trades after their Work is in place.
  - 2. Mix, place, and cure concrete to blend with in-place construction. Provide other miscellaneous concrete filling required to complete Work.
- B. Non-Shrink Grout Application: Grout base plates, equipment bases, clarifier base, and other location indicated with specified non-shrink grout. Provide non-metallic type where grout is exposed.

### **3.17 PROTECTION**

- A. No Work or walking on finished surfaces will be allowed for 16 hours after the concrete is placed.
- B. Provide plywood or other acceptable protective cover at all traffic areas throughout the job.
- C. Protect exposed concrete floors, steps, and walks from paint and other materials or equipment which may blemish or damage these surfaces.

**END OF SECTION**

## SECTION 04 05 03

### MORTAR AND MASONRY GROUT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Mortar for masonry.

##### 1.02 RELATED SECTIONS

- A. Section 04 45 10 - Stone Veneer: Mortar for stone veneer.

##### 1.03 REFERENCES

- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements For Masonry Structures; American Concrete Institute International; 2002.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International; 2002.
- C. ASTM C 5 - Standard Specification for Quicklime for Structural Purposes; 1979 (Reapproved 1997).
- D. ASTM C 91 - Standard Specification for Masonry Cement; 2001.
- E. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2000.
- F. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2002.
- G. ASTM C 150 - Standard Specification for Portland Cement; 2002a.
- H. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes; 1991 (Reapproved 1997).
- I. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2002.
- J. ASTM C 387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete; 2000.
- K. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 1997.
- L. ASTM C 476 - Standard Specification for Grout for Masonry; 2002.
- M. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2002.
- N. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout; 2002.
- O. ASTM E 518 - Standard Test Methods for Flexural Bond Strength of Masonry; 2000a.
- P. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- Q. IMIAWC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Submit proposed mix design to Architect and Independent Testing Agency. Indicate whether the Proportion or Property specification of ASTM C 270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Do not begin work prior to receiving approval of mix design from Architect and Independent



Testing Agency.

- D. Submit manufacturers product information on water repellent admixture.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

#### **1.07 ENVIRONMENTAL REQUIREMENTS**

- A. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).
- B. Hot Weather Requirements: Comply with IMIAWC (HW).

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Masonry Cement: ASTM C 91, Type N.
- B. Portland Cement: ASTM C 150, Type I - Normal; standard gray color.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Quicklime: ASTM C 5, non-hydraulic type.
- E. Mortar Aggregate: ASTM C 144.
- F. Water: Clean and potable.
- G. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
  - 1. Acceptable product: Hydracide or equal.
- H. Bonding Agent: Latex type.

#### **2.02 MORTAR COLOR**

- A. Mortar Color: Selected by Architect from full range of color admixtures.

#### **2.03 MORTAR MIXES**

- A. Mortar for Unit Masonry: ASTM C 270, Property Specification.
  - 1. Exterior, non-load bearing masonry: Type N.

#### **2.04 MORTAR MIXING**

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar unless approved in writing by the Architect.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures above 50 degrees F, or two-and-one-half hours at temperatures below 50 degrees F.

#### **2.05 GROUT MIXES**

- A. Bond Beams and Lintels: Conform to the requirements of the Structural Drawings.

## **2.06 GROUT MIXING**

- A. Mix grout in accordance with ASTM C 94/C 94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.
- C. Add water repellent admixture in accordance with manufacturer's instructions; mix uniformly.
- D. Do not use anti-freeze compounds to lower the freezing point of grout unless approved in writing by Architect.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install mortar and grout to requirements of Section 04 05 03.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.
- E. Remove excess mortar from grout spaces.

### **3.02 FIELD QUALITY CONTROL**

- A. Independent testing agency will perform field tests, in accordance with provisions of Section 01400.
- B. Test and evaluate mortar in accordance with ASTM C 780 procedures.
- C. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C 780 recommendations for preconstruction testing.
- D. Grout Mixes: Test grout batches in accordance with ASTM C 1019 procedures.
- E. Test both mortar and grout mixes for compressive strength and slump at least once during initial masonry and grouting operations. Revise mix and retest if specified requirements are not met. Exact timing and frequency of tests shall be determined by the independent testing agency and shall not be announced beforehand to the masonry contractor.

**END OF SECTION**

## SECTION 04 45 10

### STONE VENEER

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Arkansas Sandstone veneer.
- B. Masonry veneer anchors.

##### 1.02 RELATED SECTIONS

- A. Section 04 05 03 - Mortar and Masonry Grout: Bedding and pointing mortar.

##### 1.03 REFERENCES

- A. ASTM A36 - Structural Steel – Steel Lintels.
- B. ASTM A123 - Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM C270 - Mortar for Unit Masonry.
- E. ASTM C387 - Packages, Dry, Combined Materials for Mortar and Concrete.
- F. IMIAC (International Masonry Industry All-Weather Council) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturers Product Information on reinforcements, and anchors.
- C. Submit samples of sandstone illustrating color range, general shape, texture and surface characteristics.
- D. Provide Architect with at least three locations within the state of Arkansas of stone veneer jobs utilizing the proposed stone mason, the proposed stone and the specified bonding pattern.

##### 1.05 QUALIFICATIONS

- A. Stone Supplier: Company specializing in distributing Arkansas sandstone with minimum five years documented experience. The stone supplied should match the stone on the Forest Resources Annex.
- B. Installer: Company specializing in performing the work of this section with minimum five years documented experience as evidenced by at least three previous stone veneer jobs within the state of Arkansas utilizing the proposed stone and the specified bonding pattern.

##### 1.06 MOCK-UP

- A. Provide a mock-up with metal stud and sheathing backup, air space, flashings, masonry anchors and ties and showing stone veneer in all shapes and sizes indicated in pattern at the end of this specification section. Multiple mockups may be required to accept sandstone type and pattern. Size of Mock-ups will be determined by the architect. Minimum size will be 8 feet tall x 8 feet wide.
- B. When accepted, mock-up will demonstrate minimum standard for work.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site in accordance with stone supplier's recommendations.
- B. Store stone above ground on pallets or sleepers.
- C. Protect stone from discoloration by soil or other construction materials.

### **1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Cold Weather Requirements: Comply with IMIAC - Recommended Practices and Specifications for Cold Weather Masonry Construction.
- B. Materials and ambient air shall be a minimum of 40 degrees F (5 degrees C) prior to, during, and 48 hours after installation of any cut stone veneer.
- C. During temporary storage on site, at the end of working day, or during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

### **1.09 SEQUENCING**

- A. Sequence work under the provisions of Section 01 10 00.
- B. Sequence work to coordinate the installation of stone work with installation of adjacent flashing and wood siding construction.

## **PART 2 PRODUCTS**

### **2.01 STONE VENEER**

- A. Arkansas Sandstone to match the existing stone veneer on the existing Forest Resources Annex on the UA Monticello Campus and laid in a pattern to match the MCB Classroom Building. See Photos at end of this section

### **2.02 MORTAR**

- A. Mortar: As specified in Section 04 05 03.

### **2.03 ANCHORS**

- A. Stone Veneer Anchors for attachment to metal stud backup: 14 gauge screw on anchors with 9 ga. wire pintles equal to Hohman and Barnard HB-200-X (1-1/2") hot dipped galvanized (1.50 oz. P.S.F.) conforming to ASTM A153 class B2 and ACI 530/ASCE 5 spaced 16" o.c. vertically and 16" o.c. horizontally, attach each anchor to metal stud backup with two self-tapping co-polymer coated or stainless steel screws of sufficient length to penetrate metal studs at least one inch.
- C. Stone Veneer Anchors for corners and other miscellaneous applications: Hot dipped galvanized "Hardware Cloth" wire mesh 12 inches by 4 inches.

### **2.04 FLASHINGS**

- A. Plastic Flashings: Sheet polyvinyl chloride; 20 mil thick.

### **2.05 ACCESSORIES**

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; 1/2 inch wide x by maximum lengths available.
- C. Building Paper: ASTM D 226, Type I ("No.15") asphalt felt.
- D. Weep/Cavity Vents: Polyethylene tubing or approved equal.

E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Beginning of installation means installer accepts existing conditions.

#### **3.02 PREPARATION**

- A. Establish lines, levels, and coursing. Protect from disturbance.
- B. Verify that items built-in under other sections are properly located and sized.
- C. Clean stone prior to erection. Do not use wire brushes or implements which will mark or damage exposed surfaces.

#### **3.03 INSTALLATION**

- A. Lay stone veneer to match the pattern of the sandstone veneer on the existing MCB Building and Forest Resources Annex. See Photos at the end of this section.
- B. Install mortar in accordance with ASTM C780.
- C. Completely fill all voids behind stone veneer below grade and slope top of mortar to drain to weep holes at 32" OC max.

#### **3.04 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

#### **3.05 WEEP/CAVITY VENTS**

- A. Install weep/cavity vents in veneer walls at 24 inches on center horizontally above through-wall flashing that is to be placed above lintel angles, window heads and sills, door heads, and at bottom of walls.
- B. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

#### **3.06 ANCHORAGE - GENERAL**

- A. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.

- B. Attach each veneer anchor to metal stud backup using two self-tapping co-polymer coated or stainless steel screws of sufficient length to penetrate metal studs at least one inch.

### **3.07 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted such as above all openings and at base of walls.
  - 1. Extend flashings full width at such interruptions and at least 8 inches into adjacent masonry or turn up at least 8 inches to form watertight pan at non-masonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend plastic flashings to within 1/4 inch of exterior face of masonry.
- C. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

### **3.08 LINTELS**

- A. Install loose steel lintels over openings.
- B. Maintain minimum 8 inch bearing on each side of opening.

### **3.09 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joint in accordance with Section 07 90 00 for sealant performance.
- D. Form expansion joint as detailed.

### **3.10 BUILT-IN WORK**

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### **3.11 TOLERANCES**

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft non cumulative.
- C. Maximum Variation from Plumb: 1/4 inch per story, non cumulative.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft, non cumulative.
- E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft non cumulative.
- F. Maximum misalignment of vertical head joints: 1/8 inch per 2 courses, non cumulative.

### **3.12 CUTTING AND FITTING**

- A. Cut and fit for corners and penetrations. Coordinate with other sections of work to

provide correct size, shape, and location.

- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.13 FIELD QUALITY CONTROL

- A. Independent testing agency will perform field quality control tests, as specified in Section 01 40 00 and Section 04 05 03.
- B. Mortar Tests: Test each type of mortar and grout in accordance with ASTM C 780 and Section 04 05 03.

### 3.14 CLEANING

- A. Remove excess mortar upon completion of work.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

### END OF SECTION



Forest Resources Annex Building Stone



MCB Classroom Building

## SECTION 05 12 00

### STRUCTURAL STEEL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Structural steel framing members, support members and steel framing accessories.
- B. Base plates, anchor bolts and bearing plates.
- C. Grouting under base plates.
- D. Shop finishing of steel members.

##### 1.02 RELATED SECTIONS

- A. Section 05 31 33 - Steel Roof Deck.
- B. Section 05 40 00 – Cold Formed Metal Framing
- C. Section 05 50 00 - Metal Fabrications.
- D. Section 09 90 00 - Paints and Coatings.

##### 1.03 REFERENCES

- A. AISC M016 - ASD Manual of Steel Construction; American Institute of Steel Construction, Inc.; 1989, Ninth Edition.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2000.
- C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2000.
- D. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2001.
- E. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2002.
- F. ASTM A 108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality; 1999.
- G. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- H. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2002.
- I. ASTM A 242/A 242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2001.
- J. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2002.
- K. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2002.
- L. ASTM A 325M - Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric); 2000.
- M. ASTM A 449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs; 2000.
- N. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2001a.



- O. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2001.
- P. ASTM A 514/A 514M - Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2000a.
- Q. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts; 2000.
- R. ASTM A 563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2001.
- S. ASTM A 992/A 992M - Standard Specification for Structural Steel Shapes; 2002.
- T. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2002.
- U. ASTM E 94 - Standard Guide for Radiographic Examination; 2000.
- V. ASTM E 164 - Standard Practice for Ultrasonic Contact Examination of Weldments; 1997.
- W. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination; 2002.
- X. ASTM E 709 - Standard Guide for Magnetic Particle Examination; 2001.
- Y. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.
- Z. AWS D1.1 - Structural Welding Code - Steel; American Welding Society; 2004.
- AA. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2000).
- AB. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002.
- AC. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

#### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittals: Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
  2. Connections not detailed.
  3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

#### **1.05 QUALITY ASSURANCE**

- A. Fabricate structural steel members in accordance with AISC "ASD Manual of Steel Construction".
- B. Comply with Section 10 of AISC "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- C. Fabricator: Company specializing in performing the work of this section with minimum 10 years of documented experience.
- D. Erector: Company specializing in performing the work of this section with minimum 10 years of documented experience.
- E. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the state of Arkansas.

### **PART 2 PRODUCTS**

## 2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A 36/A 36M.
- B. Steel W Shapes and Tees: ASTM A 992/A 992M.
- C. Rolled Steel Structural Shapes: ASTM A 992/A 992M.
- D. Cold-Formed Structural Tubing: ASTM A 500, Grade B,  $F_y=46\text{ksi}$ .
- E. Round cold-formed structural tubing: ASTM A 500, Grade B,  $F_y=42\text{ksi}$ .
- F. Round steel pipe: ASTM A53, Grade B,  $F_y=35\text{ksi}$ .
- G. Structural Steel Bolts & Nuts: ASTM A325N unless noted otherwise.
- H. Anchor Bolts: ASTM F 1554, Grade 36.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C 1107 and capable of developing a minimum compressive strength of 7,000 psi at 28 days.
- K. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- L. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

## 2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Space shear stud connectors at in strict accordance with the drawings.
- C. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- D. Fabricate connections for bolt, nut, and washer connectors.
- E. Develop required camber for members.
- F. Connections: Weld or bolt shop connections as indicated.
  - 1. Bolt field connections, except where welded connections or other connections are indicated.
- G. Provide high-strength threaded fasteners for all bolted connections.
- H. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" (RCRBSJ).
- I. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
- J. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
- K. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.

## 2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 2.
- B. Shop prime all structural steel members. Do not prime surfaces in contact with concrete.
- C. Surface Preparation: After inspection and before shipping, clean steel work to be painted.

Remove loose rust, loose mill scale, and splatter, or slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows: "SP-1 Solvent Cleaning".

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

#### **3.02 ERECTION**

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- C. Temporary Planking: Provide temporary planking and working platforms to complete work.
- D. Field weld components and shear studs indicated on shop drawings.
- E. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- F. Do not field cut or alter structural members without approval of the Architect / Engineer.
- G. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- H. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, sloping to 45 degrees.

#### **3.03 ERECTION TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

#### **3.04 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed by the independent testing agency employed by the contractor. Provide access to places where structural steel work is being fabricated or produced and to the site at all times when structural steel is being erected.
- B. Connections: Testing agency shall visually inspect at least 40% of all field-welded and bolted connections. If deficiencies are found by visual inspection, agency shall continue visual inspection of all connections and test any connections discovered to be deficient using one of the following:
  - 1. Radiographic testing performed in accordance with ASTM E 94.
  - 2. Ultrasonic testing performed in accordance with ASTM E 164.
  - 3. Liquid penetrant inspection performed in accordance with ASTM E 165.
  - 4. Magnetic particle inspection performed in accordance with ASTM E 709.

**END OF SECTION**

## SECTION 05 21 00

### STEEL JOISTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Open web steel joists with bridging, attached seats and anchors.
- B. Loose bearing plates and anchor bolts for site placement.
- C. Framed roof openings greater than 18 inches.

##### 1.02 RELATED SECTIONS

- A. Section 05 12 00 - Structural Steel.
- B. Section 05 31 23 - Steel Roof Deck.
- C. Section 05 50 00 - Metal Fabrications.

##### 1.03 REFERENCES

- A. ASTM A108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.
- B. ASTM A325 - High Strength Bolts for Structural Steel Joints.
- C. AWS D1.1 - Structural Welding Code.
- D. FS TT-P-636 - Primer Coating, Alkyd, Wood and Ferrous Metal.
- E. SJI - Standard Specifications for Open Web Steel Joists Kand KCS Series.
- F. SJI - Standard Specifications for Longspan Steel Joists LH and LJ Series and Deep Longspan Steel Joists DLH and DLJ Series.
- G. SSPC - Steel Structures Painting Council.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings:
  - 1. Indicate standard designations, configuration, sizes, spacing, locations of joists and joist leg extensions.
  - 2. Joist coding, bridging, connections, attachments and accessories.
  - 3. Reproduction of contract drawings in any form will not be allowed.
- C. Welders' Certificates: Submit manufacturer's certificates under provisions of Section 01400 that welders employed on the Work have met AWS verification within the previous 12 months.

##### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with SJI Standard Specifications, Load Tables and Weight Tables, including headers and other supplementary framing.

## **1.06 QUALIFICATIONS**

- A. Fabricator: Company specializing in performing the work of this Section with minimum 10 years documented experience.
- B. Erector: Company specializing in performing the work of this Section with minimum 10 years documented experience.
- C. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Arkansas.

## **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Store and protect products under provisions of Section 01500 and to SJI requirements.
- B. Protect joists from distortion or damage.

## **1.08 FIELD MEASUREMENTS**

- A. Verify that field measurements are as shown on Drawings and shop drawings.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Open Web Joists Members: Refer to Structural Drawings
- B. Anchor Bolts, Nuts, and Washers: ASTM A307 and A325.
- C. Primer: FS TT-P-636.
- D. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36.
- E. Welding Materials: AWS D1.1; type required for materials being welded.

### **2.02 FABRICATION**

- A. Provide bottom and top chord extensions as indicated.

### **2.03 FINISH**

- A. Shop prime joists. Do not prime surfaces that will be field welded.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

### **3.02 ERECTION**

- A. Erect and bear joists on supports.

- B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment until completion of erection and installation of permanent bridging and bracing.
- C. After joist alignment and installation of framing, field weld joist seat to bearing plates.
- D. Position and field weld joist chord extensions and wall attachments as detailed.
- E. Frame roof openings greater than 18 inches with supplementary framing as detailed.
- F. Do not permit erection of decking until joists are braced, bridged and secured.
- G. Do not field cut or alter structural members without approval of joist fabricator.
- H. After erection, prime welds, abrasions and surfaces not shop primed.

### **3.03 ERECTION TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Alignment: 1/4 inch.

### **3.04 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed by the independent testing agency employed by the Contractor. Provide access to places where structural steel work is being fabricated or produced and to the site at all times when structural steel is being erected.
- B. Correct deficiencies in structural steel joists which inspections have indicated to be not in compliance with requirements.

**END OF SECTION**

## SECTION 05 31 33

### STEEL ROOF DECK

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Steel roof deck.
- B. Closures and fillers.
- C. Fastening of deck.

##### 1.02 RELATED SECTIONS

- A. Section 05 12 00 - Structural Steel.
- B. Section 07 53 00 – Single Ply TPO Roofing Membrane.

##### 1.03 REFERENCES

- A. AISI SG-971 - Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 1996.
- B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2002a.
- C. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 1998.
- D. SDI (DM) - Publication No. 30, Design Manual for Composite Decks, Form Decks, Roof Decks and Cellular Deck Floor Systems with Electrical Distribution; Steel Deck Institute; 2000.
- E. SDI MOC1 - Manual of Construction with Steel Deck; Steel Deck Institute; 1992, Revised 2000.
- F. SDI DDM02 - Diaphragm Design Manual; Steel Deck Institute; 1987, Second Edition.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Shop Drawings: Show location of deck units, anchorage details, sump pans, cut openings and accessories, and other information required for a thorough review.
- C. Product Certificates: Signed by the manufacturer of the steel deck, certifying the supplied products comply with specified requirements.

##### 1.05 QUALITY ASSURANCE

- A. Codes and Standards: Comply with applicable provisions of the following specifications:
  - 1. American Iron and Steel Institute Specification for the Design of Cold-Formed Steel Structural Members.
  - 2. AWS D1.3 Structural Welding Code - Sheet Steel; American Welding Society.
  - 3. Steel Deck Institute (SDI) Manuals.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage and handling.
- B. If ground storage is needed, store deck bundles off the ground, with one end elevated to provide drainage. Protect bundles against condensation with a ventilated waterproof covering. Stack bundles so there is no danger of tipping, sliding, rolling, shifting or material damage. Check bundles periodically for tightness, and retighten as necessary so wind cannot loosen sheets.

- C. Place deck bundles on the building frame near a main supporting beam at a column or wall. Do not place bundles on unbolted frames or on unattached or unbridged joists. Ensure that the structural frame is properly braced to receive the bundles.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Vulcraft
- B. Wheeling
- C. Wryco

### **2.02 MATERIALS**

- A. Sheet Steel for Deck and Accessories: Painted; ASTM A 653/A 653M Structural Steel (SS), Grade 33 or higher.
- B. Metal Decking: Sheet steel, configured as follows:
  - 1. Span Design: Multiple
  - 2. Finish: Painted
  - 3. Minimum Metal Thickness (Excluding Finish): Refer to Structural Drawings
  - 4. Nominal Height: 1.5", Type "B"
  - 5. Formed Sheet Width: 36 inch
  - 6. Side Joints: Lapped
  - 7. Flute Sides: Plain vertical face

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine support framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work of this section.

### **3.02 PREPARATION**

- A. Place deck in accordance with approved placement plans.
- B. Locate deck bundles to prevent overloading of support members.

### **3.03 INSTALLATION**

- A. Do not use deck units as a working platform or storage area until units are permanently attached in position.
- B. Do not impose construction loads that exceed load carrying capacity of deck.
- C. Install deck panels and accessories according to Steel Deck Institute specifications and recommendations, SDI Manual of Construction with Steel Deck, and in accordance with the placement plans and requirements of this section.
- D. Place deck panels on structural supports and adjust to final position with ends lapped or butted over structural supports with a minimum end bearing of 1.5 inches. Attach the deck panels firmly to the supports immediately after placement in order to form a safe working platform.
- E. Cut and neatly fit deck and accessories at skew conditions, around openings, and at other work projecting through or adjacent to the decking.
- F. Side Lap Attachment: Fasten side laps of deck units using two #10 Tek Screws per span
  - 1. Locate screws at 1/3 points of span.
- G. Perimeter Edge Attachment: Fasten perimeter edges of deck units at minimum 6 inch intervals or as shown on design drawings using one of the following methods:
  - 1. Mechanical fasteners, #12 Tek Screws.



- H. Anchor accessories to supporting members by arc spot welds or self drilling screws at 12 inch maximum intervals or as shown on design drawings.
- I. Do not cut unscheduled openings through the deck without the approval of the Architect; reinforce openings as directed.

**END OF SECTION**

## SECTION 05 40 00

### COLD FORMED METAL FRAMING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Load bearing and non-load bearing formed steel stud wall framing at exterior wall locations.
- B. Framing accessories.
- C. Formed steel furring channels.

##### 1.02 RELATED SECTIONS

- A. Section 05 50 00 - Metal Fabrications: Metal fabrications attached to stud framing.
- B. Section 06 10 00 - Wood Blocking, Sheathing and Curbing: Rough wood blocking within stud framing.
- C. Section 07 21 16 - Batt and Blanket Insulation: Insulation within framing members.
- D. Section 09 21 16 – Gypsum Board Systems: Wall sheathing.

##### 1.03 REFERENCES

- A. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- C. ASTM A591 - Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated.
- D. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board.
- E. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board.
- F. GA 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum Board.
- G. Metal Framing Manufacturers Association (MFMA) - Guidelines for the Use of Metal Framing.
- H. AISI – American Iron and Steel Institute – Cold Formed Steel Design Manual.
- I. ASTM A611 – Steel, Cold Rolled Sheet, Carbon, Structural.
- J. ASTM C955 – Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.
- K. AWCI (Association of Wall and Ceiling Industries) - Specifications Guide for Cold Formed Steel Structural Members.
- L. AWS D1.1 – Structural Welding Code.
- M. AWS D1.3 – Light Steel Welding Code.
- N. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
- O. MFMA (Metal Framing Manufacturers Association) - Guidelines for the Use of Metal Framing.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals: Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria and limitations.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing

compliance with requirements.

- D. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention, and connection details.
- E. Manufacturer's Data: Submit copies of manufacturer's calculations, specifications and installation instructions for each type of steel stud and accessories, including other data as may be required to show compliance with these specifications.
- F. Shop Drawings:
  - 1. Submit shop drawings and calculations showing complete details for the fabrication and erection of members showing size and gage designations, number, type, location and spacing of members.
  - 2. Submit details, schedules, procedures, and diagrams showing the sequence of erection.
  - 3. Include all components required for a complete framing system.
  - 4. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.
  - 5. Submit shop drawings for review prior to starting any work. Work performed prior to shop drawing review is at contractor's risk.
  - 6. Shop drawings shall be signed and sealed by a structural engineer experienced in the design of load bearing cold formed metal framing systems registered in the state of Arkansas.

#### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with GA 203 MFMA, ASTM C754, and ASTM C955.

#### **1.06 QUALIFICATIONS**

- A. Installer: Company specializing in performing the work of this section with minimum five years documented experience in erecting load bearing metal stud construction.

#### **1.07 COORDINATION**

- A. Coordinate the installation of metal stud tracks and anchors with the installation of structural steel framing members, steel floor deck, and poured in place concrete floors.
- B. Coordinate with the placement of wood blocking and other components within the stud framing system.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. ClarkDietrich, Marino-Ware, U.S. Gypsum or approved equal.

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide complete cold-formed steel framing system capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Drawings.
  - 2. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 3/4 inch.
  - 3. Design exterior wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
  - 1. Floor and Roof Systems: AISI S210

2. Wall Studs: AISI S211
  3. Headers: AISI S212
  4. Lateral Design: AISI S213.
- C. Fire Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory: or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

## **2.03 FRAMING MATERIALS**

- A. Studs and Track: Non-load bearing ASTM C645; load-bearing ASTM C 955; studs formed to channel shape with punched web; U-shaped track in matching nominal width and compatible height.
1. Material Thickness: By Metal Stud Engineer. Refer to Structural Drawings for minimum thickness.
  2. Stud Depth: Refer to Structural Drawings
  3. Flange width: By Metal Stud Engineer. Refer to Structural Drawings for minimum flange width.
  4. Galvanized in accordance with ASTM A 653/A 653M coating.
  5. Provide components fabricated from ASTM A 1008/A 1008M, Designation SS steel.
  6. Comply with requirements of Structural Drawings.
- B. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- C. Plates, Gussets, Clips: Formed Sheet Steel, thickness as indicated on structural drawings; finish to match framing components.
- D. Tracks for Non-Load Bearing Walls: Of same material and thickness as studs, bent leg retainer notched to receive studs.
- E. Fasteners: GA 203. Self drilling, self tapping screws. Refer to structural drawings for fasteners for load bearing wall construction.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC - Paint 20 Type I Inorganic zinc rich.

## **2.04 FABRICATION**

- A. Fabricate assemblies of framed sections to sizes and profiles required; with framing members fitted, reinforced, bridged and braced to suit design requirements.
- B. Refer to structural shop drawings for fabrication notes for load bearing wall construction.

## **2.05 FINISHES**

- A. Studs: Galvanize to G60 coating class.
- B. Tracks and Headers: Galvanize to G60 coating class.
- C. Accessories: Same finish as framing members.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that conditions are ready to receive work.
- B. Verify that rough-in utilities are in proper location.

### **3.02 INSTALLATION OF STUDS**

- A. Align and secure top and bottom runners for non-load bearing walls at 24 inches o.c. minimum with power fasteners.

- B. Refer to structural shop drawings for attachment of runners at load bearing walls.
- C. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- D. Install headers in load bearing walls in accordance with structural shop drawings.
- E. Install studs vertically at 16 inches o.c. unless indicated otherwise on drawings.
- F. Install studs in load bearing walls aligned with studs in walls above and below.
- G. Assure that studs in load bearing walls are resting firmly on bottom of lower runners and top of upper runners. Do not rely on screw connections alone to transfer loads from studs to runners.
- H. Align stud web openings horizontally.
- I. Secure studs to tracks using screw fastening method at both flanges. Refer to structural shop drawings for fastener requirements at load bearing walls.
- J. Stud splicing is not allowed.
- K. Fabricate corners using a minimum of three studs.
- L. Install double studs (minimum) at wall openings, door and window jambs, not more than 2 inches from each side of openings. See structural shop drawings for additional stud requirements and stud construction.
- M. Brace load bearing stud framing system rigid until concrete floors have cured and shear wall sheathing is in place.
- N. Coordinate erection of studs with requirements of door frames, window frames, and masonry; install supports and attachments.
- O. Coordinate installation of wood bucks, anchors, and wood blocking to be placed within stud framing.
- P. Blocking: Secure wood blocking to studs using self drilling, self tapping screws.
- Q. Strap bracing is required as shown on structural shop drawings. Strap bracing shall be run continuous and attached as required by structural shop drawings.
- R. Horizontal hat channel bridging is required at all load bearing walls at 48" O.C. vertically. Bridging may be omitted at walls which have strap blocking.
- S. All light gage steel, 18 gage and lighter shall have a yield strength of 33ksi (min.). All light gage steel 16 gage and heavier shall have a yield strength of 50 ksi (min.)
- T. All light gage steel properties shall comply with Steel Stud Manufacturers Association (ssma.com).

### **3.04 ERECTION TOLERANCES**

- A. Maximum Variation from True Position: 1/4 inch.
- B. Maximum Variation of any Member from Plane: 1/4 inch.

**END OF SECTION**

## SECTION 05 50 00

### METAL FABRICATIONS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Shop fabricated steel and miscellaneous metal items.

##### 1.02 RELATED SECTIONS

- A. Section 03 33 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 12 00 - Structural Steel: Structural steel for attachment of metal fabrications.
- C. Section 05 51 33 - Aluminum Ladder
- D. Section 09 90 00 - Paints and Coatings: Paint finish.

##### 1.03 REFERENCES

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2002.
- B. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2001.
- C. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2002.
- D. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2002.
- E. ASTM A 283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2000.
- F. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength; 2002.
- G. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2002.
- H. ASTM A 325M - Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric); 2000.
- I. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2001a.
- J. ASTM A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2001.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.
- L. AWS D1.1 - Structural Welding Code - Steel; American Welding Society; 2004.
- M. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2000).
- N. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2000).

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
- C. Plates: ASTM A 36.
- D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- E. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

### **2.02 FABRICATION**

- A. Fit and shop assemble items in largest practical sections for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

### **2.03 FABRICATED ITEMS**

- A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

### **2.04 FINISHES - STEEL**

- A. Prime paint all steel items.
  - 1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify that field measurements are as indicated on drawings and shop drawings.

### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into

concrete.

### **3.03 INSTALLATION**

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

### **3.04 ERECTION TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

**END OF SECTION**



## SECTION 05 51 33

### ALUMINUM LADDER

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Aluminum Fixed Vertical Ladders at the interior of the building.

##### 1.02 RELATED SECTIONS

- A. Section 03 33 00 – Cast-In-Place Concrete: Anchorage of Ships Ladder at flooring.
- B. Section 05 12 00 – Structural Steel: Anchorage of Ships Ladder.

##### 1.03 SYSTEM DESCRIPTION

- A. The system is an aluminum ladder designed to be attached to a wall. A cage should be furnished for all ladders exceeding a height dictated by local codes.
- B. Floor mounting brackets are to be furnished when ladder bottom is at floor level.  
Standard riser height is 12".

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide materials, finish, installation details, and measurements.
- C. Manufacturer's Installation Instructions: Indicate special requirements i.e.: Anchoring Requirements, clearances required, etc.
- D. Shop Drawings: Indicate ladder height, ladder profiles, riser height, tread depth and anchorage. Provide ladder elevations and typical details. Provide all information needed to indicate that ladder will work in space provided. Indicate on shop drawings floor to floor heights and clearances at each landing.

##### 1.05 WARRANTY

- A. The ladder shall carry a one year warranty against defective material and workmanship and will be replaced at no charge to the owner if ladder fails to comply with above listed items.

##### 1.06 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on construction documents.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Precision Ladders, LLC, P.O. Box 2279, Morristown, TN 37816, 1-800-225-7814
- B. Approved Equal

##### 2.02 PRODUCT

- A. LADDER
  - 1. Stringers (Siderail)
    - a. Aluminum channel. (6005-t5)
    - b. 2 1/2" X 1 1/16" X 1/8" .
    - c. A 1/8" molded polyurethane safety cap provided at top.
    - d. 2 1/2" X 2" X 3" floor bracket if required.

2. Treads

- a. Extruded aluminum (6005-t5)
- b. 2 1/4" X 3/4" X 1/4".
- c. Treads deeply serrated for safety.

3. Mounting Bracket

- a. 8-1/2" X 4-1/2" X 3" X 1/4" aluminum angle.

B. CAGE (at interior ladder)

- 1. 1/4" X 2" aluminum bar hoops (6005-t5).
- 2. 1/4" X 2" aluminum bar vertical bard (6005-t5).

C. MANUFACTURED UNITS

- 1. The fixed vertical ladder at interior is a Model FL with Cage.

D. FABRICATION

- 1. The ladder is completely fabricated ready for installation before shipment to the site.
- 2. Any cages, are to be completely fabricated ready for field assembly to the ladder before shipment to the site.

**2.04 FINISHES**

- A. Mill finish on aluminum components

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Field verify existing conditions for anchorage and floor to floor heights.

**3.02 INSTALLATION**

- A. Install Vertical Ladder as one entire unit in prepared opening in accordance with manufacturer's written instructions.
- B. Set square and level.
- C. Anchor unit securely to concrete floor and steel channel at landing as indicated on drawings.

**END OF SECTION**

## SECTION 06 10 00

### WOOD BLOCKING, SHEATHING AND CURBING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Roof blocking, nailers and curbs.
- B. Wood furring and grounds
- C. Wood blocking for fascia.
- D. Telephone and electrical panel boards.
- E. Concealed wood blocking for support of wood trim and paneling, wood casework and cabinets, aluminum storefront and curtainwall, wall mounted video monitors, white boards, toilet partitions, fire extinguisher cabinets, toilet and bath accessories, wall cabinets, and other items requiring attachment to walls.

##### 1.02 RELATED SECTIONS

- A. Section 05 31 33 - Steel Roof Deck: Metal roof decking to receive wood curbs and cants.
- B. Section 05 40 00- Cold Form Metal Framing System: Wood blocking in metal stud construction
- C. Section 06 12 50 - Tongue and Groove Wood Decking: Wood framing and blocking for wood roof decking and ceiling.
- D. section 06 18 10 – Glued Laminated Structural units: Wood framing and blocking attached to laminated wood beams.
- E. Section 06 20 00 - Finish Carpentry: Wood blocking for wood trim.
- F. Section 06 41 00 - Custom Wood Cabinets: Wood blocking for wall mounted cabinets.
- G. Section 07 62 00 – Metal Flashing, Cladding, Coping and Trim.
- H. Section 08 41 00 - Aluminum Storefronts: Wood blocking for aluminum storefront and curtainwall systems.
- I. Section 09 22 16 – Non Load Bearing Metal Stud Framing System: Wood blocking in metal stud construction.
- J. Section 10 16 50 – Plastic Laminate Toilet Partitions: Wood blocking for toilet partitions.
- K. Section 10 52 00 – Fire Extinguisher Cabinets: Wood blocking for fire extinguisher cabinets.
- L. Section 10 80 10 – Toilet Accessories: Wood blocking for toilet accessories.

##### 1.03 REFERENCES

- A. Comply with the requirements of the Structural Drawings.
- B. ANSI A208.1 - American National Standard for Particleboard; 1999.
- C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2002.
- D. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood-Preservers' Association; 2002.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2003.
- F. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology

(Department of Commerce); 1995.

G. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 1999.

H. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2002.

#### **1.04 QUALITY ASSURANCE**

- A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
  - 1. Acceptable Lumber Inspection Agencies: Any agency with rules approved by American Lumber Standards Committee.
- B. Plywood: Comply with PS 1.

### **PART 2 PRODUCTS**

#### **2.01 DIMENSION LUMBER**

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Blocking, Furring, and Nailers:
  - 1. Lumber: S4S, No. 2 or Standard Grade.

#### **2.02 CONSTRUCTION PANELS**

- A. Miscellaneous Panels:
  - 1. Concealed Plywood: PS 1, C-C Plugged, exterior grade.
  - 2. Exposed Plywood: PS 1, A-D, interior grade.
  - 3. Electrical Component Mounting: APA rated sheathing, fire retardant treated.

#### **2.03 ACCESSORIES**

- A. Fasteners and Anchors:
  - 1. Fasteners: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and treated wood locations, unfinished steel elsewhere.
  - 2. Anchors: Toggle bolt type for anchorage to hollow masonry.

#### **2.04 FACTORY WOOD TREATMENT**

- A. Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Preservative Pressure Treatment of Lumber Above Grade: AWPA Use Category UC3B, Commodity Specification A using MCQ (Micronized Copper Quaternary) waterborne copper based suspension preservative to 0.15 lb/cu ft retention.
  - 1. Kiln dry lumber after treatment (KDAT) to maximum moisture content of 19 percent.
  - 2. Use factory treated lumber in contact with masonry or concrete, including framing members and wood blocking in contact with foundation walls, existing and/ or new masonry walls and concrete.
  - 3. Use factory treated lumber in contact with roofing, flashing or waterproofing
  - 4. Use factory treated lumber where wood is used less than 18-inches above grade.
- C. Approved Manufacturers:
  - 1. Osmose: MICRO PRO/ SMART SENSE
  - 2. Great Southern Wood Preserving: YELLAWOOD

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Set members level and plumb, in correct position.
- B. Place horizontal members with crown side up.
- C. Construct curb members of single pieces to the greatest extent possible.
- D. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- E. Coordinate curb installation with installation of decking and support of deck openings.
- F. Provide miscellaneous members as indicated or as required to support finishes, fixtures, specialty items, and trim.

### **3.02 INSTALLATION OF CONSTRUCTION PANELS**

- A. Install telephone and electrical panel back boards made of plywood or other acceptable structural panels at locations indicated. Size back boards to be minimum 96 inches beyond size of telephone and electrical panels.

**END OF SECTION**

## SECTION 06 12 50

### TONGUE AND GROOVE WOOD DECKING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Softwood lumber tongue and groove wood decking for roof and ceiling applications.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Wood Framing, Blocking, Sheathing and Curbing: Wood framing for attachment of T&G wood ceiling.
- B. Section 06 18 10 - Glued Laminated Structural Units. Laminated wood beams for support of T&G wood roof deck
- C. Section 07 53 00 – TPO Roofing -
- D. Section 09 90 00 - Paints and Coatings: Staining and finishing of T&G wood ceiling and T&G wood roof deck.

##### 1.03 REFERENCES

- A. AITC 112 (American Institute Timber Construction) - Standard for Tongue and Groove Heavy Timber Decking.
- B. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.
- C. NFPA: National Forest Products Association.
- D. SPIB: Southern Pine Inspection Bureau.

##### 1.04 SYSTEM DESCRIPTION

- A. 2x6 solid timber No. 1 Grade Southern Pine per AITC Standard 112-93, kiln dried Tongue and Groove, V-Joint Face.
- B. Design roof live load: 20 psf with deflection limited to 1/240.

##### 1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate deck framing system, loads and cambers, bearing details and framed openings.
- C. Samples of Exposed To View Wood Deck: Submit two samples, 24-inches long illustrating wood grain, stain, and finish.

##### 1.06 LUMBER GRADING

- A. Perform Work in accordance with the following agencies:
  - 1. Lumber Grading Agency: Certified by ALSC.
- B. In lieu of grade stamping exposed to view lumber and plywood, submit manufacturer's certificate under provisions of Section 01 40 00 that products meet or exceed specified requirements.
- C. Maintain one copy of each document on site.

##### 1.07 QUALITY ASSURANCE

- A. Standard for Solid-Sawn Wood Decking: Comply with AITC 112, " Standard for Tongue-and-Groove Heavy Timber Roof Decking."
- B. Maintain one copy of each document on site.

## **1.08 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience; and certified by AITC.
- B. Installer: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.
- C. Design decking under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Arkansas.

## **1.09 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for fire retardant requirements.
- B. Conform to UL requirements to achieve rating indicated.

## **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. All deck placed in temporary storage at the job site shall be stored off the ground and protected from the weather.

## **1.11 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated on shop drawings.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Structural Wood Systems, P. O. Box 250, Greenville, AL 36037. (Fax) 334-382-9860, (Phone) 334-382-6534.
- B. Unit Structures, 1012 Shanhouse Blvd., Magnolia, Arkansas 71753. (Phone) 870-234-4112.

### **2.02 MATERIALS**

- A. Wood Roof Deck for exterior canopies: 2" x 6" nominal, tongue and groove, precision manufactured to permit tight joints, No. 1 Grade Southern Pine per AITC Standard 112-93.
- B. Edges of exposed face of tongue and groove is to be beveled with a 1/4" "V" to form a 1/2" "V" when two pieces are joined.
- C. Decking Configuration: Random Length and End matched.
- C. The maximum moisture content shall be 15%.

### **2.03 FINISH**

- A. Tongue and Groove decking shall be factory finished with a sealer
- B. Tongue and Groove decking may be field finished at contractor's option..

### **2.04 FASTENERS AND ACCESSORIES**

- A. Fasteners for Solid-Sawn Decking: Provide fastener size and type complying with decking standard for thickness of deck used.
- B. Fastener Material: Each piece must be toe-nailed through the tongue with one 16d common nail and also face nailed with two 16d common nails at each support. Additional nails are needed in some high wind load applications.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that support framing is ready to receive decking.

### **3.02 PREPARATION**

- A. Coordinate placement of bearing and support items.

### **3.03 INSTALLATION OF 2X6 T&G WOOD ROOF DECK**

- A. Install and Fasten solid wood decking to comply with AITC 112-93.
- B. Install tongue and groove wood decking with tongues on the upward side of the slope. Apply deck with V-edge downward and fasten to each support with two screws through each board at each rafter.
- B. Install decking in Random Length configuration.
- C. All deck placed in temporary storage at the job site shall be stored off the ground and protected from the weather.
- D. As deck is installed, it shall be covered immediately with waterproof roofing underlayment.

**END OF SECTION**



## SECTION 06 18 10

### GLUED LAMINATED STRUCTURAL UNITS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Glued laminated wood beams and rafters.

##### 1.02 RELATED SECTIONS

- A. Section 05 12 00 - Structural Steel: Steel columns for support of laminated wood beams.
- B. Section 05 50 00 - Metal Fabrications: Saddles, connectors, rods, clavises and plates.
- C. Section 06 10 00 - Wood Framing, Blocking, Sheathing and Curbing: Wood framing and blocking supported by laminated wood members.
- D. Section 06 12 50 - Tongue and Groove Wood Decking. T&G wood roof decking supported by laminated wood beams.

##### 1.03 REFERENCES

- A. AITC: American Institute of Timber Construction.
- B. ALSC: American Lumber Standards Committee.
- C. ANSI A190.1 - Structural Glued Laminated Timber.
- D. ASTM D2559 - Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing. All shop drawings shall bear the name, seal and registration number of a licensed professional engineer in the State of Arkansas. Submit design calculations.
- C. Manufacturer's standard stain colors.

##### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacture of glue laminated structural units with five years experience, and certified by the AITC. in accordance with ANSI A190.1.
- B. Erector: Company experienced in erecting glued laminated structural arches with three years experience and approved by manufacturer.
- C. Design structural members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Arkansas.
- D. Comply with all requirements of the Structural Drawings and Notes.

## 1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for loads, seismic zoning; and other load criteria.

## 1.07 DESIGN REQUIREMENTS

- A. Design Roof Live Load: 20 lbs/sq ft with deflection limited to 1/240.
- B. Comply with all requirements of the Structural Drawings and Notes.

## 1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store protect and handle products in accordance with manufacturer's printed instructions.
- B. Protect members to AITC requirements for individually wrapped.
- C. Leave individual wrapping in place until finishing occurs.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Structural Wood Systems, P. O. Box 250, Greenville, AL 36037. (Fax) 334-382-9860, (Phone) 334-382-6534.
- B. Gaylon Timber and Glu-Lam, Inc., 322 Nancy Lynn Lane., Suite 15, Knoxville, TN 37919. (Phone) 865-584-4542, [www.gaylontimber.com](http://www.gaylontimber.com)

### 2.02 MATERIALS

- A. The lumber for laminating shall be southern Pine, Kiln-dried to a moisture content of 7 to 15 percent. The lumber shall be stress graded and shall consist of grades, to provide minimum working stressed as follows:

Principal Stress - Bending:

Stress in extreme tension fiber(bending)	"Fbxx"	2,400 psi
Shear parallel to grain	"Fvxx"	240 psi
Compression perpendicular to grain	"Fcxx"	650 psi
Modulus of elasticity	"E"	1,700,000 psi

- B. All glue laminated units exposed to view are to be architectural grade.

### 2.03 FABRICATION

- A. Fabricate glue laminated structural members in accordance with AITC Architectural grade.
- B. Verify dimensions and site conditions prior to fabrication.
- C. Cut and fit members accurately to length to achieve tight joint fit.
- D. Fabricate members with camber built in.
- E. Do not splice or join members in locations other than that indicated, without permission.
- F. Fabricate steel hardware and connections with joints neatly fitted, welded and ground smooth.
- G. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

## **2.05 FINISH**

- A. Laminated wood members shall be factory finished with a clear sealer.
- B. Laminated wood members may be field finished at contractor's option.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that structural steel is in place and ready to receive glue laminated structural units.
- B. Verify sufficient end bearing area.

### **3.02 PREPARATION**

- A. Coordinate placement of anchors and bolts.

### **3.03 ERECTION**

- A. Set structural members level and plumb, in correct positions.
- B. Provide temporary bracing and anchorage to hold members in place until permanently secured.
- C. Fit members together accurately without trimming, cutting, or any other unauthorized modification.

### **3.04 TOLERANCES**

- A. Framing Members: 1/2 inch maximum from true position.

**END OF SECTION**

## SECTION 06 20 00

### FINISH CARPENTRY

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Finish carpentry items, standing and running trim.
- B. Wood casings and moldings.
- C. Exterior Wood Siding
- D. Hardware and attachment accessories.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Blocking, Sheathing and Curbing: Grounds and support framing.
- B. Section 06 12 50 - Tongue and Groove Wood Decking: Wood framing and blocking for wood roof decking and ceiling.
- C. Section 06 18 10 - Glued Laminated Structural units: Wood framing and blocking attached to laminated wood beams.
- D. Section 06 41 00 - Custom Wood Cabinets: Shop fabricated custom cabinet work.
- E. Section 09 90 00 - Paints and Coatings: Painting and finishing of finish carpentry items.

##### 1.03 REFERENCES

- A. ANSI A208.1 - American National Standard for Particleboard; 1999.
- B. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2003.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2000.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2000.
- E. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.
- F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 1999.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and substitutions for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, to a minimum scale of 1-1/2 inch to 1 ft.
- C. Provide Solid White Oak Trim and Solid Cypress Siding samples, 3-Foot long x 5 inches wide.

##### 1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom grade.
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum ten years of documented experience.

## **1.06 DELIVERY, STORAGE, AND PROTECTION**

- A. Deliver, store, protect and handle products in accordance with manufacturer's instructions.
- B. Protect work from moisture damage.

## **1.07 PROJECT CONDITIONS**

- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- B. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

## **PART 2 PRODUCTS**

### **2.01 LUMBER MATERIALS FOR STANDING AND RUNNING TRIM**

- A. Exposed Solid Wood for Transparent Finish: NHLA graded in accordance with AWI Architectural Woodwork Institute Quality Standards Illustrated, Custom: average moisture content of 6%; species and grade as follows:
  - 1. Standing and Running Trim (Clear Finish): Species White Oak, Quarter Sawn, QSI Grade I.
- C. Solid Wood for Clear Finish: Species White Oak, Quarter Sawn, QSI Grade I.
- D. Solid Wood for Semi-exposed Members: Same as exposed members. See drawings for locations
- E. Solid Wood for Concealed Members: Douglas Fir or Southern Pine.

### **2.02 LUMBER MATERIALS FOR EXTERIOR SIDING AND TRIM**

- A. Exposed solid wood siding for semi-transparent Finish: Select Cypress.
- B. Exposed solid wood trim for semi-transparent finish: Select Cypress.
- C. Kiln dry exterior siding and trim to a maximum moisture content of 19%.
- D. Exterior siding and wood trim shall be surfaced (planed) on all exposed faces and edges. Faces and edges not exposed to view may be rough sawn.
- E. Mill exterior wood siding and trim to the dimensions and profiles shown on the drawings.

### **2.03 FASTENERS**

- A. Fasteners: Of size and type to suit application; exposed heads in concealed locations and countersunk heads in exposed locations.
- B. Fasteners and Anchors: Screws (F.S. FF-S-111), nails (F.S. FF-N-105), and anchors and expansion bolts of material, type, and finish required for each use for secure anchorage.

### **2.04 FABRICATION**

- A. Fabricate to AWI Custom standards.
- B. Shop assemble work for delivery to site, permitting passage through building openings.
- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- D. Fit exposed sheet material edges with 3/8 inch matching hardwood edging. Use one piece for full length only.
- E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

### **3.02 INSTALLATION**

- A. Set and secure materials and components in place, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- C. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners, and comply with referenced standard for joinery.

### **3.03 INSTALLATION – EXTERIOR WOOD SIDING AND TRIM**

- A. Install exterior wood siding and trim, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/16 inch. Do not use additional overlay trim to conceal larger gaps.
- C. Exterior Wood Siding and Trim:
  - 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
  - 2. Stagger joints in adjacent and related members 32" minimum.
  - 3. Butt joints shall only occur over studs.
  - 4. Butt joints shall be beveled at 45 degrees.
  - 5. Cope at returns and miter at corners.
  - 6. Attach exterior wood siding using 12d hot dipped galvanized casing nails in each stud.
  - 7. Attach exterior wood trim using 16d hot dipped galvanized casing nails in each stud.

### **3.04 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 90 00.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

### **3.05 ERECTION TOLERANCES**

- A. Maximum Variation from True Position: 1/8 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

**END OF SECTION**

## SECTION 06 41 00

### CUSTOM WOOD CABINETS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Shop fabricated custom built cabinet units.
- B. Manufactured Stone: Solid Surface Counter Tops
- B. Cabinet hardware.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking for attachment of cabinets.
- B. Section 06 20 00 - Finish Carpentry: Standing and running trim.
- C. Section 09 90 00 - Paints and Coatings: Shop finishing of cabinet exterior and interior.

##### 1.03 REFERENCES

- A. AHA A135.4 - Basic Hardboard; American Hardboard Association; 1995.
- B. ANSI A208.1 - American National Standard for Particleboard; 1999.
- C. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2003, Eighth Edition, Version 1.0.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.9).
- E. GSA CID A-A-1936 - Adhesive, Contact, Neoprene Rubber; Federal Specifications and Standards; 1996.
- F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2000 (ANSI/HPVA HP-1).
- G. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2000.
- H. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; National Hardwood Lumber Association; 2003.
- I. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.
- J. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 1999.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions and Section 01 60 00 – Product Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Provide product data for finish hardware.

- D. Provide sample of each different cabinet style, showing quality of construction, pulls, cabinet hinges and finishes for approval before start of work.

### **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

### **1.06 DELIVERY, STORAGE, AND PROTECTION**

- A. Protect units from moisture damage.

### **1.07 ENVIRONMENTAL REQUIREMENTS**

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

## **PART 2 PRODUCTS**

### **2.01 WOOD MATERIALS**

- A. Exposed solid wood for Transparent Finish: Premium Grade Quartersawn White Oak.
- B. Exposed solid wood for Opaque Finish: Premium Grade Poplar
- C. Solid wood for Semi-exposed members: Same as exposed members.
- D. Solid wood for concealed Members: Douglas Fir or Southern Pine.

### **2.02 PANEL MATERIALS**

- A. Exposed Plywood at Exterior of Millwork for Transparent Finish: Premium grade, Quartersawn White Oak veneer.
- B. Exposed Plywood at Interior of Millwork and Shelving for Transparent Finish: Premium grade, Maple veneer.
- C. Exposed Plywood for Opaque Finish; Birch Veneer.
- D. Exposed Wood at Back of House for Opaque Finish: Premium Grade MDF.
- E. Concealed Plywood: Douglas Fir or Southern Pine.

### **2.03 MANUFACTURED STONE (QUARTZ) COUNTER TOPS AND SPLASHES**

- A. Q1: Manufacturer: Wilsonart, Ostler Pink Q4079.
  - 1. Thickness: Counter 3cm (1 ¼"), Backsplash 2 cm (3/4")
  - 2. Finish: Polished
  - 3. Edge Treatment: Square edge with eased corner (Refer to Drawings)
  - 4. Composition: up to 93 percent quartz aggregate combined with polyester resin binders and proprietary pigments that are fabricated into slabs using Bretonstone vacuum vibrocompaction technology.
  - 5. Flexural strength: Greater than 4500 psi, ASTM D790
  - 6. Flexural Strain: Less than 0.375 percent, ASTM D790
  - 7. Flexural Modulus: Greater than 3.75 MPsi, ASTM D790
  - 8. Stain resistance (24 hour) no effect to moderate effect , NEMA LD-3
  - 9. Abrasion Resistance: Greater than 100 in. lbs, ASTM C501
  - 10. Density: Greater than 2.1 g/cm per ASTM C97



11. Compressive Strength: Greater than 20,000 psi, ASTM C170
12. Moisture Absorption: Less than 0.03 percent per ASTM C97
13. Surface Burning Characteristics: Class I and Class A, ASTM E84

B. Accessory Products

1. Adhesive for Bonding Quartz Composition Surfacing: Two-component premium grade adhesive, color to match quartz surfacing
2. Adhesive for Bonding Quartz to other materials: one component silicon, to ASTM C920
3. Joint Sealant: Manufacturers standard mildew-resistant, FDA/UL recognized silicone sealant in color matching or clear formulations

C. Fabrication:

1. For warranty coverage: Fabricator/Installer shall be approved by quartz composition manufacturer
2. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and composition quartz manufacturer requirements.
3. Form joints between components using manufacturers' standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Provide blocking at all cutouts and directly under seams as recommended by manufacturer.
4. Provide holes and cut outs for plumbing accessories as indicated on the drawings.
5. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
6. Finish: All surfaces shall have a high polished uniform finish, with a gloss rating of 70-80.

**2.04 HARDWARE**

A. Cabinet Doors:

- |               |  |
|---------------|--|
| 1 pr. hinges: | Blum "Clip", Half and full overlay, 110° opening     |
| 1 pull:       | Mockett DP128/6, Finish to be Selected by Architect. |

**2.05 FINISHING**

- A. Finishing: Site finished as specified in Section 09 90 00.

**2.06 FABRICATION**

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

### **3.02 INSTALLATION**

- A. Install work in accordance with AWI Custom Quality Standard.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- D. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finishes where transparent finish is specified.
- E. Cabinets: Install without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and provide unencumbered operation. Complete the installation of hardware and accessory items. Maintain veneer sequence matching of cabinets.
- F. Countertops: Anchor securely to base units and other support systems.

### **3.03 ADJUSTING**

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

### **3.04 CLEANING**

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

**END OF SECTION**

## SECTION 06 65 00

### PLASTIC SIMULATED WOOD TRIM

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Free-Foam Cellular PVC Trim Boards for:
  - 1. Exterior Fascia

##### 1.02 RELATED SECTIONS

- A. Section 06 10 53 – Wood Blocking and Sheathing
- B. Section 09 90 00 – Painting and Coatings

##### 1.03 REFERENCES

- A. ASTM D 792 – Density and Specific Gravity of Plastics by Displacement.
- B. ASTM D 570 – Water Absorption of Plastics.
- C. ASTM D 638 – Tensile Properties of Plastics.
- D. ASTM D 790 – Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- E. ASTM D 1761 – Mechanical Fasteners in Wood.
- F. ASTM D 5420 – Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by means of a Striker Impacted by a Falling Weight.
- G. ASTM D 256 – Determining the Pendulum Impact Resistance of Plastics.
- H. ASTM D 696 – Coefficient of Linear Thermal Expansion of Plastics Between minus 30 degrees C and plus 30 degrees C with a Vitreous Silica Dilatometer.
- I. ASTM D 635 – Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- J. ASTM E 84 – Surface Burning Characteristics of Building Materials.
- K. ASTM D 648 – Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- L. ASTM D 3679 – Standard Specification for Rigid Poly Vinyl Chloride (PVC) Siding.
- M. ASTM D 2240 – Rubber Property – Durometer Hardness.
- N. ASTM D 3345 – Standard Test Method for Laboratory Evaluation of Wood and Other Cellulosic Materials for Resistance to Termites.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittals and Substitutions.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Verification Samples: For each product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with a minimum 5 years producing PVC trim products.
- B. Installer Qualifications: Installer with a minimum of 3 years experience with the installation of PVC trim products.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.
  - 4. Accepted mock-ups shall be comparison standard for remaining work.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners.
- B. Store materials under a protective covering to prevent jobsite dirt and residue from collecting on the boards.

### 1.07 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

### 1.08 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

### 1.09 WARRANTY

- A. Provide manufacturer's transferable limited lifetime warranty against defects in manufacturing that causes the products to rot, corrode, delaminate, or excessively swell from moisture.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturer: **Versatex**, which is located at: 400 Steel St.; Aliquippa, PA 15001;  
Tel: 724-857-1111; Fax 724-857-1171; Email: [request info \(sales@versatex.com\)](mailto:request info (sales@versatex.com)); Web: [www.versatex.com](http://www.versatex.com)
- B. Product available through Lumber 1, Mayflower AR.
- C. Substitutions: No permitted.

### 2.02 MATERIALS

- A. PVC: Free Foam Cellular PVC material with a small-cell microstructure and density of .55 grams/cm<sup>3</sup>.
  - 1. Performance and physical characteristic requirements:
    - a. Physical:

- 1) Density: 0.55 g/cm<sup>3</sup> when tested in accordance with ASTM D 792.
- 2) Water Absorption: Less than 0.50 percent when tested in accordance with ASTM D 570.

b. Mechanical:

- 1) Tensile Strength: 3582 psi when tested in accordance with ASTM D 638.
- 2) Tensile Modulus: 107,000 psi when tested in accordance with ASTM D 638.
- 3) Flexural Strength: 5179 psi when tested in accordance with ASTM D 790.
- 4) Flexural Modulus: 215,600 psi when tested in accordance with ASTM D 790.
- 5) Modulus of Elasticity: 209,500 psi when tested in accordance with ASTM D 638.
- 6) Elongation: 9.0 percent when tested in accordance with ASTM D 638.
- 7) Nail Hold: 398 lbf/in of penetration when tested in accordance with ASTM D 1761.
- 8) Compressive Strength: 6,553 psi (thickness dependent).
- 9) Compressive Modulus: 2,305 lbf/in (thickness dependent).
- 10) Screw Hold: 240 lbf/in of penetration when tested in accordance with ASTM D 1761.
- 11) Staple Hold: 69 lbf/in of penetration when tested in accordance with ASTM D 1761.
- 12) Gardner Impact: 34 In-lbs when tested in accordance with ASTM D 5420.
- 13) Notched Izod Impact: 0.270 Ft-lbs/inch when tested in accordance with ASTM D 256.
- 14) Termite Resistance: Rating of 10 as tested in accordance with ASTM D 3345.
- 15) Hardness: 60+ when tested in accordance with ASTM D 2240.
- 16) Parking Garage Ceiling Soffit System: 225 psf when tested in accordance with UL 580.

c. Thermal:

- 1) Coefficient of Linear Expansion:  $3.25 \times 10^{-5}$  in/in/degrees F when tested in accordance with ASTM D 696.
- 2) Burning Rate: Failed to Ignite when tested in accordance with ASTM D 635.
- 3) Flame Spread Index: 20 when tested in accordance with ASTM E 84.
- 4) Heat Deflection Temp (264 psi): 146 degrees F when tested in accordance with ASTM D 648.
- 5) Heat Deflection Temp (66 psi): 153 degrees F when tested in accordance with ASTM D 648.
- 6) Oil Canning (@ 140 degrees F: Passed when tested in accordance with ASTM D 648.

2. Manufacturing Tolerances:

- a. Variation in component length: Minus 0.00 / plus 1.00.

- b. Variation in component width: plus or minus 1/32 inch.
  - c. Variation in component thickness: plus or minus 1/32 inch.
  - d. Variation in component edge cut: plus or minus 2 degrees.
  - e. Variation in Density plus or minus 0.02 grams per cubic centimeter.
3. Workmanship, Finish, and Appearance:
- a. Free Foam Cellular PVC that is homogeneous and free of voids, holes, cracks, foreign inclusions and other defects. Edges must be square and top and bottom surfaces shall be flat with no convex or concave deviation.
  - b. Uniform surface free from cupping, warping, and twisting.

### **2.03 SIMULATED WOOD TRIM**

- A. PVC Trimboard: Versatex Trimboard with Sealed Edge.
- 1. Size: As indicated on Drawings
  - 2. Finish: Smooth/Smooth finish

### **2.04 ACCESSORIES**

- A. Fasteners:
- 1. Use 12 gauge stainless steel fasteners designed for wood trim and siding. Fastener should have sufficient flexural and tensile strength to resist bending.
  - 2. Use fasteners with thin shanks, blunt points, and full round heads that are long enough to penetrate the substrate a minimum of 1-1/4 inches.
  - 3. Do not use staples, small brads and wire nails. Avoid using fine threaded wood screws and ring-shank fasteners.
  - 4. Use standard nail guns with a pressure setting between 70 psi and 100 psi. The recommended pressure depends on the type of gun, type of nail, ambient temperature, and the substrate. Care should be taken not to overdrive the nail into the material.
  - 5. Pre-drilling is not typically required unless large fasteners are used or the product is installed during temperatures below 40 degrees F.
  - 6. Use two fasteners for every framing member for trimboard applications. Sheet and trimboards 8 inches and wider require additional fasteners.
  - 7. Install fasteners no more than 2 inches from the end of each board.
  - 8. Avoid fastening simulated wood trim over hollow or uneven areas. Fasten onto flat, solid substrates.
  - 9. 3/8 inch and 1/2 inch thick Sheet and Beadboard is not designed to be ripped and used for trim applications. These products must be glued and mechanically fastened to the substrate.
- B. Adhesives: Finishing Systems.
- 1. All bonded surfaces must be smooth, clean, and in complete contact with each other for best results.
  - 2. Adhere simulated wood trim to itself with PVC cement or cellular PVC adhesives to prevent joint separation. Acceptable adhesives are PVC Trim Welder, IPS Weld-On 705 (white), and Zevo PVC Trim adhesive.
  - 3. PVC cements cure quickly (3-5 minutes or less), and have a limited work time.
  - 4. Scarf cut joints are recommended where applicable.

5. Bonded joints should be secured with fasteners and fastened with two rows on each side of the joint.
  6. When bonding simulated wood trim to other substrates, consult the adhesive manufacturer to determine suitability.
- C. Nail Hole Filler: Cortex plug system by Fasten Master.
- D. Sealants:
1. Use urethane, polyurethane, polymer blends or acrylic based sealants that do not contain silicone as specified in Section 07 90 00 – Joint Sealers.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify the Architect of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best results for the substrate under the project conditions.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Cutting:
  1. Simulated wood trim can be cut using standard woodworking saws. Conventional carbide-tipped blades designed for cutting wood are preferred. Avoid using fine-tooth metal-cutting blades.
  2. Rough-cut edges are typically caused by excessive friction, poor board support, or worn or improper tooling.
- C. Drilling:
  1. Simulated wood trim can be drilled using standard woodworking drill bits. Do not use drill bits made for rigid PVC.
  2. Avoid frictional heat build-up.
  3. Remove shavings periodically from a drill hole as necessary.
- D. Milling and Moulding:
  1. Simulated wood trim can be milled or moulded using standard milling or moulding machines found in millwork shops.
  2. Rake angle 20 to 30 degrees. 25 degrees is recommended.
  3. Cutting speed to be optimized with the number of knives and feed rate.
- E. Routing:
  1. Simulated wood trim can be routed with virtually any piece of equipment used to rout wood.
  2. Carbide tipped router bits are recommended.
  3. Machinery that allows for multiple cutting speeds will allow you to optimize the process

obtaining a smoother finished part.

F. Edge Finishing:

1. Traditional sanding, grinding or filing tools used for woodworking are preferred.

G. Nail Location:

1. For trimboard applications use two fasteners per framing member.
2. Use additional fasteners (3/4 inch preferred) for trimboard 8 inches and wider.
3. Install fasteners a maximum of 2 inches from the end of each board.

H. Expansion and Construction:

1. Simulated wood trim expands and contracts with changes in temperature. Properly fastening along the entire length is required to minimize expansion and contraction.
2. Allow 3/16 inch space per 18-foot run of trim for expansion and contraction.
3. Bond joints between pieces of simulated wood trim to eliminate separation.
4. Allow expansion and contraction space at the ends of long runs.

I. Cleaning:

1. Clean simulated wood trim with mild detergent and water.
2. Products with pumice, such as Soft Scrub, may be applied with a nylon brush.
3. For more stubborn stains use a mild household cleaner and degreaser like Clorox Cleanup, Clorox Outdoors, Denatured Alcohol, Bleach, Mr. Clean Magic Eraser or Corte Clean with nylon brush.

J. Painting:

1. Be sure surface to be painted is clean, dry, and free of dirt, loose or peeling paint, mildew, chalk, grease, and any other surface contaminants before paint application.
2. Finish nail holes with nail hole filler or a UV resistant acrylic caulk.
3. Paint as specified in Section 09 90 00 – Paints and Coatings.
  - a. Use 100 percent acrylic latex or 100 percent acrylic latex with urethane additive paint with a light reflective value (LRV) equal to or greater than 55 units.
  - b. Follow the paint manufacturer's application recommendations.

**3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion

**END OF SECTION**



## SECTION 07 21 16

### BOARD AND BATT INSULATION

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Thermal batt insulation in exterior wall construction.
- B. Sound batt insulation in interior wall construction.
- C. Rigid board insulation for exterior walls.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Wood Framing, Blocking, Sheathing and Curbing: Supporting construction for batt insulation in roof.
- B. Section 06 12 50 - Tongue and Groove Wood Decking: Wood ceiling installed over batt insulation at roof.
- C. Section 07 84 00 - Firestopping insulation: Firestopping in exterior walls at second floor slab.
- E. Section 09 22 16 - Non Load Bearing Metal Stud Framing System: Supporting construction for batt insulation in walls.
- F. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wall board and sheathing installed over batt insulation.

##### 1.03 REFERENCES

- A. ASTM C 552 - Standard Specification for Cellular Glass Thermal Insulation; 2000.
- B. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2002.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
- D. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials; 2000.
- E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2000.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

##### 1.05 COORDINATION

- A. Coordinate Work under this Section with work of , Section 07 62 00 Standing Seam Metal Roofing, Flashing, Cladding, and Trim, 08 41 00 - Metal Framed Storefronts, 09 22 16 - Non Load Bearing Metal Framing, and 09 21 16 - Gypsum Board Systems.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Insulation:
  - 1. Owens Corning.
  - 2. Manville.
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 BATT INSULATION MATERIALS**

- A. Thermal Batt Insulation for installation in metal stud wall construction: ASTM C 665; preformed glass fiber batt; conforming to the following:
  - 1. Thermal Resistance: R of 19.
  - 2. Thickness: 6 inch.
  - 3. Batt Size: 16 inch wide batts.
  - 4. Facing: Unfaced.
  - 5. Surface Burning Characteristics for concealed installation: When batt insulation is installed fully concealed, it shall have a flame spread/smoke developed index of 75/450, when tested in accordance with ASTM E 84.
  - 6. Surface Burning Characteristics for exposed installation: When batt insulation is installed exposed, it shall have a flame spread/smoke developed index of 25/450, when tested in accordance with ASTM E 84.
- B. Sound Batt Insulation: ASTM C 665; preformed glass fiber batt; conforming to the following:
  - 1. Thickness: 3.5 inch.
  - 2. Thermal Resistance: R of 13
  - 3. Facing: Unfaced.
  - 4. Surface Burning Characteristics for concealed installation: When batt insulation is installed fully concealed, it shall have a flame spread/smoke developed index of 75/450, when tested in accordance with ASTM E 84.

### **2.02 RIGID INSULATION BOARD MATERIALS**

- A. Rigid Insulation Board: Extruded polystyrene board insulation equal to Owens Corning Foamular 75, conforming to the following:
  - 1. Thickness: 3/4 inch.
  - 2. Thermal resistance: R-4.0.
  - 3. Compressive strength: 15 PSI.
  - 4. Edge Condition: Square.
  - 5. Board Size: 16" X 8'-0".

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

### **3.02 BATT INSTALLATION**

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

### **3.03 RIGID BOARD INSTALLATION**

- A. Coordinate installation of rigid board insulation with installation of masonry veneer anchors.
- B. Install insulation in accordance with manufacturer's instructions.
  - 1. Use cap-head screws (2 screws per stud).
- C. Install over exterior wall sheathing continuous without gaps or voids.
- D. Tape joints between insulation boards.

### **3.04 PROTECTION OF FINISHED WORK**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

## SECTION 07 25 10

### FLUID APPLIED VAPOR BARRIER EPOXY

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Application of an epoxy based liquid applied vapor barrier to concrete below owner supplied and installed solid wood flooring.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 – Wood Blocking and Sheathing

##### 1.03 REFERENCES

- A. ASTM C695 - Standard Test Methods for Compression Strength
- B. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- C. ASTM D570 - Standard Test Method for water absorption.
- D. ASTM D2794 - Standard Test Method for resistance of organic coatings to the effects of rapid deformation (impact)
- E. ASTM D4541 - Standard Test Method for the Pull-Off Strength of a coating system.
- F. ASTM D638 - Standard Test Method for the Tensile Strength of Plastics.
- G. ASTM D522 - Standard Test Method for the resistance to cracking of attached organic coatings.

##### 1.04 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittals
- B. Submit manufacturer's product data and application instructions.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the vapor barrier.
  - 2. Vapor Barrier Installer performing Work shall be approved by vapor barrier membrane manufacturer.
- B. Obtain vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.

##### 1.06 MOCK-UPS

- A. Prior to installation of vapor barrier, apply vapor barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution.
- B. Apply vapor barrier mock-up, 6-feet long x full width of the recessed floor area that is to receive wood blocking, decking and finished wood flooring.

##### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean dry area in accordance with manufacturer's instructions.
- C. Store at temperatures at or above 40°F (4°C), free from contact with cold or frozen surfaces.
- D. Protect materials during handling and application to prevent damage or contamination.

## 1.08 ENVIRONMENTAL REQUIREMENTS

- A. Product not intended for uses subject to abuse or permanent exposure to the elements.
- B. Do not apply membrane when air or surface temperatures are below 60°F or above 90°F or relative humidity is above 70%.

## PART 2 PRODUCTS

### 2.01 MANUFACTURER

- A. Provide air barrier products manufactured by **Resinwerks, LLC, Floor Coating Systems**, 7205 Gilpin Way Suite 200, Denver, CO 80229, 720-484-5160, [www.resinwerks.com](http://www.resinwerks.com)
- B. Approved Equal

### 2.02 MATERIALS

- A. Fluid-Applied, Vapor Barrier Epoxy: BPA Free Moisture Mitigation Primer/Base Coat formulated for application in a range of 12 - 20 mils (dry) per layer, two layers (24-40 mils) minimum.
  - 1. Basis of Design Product: **Resinwerks Vapor Barrier Epoxy**
  - 2. Compressive Strength, ASTM C695: 11,000 PSI
  - 3. Vapor Permeance, ASTM E 96/E96M: **0.059 PERMS (grains h-1 ft-2 in Hg-1)**
  - 4. Water Absorption, ASTM D570: Less Than 0.1%:
  - 5. Impact RESistance, ASTM D2794; Greater Than 160.
  - 6. Adhesion/Pull Off, ASTM D638: 2500 PSI
  - 7. Elongation/Tensile Strength, ASTM D638: 2500 PSI
  - 8. Flexibility, ASTM D522: Pass

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Surface Condition: Before applying vapor barrier materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.
  - 1. Verify concrete surfaces are visibly dry, have cured for time period recommended by vapor barrier manufacturer, and are free from release agents, curing agents, and other contaminants.
  - 2. Test for capillary moisture by method recommended in writing by vapor barrier manufacturer..
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INTERFACE WITH OTHER WORK

- A. Commencement of Work: Commence work once vapor barrier substrates are adequately protected from weather and will remain protected during remainder of construction.
- B. Subsequent Work: Coordinate vapor barrier work with work of other sections installed subsequent to vapor barrier installation.

### 3.3 PREPARATION

- A. Clean, prepare, and treat substrate in accordance with vapor barrier manufacturer's written instructions.

### 3.4 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply vapor barrier per manufacturer's most recently published instruction.

- B. Vapor Barrier: Immediately following mixing, pour vapor barrier onto substrate in a uniform ribbon and spread evenly with a notched squeegee. Immediately backroll with 3/8" nap non-sheeding roller to help insure full coverage and uniform thickness.
- C. Use a brush or small roller to cut in along the perimeter walls or any other obstructions.
- D. Dependent on ambient environmental and slab temperatures, material will be dry to the touch and ready for subsequent applications within 4-6 hours.
- E. Contact the manufacturer for additional application specifics and recommendations.
- F. Do not cover vapor barrier until it has been tested and inspected by Owner's testing agency.

### **3.5 PROTECTION**

- A. Cover vapor barrier membrane as soon as possible, since it is not designed for permanent exposure.

**END OF SECTION**

## SECTION 07 26 20

### FLUID APPLIED AIR AND WATER BARRIER

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Application of liquid applied vapor permeable air and water barrier to Sheathing behind Stucco, Wood Siding and Stone Veneer to protect sheathing from water penetration.
- C. Application of materials to provide bridge and seal air leakage pathways in
  - 1. Wall and roof connections and penetrations.
  - 2. Connections to foundation walls.
  - 3. Walls, windows, curtain walls, storefronts, louvers or doors
  - 4. Expansion and control joints.
  - 5. Masonry ties.
  - 6. All other penetrations through the wall assembly.

##### 1.02 RELATED SECTIONS

- A. Section 04 45 10 – Stone Veneer
- B. Section 06 10 00 – Wood Blocking and Sheathing
- C. Section 06 20 00 – Finish Carpentry: Wood Siding
- D. Section 07 21 16 – Board and Batt Insulation.
- E. Section 08 41 00 – Aluminum Entrance Storefront, Curtain Wall and Storefronts.

##### 1.03 REFERENCES

- A. ASTM D412-98a(2002)e1 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- B. ASTM E96-00e1 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.
- C. ASTM E283-91 (1999) - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- D. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
- E. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.
- F. ASTM E2178-01 - Standard Test Method for Air Permeance of Building Materials.
- G. ASTM E2357 - 05 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

##### 1.04 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittals
- B. Submit manufacturer's product data and application instructions.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the air barrier.

2. Air Barrier Installer performing Work shall be approved by air barrier membrane manufacturer.
- B. Obtain air/vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.
- C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

#### 1.06 MOCK-UPS

- A. Prior to installation of air barrier, apply air barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution.
- B. Apply air barrier in field-constructed mock-ups of assemblies specified in Section 04 45 10 – Stone Veneer
- C. Construct typical exterior wall panel, 8 feet long by 8 feet wide, incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing; illustrating materials interface and seals.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean dry area in accordance with manufacturer's instructions.
- C. Store at temperatures at or above 40°F (4°C), free from contact with cold or frozen surfaces.
- D. Protect materials during handling and application to prevent damage or contamination.

#### 1.08 ENVIRONMENTAL REQUIREMENTS

- A. Product not intended for uses subject to abuse or permanent exposure to the elements.
- B. Do not proceed with product application if rainfall is forecast or imminent within 12 hours.
- C. Do not apply membrane when air or surface temperatures are below 40°F (4°C).
- D. Do not apply when air, material and surface temperatures are expected to fall below 32° F (0° C) within 24 hours of completed application.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURER

- A. Provide air barrier products manufactured by **Tremco, Inc., Commercial Sealants and Waterproofing Division, An RPM Company**, Beachwood OH; (866) 321-6357; email: [techresources@tremcoinc.com](mailto:techresources@tremcoinc.com); [www.tremcosealants.com](http://www.tremcosealants.com),
- B. Approved Equal

#### 2.02 MATERIALS

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, UV-resistant, synthetic membrane, formulated for application in a range of 48 - 70 mils (wet), 25 - 35 mils (dry)
  1. Basis of Design Product: **Tremco, Inc., ExoAir 230.**
  2. Air Permeance, ASTM E 2178: 0.004 cfm/sq. ft of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference, maximum.
  3. Vapor Permeance, ASTM E 96/E96M: Minimum 12 perms (690 ng/Pa x s x sq. m).
  4. Elongation, Ultimate, ASTM D 412, Die C: 600 percent, minimum.
  5. Combustion Characteristics: Class A, flame spread, not greater than 25; smoke developed, not greater than 450, per ASTM E 84.
  6. UV Resistance, QUV-B: Over 160 cycles of UV and water spray with no observable deterioration.
  7. VOC Content: Less than 50 g/L.



B. Approved Equal.

## 2.03 ACCESSORIES

- A. General: Accessory materials as described in manufacturer's written installation instructions, recommended to produce complete air barrier assembly meeting performance requirements, and compatible with air barrier membrane material and adjacent materials.
- B. Primer: Liquid primer meeting VOC limitations, recommended for substrate by membrane air barrier manufacturer, when installing modified bituminous self-adhered membranes.
1. Basis of Design Product: **Tremco, Inc., ExoAir Primer**
- C. Transitions:
1. Counterflashing Strip: Modified bituminous, **40 mils (1.0 mm)** thick self-adhering composite sheet consisting of **32 mils (0.8 mm)** of SBS rubberized asphalt laminated to an **8 mils (0.2 mm)** high-density, cross-laminated polyethylene film, for counterflashing of metal flashings and for substrate transitions and for termination of air barrier to bituminous roof membranes and to air barrier terminations at openings.
    - a. Basis of Design Product: Tremco, Inc., ExoAir TWF Thru-Wall Flashing.
  2. High Temperature Flashing Strip and Underlayment: Butyl, **24 mil** thick self-adhering composite sheet consisting of **20 mils** of butyl laminated to **4 mil** polyethylene film; thermally stable under intermittent, non-continuous exposure up to **240 deg F (115 deg C)**.
    - a. Basis of Design Product: **Tremco, Inc., ExoAir 110AT**.
  3. Flashing Strip: Butyl, **22 mil** thick self-adhering composite sheet consisting of **16 mils** of butyl laminated to **6 mil** polypropylene film; thermally stable under intermittent, non-continuous exposure up to **240 deg F (115 deg C)**
  4. Opening Transition Assembly: Cured low-modulus silicone extrusion, with reinforcing ribs, sized to fit opening widths, [with aluminum race for insertion into aluminum framing extrusions,] with the following characteristics:
    - a. Basis of Design Product: Tremco, Inc., Proglaze ETA Engineered Transition Assembly. Tear Strength: 110 lb/in (19.3 kN/m)
  5. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with manufacturer's recommended silicone sealant for bonding extrusions to substrates.
    - a. Basis of Design Product: Tremco, Inc.; Spectrem SimpleSeal.
- D. Reinforcing Fabric: High strength mesh fabric consisting of open-weave glass fiber saturated with synthetic resins formulated for high moisture resistance, for reinforcing of liquid applications; not less than **2.5 oz/sq. yd (85 g/sq. m)**.
1. Basis of Design Product: **Tremco, Inc., Tremco 2011**.
- E. Liquid Joint Sealants:
1. ASTM C 920, single-component polyurethane, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.
    - a. Basis of Design Product: **Tremco, Inc., Dymonic 100**.
  2. ASTM C 920, single-component, neutral-curing silicone, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories post installation of the membrane.
    - a. Basis of Design Product: **Tremco, Inc., Spectrem 1**.
- F. Sprayed Polyurethane Foam Sealant: Sprayed Polyurethane Foam Sealant: Foamed-in-place, **1.5- to 2.0-lb/cu. ft. (24- to 32-kg/cu. m)** density, with flame-spread index of 25 or less per ASTM E 162, for filling of gaps at openings and penetrations.
1. Basis of Design; Tremco Inc., Flexible Low Expanding Foam (LEF)

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Surface Condition: Before applying air barrier materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.
  - 1. Verify concrete and masonry surfaces are visibly dry, have cured for time period recommended by membrane air barrier manufacturer, and are free from release agents, curing agents, and other contaminates.
  - 2. Test for capillary moisture by method recommended in writing by air barrier manufacturer..
  - 3. Verify masonry joints are filled with mortar and struck flush.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INTERFACE WITH OTHER WORK**

- A. Commencement of Work: Commence work once air barrier substrates are adequately protected from weather and will remain protected during remainder of construction.
- B. Sequencing of Work: Coordinate sequencing of air barrier work with work of other sections that form portions of building envelope air barrier to ensure that flashings and transition materials can be properly installed and inspected. Roofing systems shall be capped and sealed, or top of walls protected, in such a way as to eliminate the ability of water to saturate the wall or interior space, both before and after, air barrier system installation. Coordinate installation of EXOAIR® 230 with the roofing trade to ensure compatibility and continuity with the roofing system.
- C. Subsequent Work: Coordinate air barrier work with work of other sections installed subsequent to air barrier to ensure complete inspection of installed air barrier and sealing of air barrier penetrations necessitated by subsequent work.

### **3.3 PREPARATION**

- A. Clean, prepare, and treat substrate in accordance with air barrier manufacturer's written instructions.
  - 1. Mask adjacent finished surfaces.
  - 2. Remove contaminants and film-forming coatings from substrates.
  - 3. Remove projections and excess materials and fill voids with substrate patching material.
  - 4. Prepare and treat joints and cracks in substrate per ASTM C 1193 and membrane air barrier manufacturer's written instructions.

### **3.4 APPLICATION OF ACCESSORY MATERIALS**

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions. Install transition materials and other accessories to form connect and seal membrane air barrier material to adjacent components of building air barrier system, including, but not limited to, roofing system air barrier, exterior fenestration systems, door framing, and other openings.
- B. Primer: Apply primer to substrates when recommended by air barrier manufacturer at required rate for those substrates that will be receiving a modified bituminous self-adhered membrane. Reprime areas not covered within 24 hours.
- C. Assembly Transitions: Connect and seal exterior wall air barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
  - 1. Opening Transitions: Fill gaps at perimeter of openings with foam sealant and apply approved transition or accessory material

2. Penetrations: Fill gaps at perimeter of penetrations with foam sealant and level with approved sealant. or seal transition strips around penetrating objects and terminate with approved sealant.
  3. Joints: Bridge and cover isolation joints, expansion joints, and discontinuous joints between separate assemblies utilizing approved transition or accessory materials.
  4. Changes in Plane: Apply approved sealant beads at corners and edges to form smooth transition.
  5. Substrate Gaps: Cover gaps with stainless steel sheet mechanically attached to substrate and providing continuous support for air barrier.
- D. Flashings: Seal top of through-wall flashings to membrane air barrier with a continuous bead of approved sealant recommended by air barrier manufacturer.
  - E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following air barrier manufacturer's recommendations and extend repair beyond repaired areas to maintain continuity.

### **3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION**

- A. General: Apply fluid air-barrier material to form a seal with transition materials and accessories to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
- B. Membrane Air Barrier: Apply fluid air barrier material in full contact with substrate to produce a continuous seal according to membrane air barrier manufacturers written instructions.
  1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, **-in a range of 25 – 35 mils (1.0-mm)** dry film thickness depending on substrate, applied in one or more equal coats, roller- or spray-applied.
- C. Connect and seal exterior wall air-barrier membrane continuously to subsequently-installed roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, wall openings, and other construction used in exterior wall openings, using approved transitions and accessory materials.
- D. Wall Openings: Apply approved sealant to adhere silicone extrusion to perimeter of windows, curtain walls, storefronts, doors, and louvers. Apply [opening transition assembly] [preformed silicone sealant extrusion] according to air barrier transition manufacturer's written instructions.
- E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following air barrier manufacturer's recommendations and extend repair beyond repaired areas to maintain continuity.
- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### **3.6 PROTECTION**

- A. Cover air barrier membrane as soon as possible, since it is not designed for permanent exposure.

**END OF SECTION**

## SECTION 07 42 43

### ALUMINUM-COMPOSITE WALL PANELS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Composite metal panels employed as a wall cladding system.

##### 1.02 RELATED SECTIONS

- A. Section 07 90 00 - Joint Sealers: Material and execution requirements for sealer to be installed by panel installer.
- B. Section 08 41 13 – Aluminum Entrances, Curtain Wall and Storefronts.

##### 1.03 DEFINITIONS

- A. Panel Material Manufacturer: The entity who makes the aluminum composite sheets and applies the finish.
- B. Panel System Manufacturer: The entity who fabricates the sheets into shapes and assembles them with supports, anchors, etc., to form a wall system.

##### 1.04 REFERENCES

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 1998.
- B. AAMA 508-05 - Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
- C. ASTM C 297 - Standard Test Method for Tensile Strength on Flat Sandwich Constructions in Flatwise Plane; 1994 (Reapproved 1999).
- D. ASTM D 1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998.
- E. ASTM D 1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 1996 (Reapproved 2001).
- F. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2004.
- G. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000a.
- H. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen; 1991 (Reapproved 1999).
- I. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.
- J. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors By Uniform Static Air Pressure Difference; 2000.
- K. CAN/ULC-S134M - Fire Test of Exterior Wall Assemblies; 1992 (R1998).
- L. UBC Std 26-1 - Test Method to Determine Potential Heat of Building Materials; 1997.
- M. UBC Std 26-3 - Room Fire Test Standard for Interior of Foam Plastic Systems; 1997.
- N. UBC Std 26-9 - Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-Bearing Wall Assemblies Containing Combustible Components Using the

Intermediate-Scale, Multistory Test Apparatus; 1997.

### **1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittals: Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's product data sheet for each specified product.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures; include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets and location and configuration of joints necessary to accommodate thermal movement.
- D. Selection Samples: Panel material manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for factory applied finishes.
- E. Verification Samples: Two 6-inch by 6-inch samples of panel material in thickness specified; include separate sets of draw down samples on aluminum substrate, not less than 6-inches by 6-inches, of each color and finish selected, for color approval.
- F. Panel System Samples: Not less than 12 inches by 12 inches, showing 4-way joint, including clips, anchors, supports, fasteners, closures and other panel accessories.
- G. Test Reports: Certified test reports showing compliance of panel system with specified performance characteristics and physical properties.
- H. Certificate: Panel material manufacturer's certificate certifying that materials comply with specified performance characteristics and physical requirements.
- I. Certificate: Panel material manufacturer's certificate certifying that coil-coated finish has been or will be applied and warranted by panel material manufacturer.
- J. Panel material and panel system manufacturers' installation instructions.
- K. Installer's qualification statement.
- L. Warranty documents specified herein.
- M. Substitutions for products specified under this section must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least three calendar days before the bid date.

### **1.06 QUALITY ASSURANCE**

- A. Panel Material Manufacturer Qualifications: Company with a minimum of 10 years of continuous experience manufacturing panel material of the type specified.
  - 1. Able to provide specified warranty on finish, without delegation to a third party.
  - 2. Able to provide list of 5 other projects of similar size, including approximate date of installation and name of Owner for each.
- B. Panel System Manufacturer Qualifications: Company with at least 10 years of experience fabricating similar sized metal panel projects and qualified by panel material manufacturer; capable of providing field service representation during construction.
- C. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.
- D. Mock-Up: Contractor shall arrange and pay for installation at project site of a mock-up using acceptable products and approved installation methods. Obtain Owner's and Architect 's acceptance of finish color, texture and pattern and workmanship standard.
  - 1. Mock-Up Size and Location: 8 feet long by 9 feet wide, which includes panel system,

- attachments to building, flashing, and weep drainage system, sealants and seals, and connection to new window wall system.
  - 2. Maintain mock-up during construction for workmanship comparison.
  - 3. Mock-up may be a part of the work. Verify location with Architect. Install Mock-up 30 days before scheduled installation of panels.
- E. Preinstallation Meeting: Conduct a preinstallation meeting to verify project requirements, substrate conditions, installation instructions and warranty requirements.

### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Deliver panel system components in manufacturer's original, unopened, undamaged containers with identification labels intact.
1. Protect finish of panels by applying heavy duty removable plastic film during production.
  2. Package panels for protection against transportation damage.
  3. Provide markings to identify components consistently with drawings.
  4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
- B. Store panel system components protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
1. Store panels in well ventilated space out of direct sunlight.
  2. Protect panels from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
  3. Slope panels to ensure positive drainage of any accumulated water.
  4. Do not store panels in any enclosed space where ambient temperature can exceed 120 degrees F.
  5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

### **1.08 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

### **1.09 WARRANTY**

- A. See Section 01 70 00 – Contract Closeout, for additional warranty requirements.
- B. Panel and Finish Warranty: Submit panel material manufacturer's standard warranty document executed by authorized company official, covering both panel construction and finish in same warranty.
1. Warranty Period: 20 years commencing on Date of Substantial Completion.
  2. Manufacturer's warranty is in addition to and not a limitation of, other rights Owner may have under the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Panel System Manufacturer: manufacturer approved by panel manufacturer.
- B. Panel Material Manufacturer: ALCOA Architectural Products, 50 Industrial Blvd., Eastman, GA 31023, (800-841-7774 or 478-374-4746)
- C. Substitutions: Substitutions for products specified under this section are encouraged but must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least three calendar days before the bid date.

- D. Single Source: Obtain composite panel products from a single manufacturer.

## 2.02 WALL PANEL SYSTEM

- A. Wall Panel System Type: Reynobond® Aluminum Composite Panel or approved equal with joints as shown and detailed on drawings. Provide moisture barrier and sheathing as shown on drawings.
- B. System Performance: Composite panels shall be capable of withstanding building movements and weather exposures based on the following test standards required by the Architect and/or the local building code.
  - 1. Wind Performance: Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 20 pounds per square foot (psf) and 30 psf on parapet and corner panels. Wind load testing shall be conducted in accordance with ASTM E330 to obtain the following results.
    - a. Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed  $L/175$  or  $3/4"$ , whichever is less.
    - b. Normal to the plane of the wall, the maximum panel deflection shall not exceed  $L/60$  of the full span.
    - c. Maximum anchor deflection shall not exceed  $1/16"$ .
    - d. At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed  $L/100$  of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed  $1/16"$ .
  - 2. Thermal Movement: Allow for free horizontal and vertical thermal movement, due to expansion and contraction of components over a temperature range from -30 degrees F to 130 degrees F.
    - a. Buckling, opening of joints, undue stress on fasteners, failure of sealants, or any other detrimental effects of thermal movement will not be permitted.
    - b. Take into account the ambient temperature range during fabrication, assembly and erection operations.
  - 3. Air Leakage: 0.06 cfm/sq ft of wall area, maximum, when tested at 1.57 psf in accordance with ASTM E 283.
  - 4. Water Penetration: No water infiltration under static pressure when tested in accordance with ASTM E 331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
    - a. Water penetration is defined as the appearance of uncontrolled water in the wall.
    - b. Design wall systems to drain to the exterior face of the wall water leakage at joints and condensation that occurs within the construction.

## 2.03 PANEL FABRICATION

- A. Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.
  - 1. Panel Thickness: 4 mm (.020")
  - 2. Panel Squareness Tolerance: Maximum deviation from square of 0.2 inch.
  - 3. Core: Thermoplastic material that meets performance characteristics specified when fabricated into composite assembly.

4. Face Sheets: AA3000 Series alloy, or equivalent; 0.0197 inch (0.50mm) thick.
5. Bond Integrity: Tested for resistance to delamination as follows:
  - a. Bond Strength: 427 psi minimum, when tested in accordance with ASTM C 297.
  - b. Peel Strength: 27.6 in-lb/in minimum, when tested in accordance with ASTM D 1781.
  - c. No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
6. Fire Performance:
  - a. Flame Spread: Less than 25, when tested in accordance with ASTM E 84 in thickness specified.
  - b. Smoke Developed: Less than 450, maximum, when tested in accordance with ASTM E 84 in thickness specified.
  - c. Surface Flammability: Pass when tested in accordance with modified ASTM E 108 in thickness specified.
7. Finish: As specified below.

## B. FINISHES

1. Coil coated KYNAR® 500 or HYLAR® 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin in conformance with the following general requirements of AAMA 2605.
  - a. Color: To be Selected by Architect
  - b. Coating Thickness: 1.0 mil.
  - c. Hardness: ASTM D-3363; F-2H minimum using Eagle Turquoise Pencil.
  - d. Impact:
    - 1.) Test method: ASTM D-2794; Gardner Variable Impact Tester with 5/8" mandrel.
    - 2.) Coating shall withstand reverse impact of 1.5"/pounds per mil substrate thickness.
    - 3.) Coating shall adhere tightly to metal when subjected to #600 Scotch Tape pick-off test. Slight minute cracking permissible. No removal of film to substrate.
  - e. Adhesion:
    - 1.) Test Method: ASTM D-3359.
    - 2.) Coating shall not pick off when subjected to an 11" x 11" x 1/16" grid and taped with #600 Scotch Tape.
  - f. Humidity Resistance
    - 1.) Test Method: ASTM D-2247.
    - 2.) No formation of blisters when subject to condensing water fog at 100% relative humidity and 95°F for 4000 hours.
  - g. Weather Exposure
    - 1.) Outdoor:
      - a. Ten-year exposure at 45° angle facing south Florida exposure.
      - b. Maximum color change of 5 Delta E units as calculated in accordance with ASTM D-2244.
      - c. Maximum chalk rating of 8 in accordance with ASTM D-4214.
 No checking, crazing, adhesion loss.
- C. Accessories: Provide panel system manufacturer's standard accessories, including fasteners, clips, anchorage devices and attachments.
- D. Joint Sealer: As specified in Section 07 90 00.



## **2.04 FABRICATION**

- A. Shop fabricate panels to sizes and joint configurations indicated on the drawings, following panel material manufacturer's instructions and recommendations.
  - 1. Form panel lines, breaks and angles to be straight and true, with surfaces that are free from warp or buckle.
  - 2. Fabricate with sharply cut edges, with no displacement of aluminum sheet or protrusion of core.
- B. Fabricate panels for installation using concealed fasteners.
- C. Fabrication Tolerances: Provide panels fabricated with the following maximum deviations from true:
  - 1. Width: Plus 0.08 inch.
  - 2. Length: Plus 0.22 inch.
  - 3. Bow: Maximum 0.5 percent of length or width.
  - 4. Squareness: Maximum 0.2 inch out of square.
- D. Where final dimensions cannot be established by field measurements, provide allowance for field adjustment as recommended by the fabricator.

## **2.05 ACCESSORIES**

- A. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
- B. Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
- C. Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.
- D. Fabricate flashing materials from 0.030" minimum thickness aluminum sheet painted to match the adjacent curtain wall / panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.
- E. Fasteners (concealed/exposed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates are complete and have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. Protect adjacent work areas and finish surfaces from damage during product installation.

### **3.03 INSTALLATION**

- A. Comply with instructions and recommendations of panel manufacturer and panel system manufacturer and in accordance with approved shop drawings.
- B. Do not form panels in field unless absolutely necessary; if so, comply with panel manufacturer's recommendations and guidelines for field forming.
- C. Install panels plumb, level and true, anchored securely in place.

- D. Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted. Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.
- E. Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support
- F. Conform to panel fabricator's instructions for installation of concealed fasteners.
- G. Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded, and broken members.
- H. Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.
- I. Seal joints with joint sealer approved by manufacturer; comply with requirements of Section 07 90 00.
- J. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels of 0.25 inch in 20 feet, non-cumulative.

#### **3.04 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

#### **3.05 ADJUSTING AND CLEANING**

- A. Touch-up, repair or replace damaged products before Substantial Completion.
- B. Repair damaged panels so that repairs are not discernible at a distance of 10 feet; remove and replace damaged panels that cannot be repaired.
- C. Remove protective film immediately after installation of joint sealers and immediately prior to completion of composite metal panel work.
- D. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- E. Remove temporary coverings and protection of adjacent work areas.
- F. Clean installed products in accordance with manufacturer's instructions.
- G. Remove construction debris and leftover and damaged materials from project site and dispose of legally.

#### **3.06 PROTECTION**

- A. Protect finish of installed panels from damage during construction.

**END OF SECTION**

## SECTION 07 53 00

### SINGLE PLY TPO ROOFING MEMBRANE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Fully adhered single ply TPO membrane roofing system with terminations, flashings, and accessories.
- B. Rigid Roof insulation system.

##### 1.02 RELATED SECTIONS

- A. Section 05 31 33 – Steel Roof Deck.
- B. Section 06 10 00 – Wood Blocking and Curbing: Wood nailers.
- C. Section 06 12 50 – Tongue and Groove Wood Decking
- D. Section 07 62 00 – Pre-Finished Metal Flashing and Trim: Pre-finished metal Gutters, copings and flashings.
- E. Section 07 90 00 – Joint Sealants

##### 1.03 REFERENCES

- A. ASTM D-751 - TPO Membrane Thickness, Breaking Strength and Elongation.
- B. ASTM D-5884 - TPO Membrane Tearing Strength.
- C. ASTM C-728 - Perlite Thermal Insulation Board.
- D. ASTM C-1002 - Steel Drill Screws for the Application of Gypsum Board.
- E. ASTM C-1013 - Membrane Faced Rigid Cellular Polyurethane Roof Insulation.
- F. ASTM D-1449 - Ozone Resistance of TPO Membranes.
- G. ASTM D-2137 - Brittleness Point of TPO Membranes.
- H. ASTM D1204 - Dimensional Stability of TPO Membranes.
- I. ASTM C 1289-98 – Specification for Faced Rigid Polyisocyanurate Thermal Insulation Board
- J. ASTM C 1303 – Test method for estimating the Long Term Change in the Thermal resistance of Rigid Closed Cell Plastic Foams
- K. ASTM C 208 – Specification for Cellulosic Fiber Insulation Board
- L. FM - Roof Assembly Classifications.
- M. NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual.
- N. ULI - Fire Hazard Classifications.

##### 1.04 SYSTEM DESCRIPTION

- A. Fully adhered single ply TPO Roofing System: .060 mil (1.5 mm) Single ply membrane system consisting of a flexible Thermoplastic Polyolefin produced with a polyester weft inserted reinforcement.
- B. Insulation System: Rigid Isocyanurate Insulation Board with Glass Mat Facing,
- C. Roof insulation system, attachment and all accessories shall provide FM Class I-90 roof assembly and shall be approved by membrane manufacturer for issuance of full system warranty.

### **1.05 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout plan and fastener attachment pattern for insulation system. Indicate layout plan of membrane sheets and seams, direction of laps, flashing details and termination details.
- C. Product Data: Provide manufacturers data on insulation, membrane materials, flashing materials and termination materials with manufacturers certification that materials meet or exceed specified requirements.
- D. Manufacturers installation instructions: Indicate special precautions required for seaming the membrane. If manufacturers standard details are not exactly applicable, then custom drawn details shall be submitted to address all conditions.
- E. Manufacturer's Letter of Intent to Provide Warranty: Submit a letter from the manufacturer which acknowledges their intent to provide the specified warranty covering both materials and installation including a sample of their full system warranty worded exactly as it will be in final form.

### **1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's printed instructions.
- B. Roof Assembly Classification: FM Class I-90 Construction in accordance with FM Construction Bulletin 1-28.

### **1.07 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with ten years documented experience.
- B. Applicator: Company specializing in performing the work of this section with five years documented experience and approved by membrane manufacturer.

### **1.08 INSTALLER'S WARRANTY**

- A. Installer's warranty for a period of two years shall be furnished upon completion of all work, and as a condition to its acceptance, final payment and project close-out.
- B. Installer's warranty shall be issued on company's printed letterhead, agreeing to correct all leaks and defects in the roofing system to the satisfaction of the Owner and the manufacturer of the installed roof system.
- C. During the two year warranty period, the Roofing Installer shall, upon notice from the Owner, respond promptly to determine and repair source of leaks or defects at no cost to the Owner.

### **1.09 MANUFACTURER'S WARRANTY**

- A. Provide manufacturers standard full system twenty year weathertightness warranty covering roof insulation system, roofing membrane and flashings. Warranty shall cover both materials and installation. Warranty shall have a dollar limit of not less than the owner's original cost of the roofing system. Warranty shall be transferable at any time during the warranty period. Surety company bonds are not acceptable.
- B. General Description of the Roof to be Covered by the Terms of the Manufacturer's Roof Warranty: Under this guarantee, the Manufacturer and/or Installer will make repairs necessary to correct roof leaks or roof system defects resulting from the following causes:
  - 1. Premature deterioration of part of the roofing system as a result of ordinary wear and tear by the elements.
  - 2. Improper workmanship on the part of the Roofing Installer.
  - 3. Blisters, bare spots, fish mouths, wrinkles, ridges, splits, or open seams not caused by structural failure of the roof deck or its supporting members.
  - 4. Slippage of any part of the roofing system.

5. Breaks in flashing not caused by failure of any metal work.
  6. Wet insulation or decking damaged as a result of roof leaks attributed to defective material or workmanship.
- C. General Description of Roof Damage Covered by Terms of the Manufacturer's Roof Warranty: The Manufacturer's warranty shall not cover any failure of the roof system of any part thereof as a result of the following causes:
1. Construction activities, repair of roof mounted equipment, traffic or storage of materials thereon.
  2. Settlement, expansion, contraction, distortion, cracking or failure of the roof deck, coping, walls or structural members.
  3. Distortion, expansion, or contraction of any unguaranteed flashing or wrinkles, ridges, or splits caused by structural failure of the roof deck or its supporting members.
  4. Infiltration or condensation of moisture in, through or around the walls, equipment, building structure or underlying or surrounding materials not covered by the roof membrane or flashings.
  5. Vandalism.
  6. Lightning, hail, tornados, floods or other natural disasters.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site in accordance with manufacturer's printed instructions.
- B. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- C. Store products in weather protected environment, clear of ground and moisture.
- D. Stand roll materials on end.

#### **1.11 ENVIRONMENTAL REQUIREMENTS**

- A. Do not apply insulation or roofing membrane during inclement weather or in ambient temperatures below 40 degrees F.
- B. Do not apply insulation or roofing membrane to damp or frozen deck surface.
- C. Proceed with roofing work only when weather conditions comply with manufacturers recommendations.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

#### **1.12 COORDINATION**

- A. Coordinate the work with installation of associated metal roofing, wall panels and flashings as the work of this section proceeds.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS - MEMBRANE MATERIALS**

- A. This specification has been written around products manufactured by Elevate. Equal systems by the following manufacturers will also be acceptable.
  1. Johns Manville.
  3. Sarnafil.
- B. Substitutions from other manufacturers will be considered on an individual basis in accordance with Section 01 33 00.

#### **2.02 MEMBRANE MATERIAL**

- A. Membrane: Reinforced, UltraPly TPO-XR synthetic single-ply membrane composed of Thermoplastic Polyolefin polymer, and Ethylene Propylene Rubber.
  1. Membrane Type: .060 Reinforced TPO-XR 115

- 2. Membrane Color: Tan
- B. UltraPly TPO-XR Flashing:
  - 1. Description: Non-reinforced, TPO, single-ply flashing composed of Thermoplastic Polyolefin polymer, and Ethylene Propylene Rubber.
    - a. Nominal Thickness: .060 inch
- C. Bonding Adhesive:
  - 1. Description: SBR-based, formulated for compatibility with the UltraPly TPO-XR membrane & a wide variety of substrate materials, including masonry, wood, and insulation facings.
  - 2. Product/Producer:
    - a. UltraPly TPO-XR Bonding Adhesive by Firestone or TPO XR Stick low rise foam adhesive.
- D. Pourable Sealer:
  - 1. Description: 2-Part urethane, 2-color for reliable mixing.
- E. Seam Plates:
  - 1. Description: Steel with barbs and a Galvalume coating.
  - 2. Reference Standard: Corrosion-resistant to meet FM-4470 criteria.
- F. Termination Bar:
  - 1. Description: 1.3 x 0.10" thick aluminum bar with integral caulk ledge.
  - 2. Product/Producer:
    - a. Firestone Termination Bar by Firestone.
- G. Membrane Fasteners:
  - a. No mechanical membrane fasteners allowed with the exception of metal accessories into wood nailers.
- H. UltraPly TPO-XR Cut Edge Sealant:
  - 1. Polymeric sealant for use where exposed reinforcement is encountered.
  - 2. Product/Producer:
    - a. Firestone UltraPly TPO-XR Cut Edge Sealant by Firestone.
- I. UltraPly TPO-XR General Purpose Sealant:
  - 1. Polymeric one part general purpose sealant.
  - 2. Product/Producer:
    - a. Firestone UltraPly TPO-XR General Purpose Sealant by Firestone.
- J. UltraPly TPO-XR Coated Metal:
  - 1. Galvanized Steel with Manufacturers bonded TPO-XR Coating.
  - 2. Product/Producer:
    - a. Firestone UltraPly TPO-XR Coated Metal by Firestone.
- K. UltraPly TPO-XR Molded Flashing Accessories:
  - 1. Unreinforced UltraPly TPO-XR membrane Pre-Molded for a variety of flashing details (i.e. Pipe Boots, Inside-Outside corners, etc.)
  - 2. Product/Producer:

- a. Firestone UltraPly TPO-XR Pre-Molded Flashing Accessories by Firestone.

### **2.03 FLASHINGS**

- A. UltraPly TPO flashing made from a flexible non-reinforced thermoplastic polyolefin membrane.
- B. Membrane Color: Tan
- C. Counter Flashings: metal, as specified in Section 07 62 00.

### **2.04 ACCESSORIES**

- A. Ultraply TPO Quickseam Flashing where roof membrane is terminated at metal flashings.
- B. Ultraply TPO inside and outside corners.
- C. UltraPly TPO pipe flashings.
- D. Reinforced ULTRAPLY TPO-XR Walkway Pads, .130" X 30" X 50' with Patterned traffic bearing surface.
- E. Roof Tape: Fiberglass roof tape over insulation joints.
- F. Fiber Cant and Tapered Edge Strips: Asphalt impregnated wood fiberboard, preformed to 45 degree angle or tapered edge strip.
- G. Insulation Fasteners: Appropriate for purpose intended and approved by system manufacturer; length required for thickness of material with appropriate washers.
- H. Sealants: As recommended by membrane manufacturer.

### **2.05 INSULATION SYSTEM**

- A. Insulation System: 3.3 inch thick isocyanurate foam insulation board with minimum "R" value of 20 LTTR over metal roof decking in accordance with drawings.
- B. Rigid insulation system shall be approved by manufacturer of roofing membrane for inclusion in full system warranty.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secured.
- C. Verify deck is clean and smooth, free of depressions, waves, or projections.
- D. Verify deck surfaces are dry and free of snow or ice. Verify flutes of metal deck are clean and dry.
- G. Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and wood nailing strips are in place.
- H. Verify that existing roof surface is secure to receive new roof insulation and that edge conditions are acceptable for installation of new insulation.

### **3.02 INSULATION APPLICATION**

- A. Apply roof insulation with mechanical fasteners according to manufacturers recommendations to achieve a U.L. I-90 rating with joints run continuously in both directions. For multiple layer applications, offset joints of each layer a minimum of 6" from all joints of pervious layer.
- B. Apply roof tape over all joints and edges of rigid polyisocyanurate insulation. Lap ends of tape a minimum of 4".
- C. Installation of insulation system shall fully comply with membrane manufacturers requirements for a full system warranty.

### **3.03 MEMBRANE APPLICATION**

- A. Install roof membrane in strict conformance with manufacturers instructions, beginning at the low point of the roof, starting with the installation of perimeter panels.

### **3.04 MEMBRANE ATTACHMENT**

- A. Starting at the highest roof elevation, unroll and position UltraPly TPO XR membrane. Position UltraPly TPO XR membrane panels so the laps will be completed in “shingle fashion”, and not “buck” or hold water. Unroll UltraPly TPO XR membrane sheet and position in place. Fold sheets in half width-wise.
- B. Fold the properly positioned panels of UltraPly TPO XR membrane back to expose the substrate to receive I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive.
- C. Dispense I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive on the substrate as follows:
  - 1. Fully spray adhesive to obtain full coverage, approximately 1/8" to 1/4" (3 to 6 mm) thick after foaming.
  - 2. For extruded bead applications, apply a 3/4" to 1" (19 to 25 mm) wide bead, when wet, of the adhesive at a rate of 4", 6" or 12" (102, 152, or 305 mm) on center, depending on application requirements.  
NOTE: Closer bead spacing may be required at building corners and edges depending on wind zone. Apply I.S.O.Spray S Insulation Adhesive or XR Stick Bonding Adhesive to the substrate achieving a light yellow color foam.
  - 3. If the I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive does not rise, stop dispensing; troubleshooting is required to determine why the I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive is not rising.
  - 4. Do not apply I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive to UltraPly XR Membrane. Keep lap areas of UltraPly TPO XR Membrane clean and free of adhesive. Remove any adhesive that contaminates the lap areas immediately, and clean the lap area with appropriate cleaning materials.
  - 5. Allow I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive to rise (within 1 to 2 minutes, depending on ambient conditions), then bond the UltraPly TPO XR Membrane into the freshly installed adhesive. The rise time will vary based on ambient conditions, e.g. temperature and humidity.
- D. Roll the freshly bonded UltraPly TPOXR Membrane using a 150lb(68kg) roller (such as linoleum roller or landscaping roller) to ensure proper adhesion. Note: Roller not to exceed 150 lb (68 kg).
- E. Performance of I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive should be periodically monitored during the workday to verify that sufficient rise, adhesion, and full bonding is occurring.
- F. Do not attempt to apply I.S.O.SPRAY S Insulation Adhesive or XR Stick Bonding Adhesive when unfavorable conditions exist.

### **3.05 MEMBRANE SEAMING**

- A. Clean the lap splice area using a clean white cotton cloth dampened with Firestone SW-100 (Splice Wash), thoroughly cleaning an area at least 6" from the edge of both sheets.
- B. Wherever possible, all field splices in the roof membrane should be completed using an automatic heat welder that has been designed for hot air welding of thermoplastic membranes.
- C. Width of seams shall be in strict accordance with membrane manufacturer's requirements. Use silicone rollers to assure proper mating of surfaces s heat welding proceeds.
- D. Use hand held heat welders only on vertical welds or where an automatic welder can not be used.



**3.05 FLASHINGS AND ACCESSORIES**

- A. Install flashings and accessories in strict accordance with membrane manufacturer's requirements, including attachments, fasteners and welds.
- B. Use only those accessories provided by membrane manufacturer.
- C. Install roof drains in strict accordance with membrane manufacturer's requirements.

**3.06 CLEANING**

- A. In areas where roof surfaces or finished surfaces of adjacent construction are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- B. Repair or replace defaced or disfigured finishes caused by work of this section.

**3.07 PROTECTION**

- A. Protect building surfaces against damage from roofing work.
- B. Where traffic must continue over finished roof membrane, protect surfaces in accordance with membrane manufacturer's requirements.

**END OF SECTION**

## SECTION 07 62 00

### PRE-FINISHED METAL SIDING, FLASHING, CLADDING, COPING, DOWNSPOUTS, GUTTER AND TRIM

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Pre-finished metal gutters, scuppers, downspouts, drip edges, coping and flashings.
- B. Pre-finished metal fascia cladding.
- C. Metal Siding for Equipment Screen.

##### 1.02 RELATED SECTIONS

- A. Section 05 31 33 - Steel Roof deck.
- B. Section 06 10 53 - Wood Blocking, Sheathing and Curbing.
- C. Section 07 53 00 – Single Ply TPO Roofing Membrane
- D. Section 07 90 00 - Joint Sealers.

##### 1.03 REFERENCES

- A. ASTM B209 - Aluminum Alloy Sheet and Plate.
- B. ASTM D4586 - Asphalt Roof Cement, Asbestos-Free.
- C. ASTM D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- D. NRCA (National Roofing Contractors Association) - Roofing Manual.
- E. SMACNA - Architectural Sheet Metal Manual, 7<sup>th</sup> Edition, 2012.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Indicate material, fastening methods, termination's, installation details and color selections.
- C. Samples: Submit actual samples of manufacturers full range of colors.
- D. Shop Drawings: Submit drawings of each type of drip edge, coping, fascia trim, etc.
- E. Warranty: Submit a sample of the manufacturers standard 20 year Weathertightness Warranty.
- F. Installer shall submit proof of AISC certification.

##### 1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Manual Sixth Edition, 2003, standard details and requirements.
- B. Roofing installation shall comply with requirements for UL-580 Class 90 Wind Uplift rating.

##### 1.06 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in standing seam metal roofing and flashing work with five years documented experience.
- B. Pre-finished metal flashing and trim Contractor shall be AISC certified.

## **1.07 PRE-INSTALLATION CONFERENCE**

- A. Convene one week prior to commencing work of this section at job site.
- B. Include Project Architect, Owner Representatives, Contractor and Installer.

## **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site in accordance with manufacturer's recommendations.
- B. Stack preformed and pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials which may cause discoloration or staining.

## **PART 2 PRODUCTS**

### **2.01 PRE-FINISHED METAL CLADDING, FLASHING, COPING, AND TRIM**

- A. Pre-Finished Metal Flashing, Cladding and Trim: Fabricated from .040 3105-H14 aluminum with Kynar 500 or Hylar 5000 finish.
  - 1. Immediately upon completion of the metal finish, manufacturer shall apply a transparent strippable film coating not less than 1.0 mils dry film thickness suitable for protection of the panel finish and easily hand stripped from the surface upon completion of installation.
- B. Pre-Finished Metal Coping: Fabricated from .040 3105-H14 aluminum with Kynar 500 or Hylar 5000 finish. Formed metal coping to match Figure 3-4A and seams to match Figure 3-3 detail 21 in SMACNA Manual Seventh Edition.
- C. Prefinished Metal Scupper: Fabricated from .040 3105-H14 aluminum with Kynar 500 or Hylar 5000 finish. Formed metal scupper to match Figure 1-30A in SMACNA Manual Seventh Edition

### **2.02 PRE-FINISHED METAL GUTTERS AND DOWNSPOUTS**

- A. Pre-Finished Metal Gutters: Fabricated from .040 3105-H14 aluminum with Kynar 500 or Hylar 5000 finish. Conform to SMACNA Architectural Sheet Metal Manual, 7<sup>th</sup> Edition; Figure 1-2, Style A, 6" X 6"
  - 1. Gutter straps: Fabricated from prefinished .040 aluminum. Conform to SMACNA Architectural Sheet Metal Manual, 7<sup>th</sup> Edition; Figure 1-19B.
- B. Pre-Finished Metal Downspouts: Fabricated from .040 3105-H14 aluminum with Kynar 500 or Hylar 5000 finish. Conform to SMACNA Architectural Sheet Metal Manual, 7<sup>th</sup> Edition; Figure 1-32A, 5" Dia.
  - 1. Downspout straps: Fabricated from prefinished .040 aluminum. Conform to SMACNA Architectural Sheet Metal Manual, 7<sup>th</sup> Edition; Figure 1-35J.

### **2.03 METAL SIDING FOR EQUIPMENT SCREEN**

- A. Wall Panels: Equal to Firestone UNA-CLAD UC-500 0.040 (1.02mm) Aluminum flush panels with interlocking leg and concealed fastening system.
  - 1. Panel Width: 12"
  - 2. Height: 1"
  - 3. Panel Configuration: Flush interlocking panels with Concealed Fastener, smooth finish
  - 4. Finish: Selected by Architect from Manufacturers standard range of finishes.
    - a. Full strength Kynar 500 coating consisting of proper cleaning, pretreatment, conversion coating, epoxy-resin baked-on prime coat and fluorocarbon coating baked 15 minutes at 450 degrees F. to produce a finish coat not less than 1.0 mils thick.
  - 5. Material: Coil Coated Aluminum

## **2.04 ACCESSORIES**

- A. Fasteners: Galvanized steel, Aluminum, Stainless steel or same material and finish as exposed metal with soft neoprene washers where required.

## **2.05 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet, interlockable with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem all exposed edges 1/2 inch minimum.
- E. Job form fascia sections true to shape, accurate in size, square, and free from distortion or defects.
- F. Fabricate with required connection pieces.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, all wood blocking is in place, and nailing strips are properly located.
- B. Verify that decking, blocking and trim are ready to receive the work of this section.

### **3.02 PREPARATION**

- A. Install starter and edge strips, and cleats before starting installation.
- B. Place eave edge metal flashings tight to fascia boards. Weather lap joints 2" and seal with plastic cement. Secure flange with nails spaced at 6" OC.

### **3.03 INSTALLATION – FLASHING, CLADDING, TRIM AND COPING**

- A. Conform to details included in the SMACNA Manual, 6<sup>th</sup> Edition, 2003.
- B. Insert flashings into reglets to form tight fit. Secure in place with wedges. Seal flashings into reglets with sealant.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where detailed.
- D. Apply plastic cement compound between metal flashings and felt flashings.
- E. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- F. Seal metal joints watertight.
- G. Provide for thermal expansion of all exposed sheet metal work exceeding 10 feet running length.
- H. Maximum length of pre-finished metal flashings should be 10' - 0".
- I. Form fascia to wood substrate to form tight fit. Secure in place with required fasteners. conceal fasteners where possible and seal all joints watertight.

### **3.04 INSTALLATION OF GUTTERS AND DOWNSPOUTS**

- A. Conform to details included in the SMACNA Manual, 6<sup>th</sup> Edition, 2003.
- B. Seal all metal joints watertight.
- C. Secure gutter to substrate using straps spaced at 32" OC maximum.

- D. Install gutter straps so that attachment is located behind roof edge flashing. No exposed fasteners will be allowed inside gutters.
- E. Seal all gutter joints watertight and seal all downspout-to-gutter joints watertight.

**3.05 CLEANING AND PROTECTION**

- A. Clean exposed surfaces of pre-finished metal work promptly after completion of installation, including removal of strippable coating. Comply with recommendations of both the panel and coating manufacturer.
- B. Protection: The installer of pre-finished metal shall advise the contractor in writing of protection and surveillance procedures which can be foreseen as needed to ensure that the work will be without damage or deterioration at the time of final acceptance after completion of other construction work.
- C. Clean exposed surfaces of pre-finished metal cladding promptly after completion of installation. Comply with sheet metal producer's recommendations.

**END OF SECTION**

## SECTION 07 72 33

### ROOF HATCHES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Prefabricated roof hatch, with integral support curb, operable hardware, and counterflashing.
- B. Roof Hatch Safety Railing

##### 1.02 RELATED SECTIONS

- A. Section 05 12 00 - Structural Steel: Steel Framing
- B. Section 05 50 00 - Metal Fabrications: Steel roof support framing.
- C. Section 07 53 00 – Single Ply TPO Roofing Membrane

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on unit construction, size, configuration, jointing method, location when applicable, and attachment method.
- C. Shop Drawings: Show profiles, accessories, location and dimensions
- D. Contract Close-out: Contractor to provide manufacturer's 5-Year Warranty.

##### 1.04 PRODUCT HANDLING

- A. All materials to be delivered in manufacturer's original packaging.
- B. Store materials in a dry, protected, well ventilated area. The contractor shall thoroughly inspect the product upon receipt and report damaged material immediately to the delivering carrier and manufacturer.

##### 1.05 WARRANTY

- A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Babcock-Davis Associates, Arlington, Mass; Bilco Company, New Haven, Connecticut or approved equal.

##### 2.02 ROOF HATCHES

- A. Unit: Furnish and install where indicated on plans metal roof hatch" Type E", size width: 36" (762mm) x length: 36" (2438mm). Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- B. Integral Steel Curb: Shall be 12-inches in height with integral cap flashing. The curb shall be formed with a 3-1/2" flange with 7/16" holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that includes flashing system.
- C. Curb Insulation: Shall be rigid, high-density fiberboard of 1" (25.4mm) thickness on outside of curb.

- D. Flush Steel Cover: 14 gauge, paint bond G-90 galvanized steel with 3" (76mm) beaded flange with formed reinforcing members.
- E. Cover Insulation: Fiberglass of 1" (25.4mm) thickness, fully covered and protected by a metal liner gauge paint bond G-90 galvanized steel.
- F. Hardware:
  - 1. Engineered Composite Compression Spring Tubes. Steel Compression springs.
  - 2. Spring Latch with inside-outside handles. Two point lock enclosure – same material as cover.
  - 3. Steel hold open arm with vinyl covered grip handle for easy release.
  - 4. Padlock hasp on interior.
- G. Hinges: Manufacturer's recommended Heavy duty pintle hinges.
- H. Finish: Red Oxide Primed Steel.
- I. Roof Hatch Safety Railing System: Bil-Guard 2.0 Model No. RL2-E.

### **2.03 FABRICATION**

- A. Fabricate components free of visual distortion or defects. Weld corners and joints.
- B. Provide for removal of condensation occurring within components or assembly.
- C. Fit components for weathertight assembly.

## **PART 3 EXECUTION**

### **3.01 INSPECTION**

- A. Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

### **3.02 INSTALLATION**

- A. Install in strict accordance with manufacturer's printed instructions.
- B. Coordinate with installation of roofing system and related flashings for weathertight installation.
- C. Apply bituminous paint on surfaces of units in contact with cementitious materials or dissimilar metals.
- D. The installer shall mechanical fasteners consistent with the roof requirements.

**END OF SECTION**

## SECTION 07 84 00

### FIRESTOPPING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Firestopping materials.
- B. Firestopping of all penetrations and interruptions to fire rated assemblies between floors and lobby, whether indicated on drawings or not.

##### 1.02 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.
- B. Section 08 41 00 – Aluminum Storefronts and Curtain Wall: Sealants required in conjunction with aluminum storefront and curtain wall system.

##### 1.03 REFERENCES

- A. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000a.
- B. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2002.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- D. FM 4991 - Approval of Firestop Contractors; Factory Mutual Research Corporation; 2001.
- E. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- F. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals: Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

##### 1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.
  - 1. Listing in the current classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience installing work of this type.

#### PART 2 PRODUCTS

##### 2.01 FIRESTOPPING ASSEMBLIES

- A. Firestopping:
  - 1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E 814 that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.

##### 2.02 MATERIALS



- A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
- B. Foam Firestopping: Single component foam compound.
- C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers.
- D. Fiber Packing Material: Mineral fiber packing insulation.
- E. Intumescent Putty: Compound which expands on exposure to surface heat gain.
- F. Manufacturers:
  - 1. Grace Construction Products: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
  - 2. 3M Fire Protection Products: [www.mmm.com/US/arch\\_construct](http://www.mmm.com/US/arch_construct).
  - 3. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
  - 4. Pecora Corporation.
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design.

### **2.03 CURTAIN WALL INSULATION SYSTEM**

- A. Thermafiber "Impasse" curtain wall insulation system or approved equal. System to be used where studs bypass structure at second floor level.
- B. Materials:
  - 1. Thermafiber FireSpan™ Insulation-minimum 2" thickness, foil facing optional.
  - 2. Thermafiber Safing Insulation – 4" thickness, (minimum 25% compression)
  - 3. Thermafiber Safing Z-Clips.
  - 4. Smoke sealant.
  - 5. Thermafiber Insulation Hangers.
  - 6. Thermafiber T-Bar Insulation Brace.
  - 7. Thermafiber Universal T-Bar Attachment Clip (proprietary).
  - 8. Attachment screws (hex head, self-drilling #10 x ½" metal screws).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify openings are ready to receive the work of this section.

### **3.02 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- B. Remove incompatible materials which may affect bond.
- C. Install backing materials to arrest liquid material leakage.

### **3.03 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

### **3.04 CLEANING AND PROTECTION**

- A. Clean adjacent surfaces of firestopping materials.
- B. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**

## SECTION 07 90 00

### JOINT SEALERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Sealants and joint backing.

##### 1.02 RELATED SECTIONS

- A. Section 04 45 10 – Stone Veneer: Sealants required in conjunction with Control Joints in masonry veneer.
- B. Section 07 62 00 – Pre-Finished Metal Flashing, Cladding and Trim: Sealants required in conjunction with Metal Cladding, Flashing, Cladding and Trim.
- C. Section 08 41 00 – Aluminum Storefronts and Curtain Wall Systems: Sealants required in conjunction with aluminum storefront system.
- D. Section 08 80 00 - Glazing: Glazing sealants and accessories.

##### 1.03 REFERENCES

- A. ASTM C 834 - Standard Specification for Latex Sealants; 2000.
- B. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2002.
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2002.
- D. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2000.
- E. ASTM D 1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2000.
- F. ASTM D 1667 - Standard Specification for Flexible Cellular Materials--Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam); 1997.
- G. ASTM D 2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for concrete Pavements; 1991 (Reapproved 1998).
- H. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals: Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Samples: Submit two complete sets of samples illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.
- C. Perform work in accordance with each sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

## **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- B. Do not proceed with installations of sealants under adverse weather conditions, or when temperatures are above or below manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength.

## **1.07 COORDINATION**

- A. Coordinate the work with all sections referencing this section.

## **1.08 JOB CONDITIOINS**

- A. Examine joint surfaces, backing, and anchorage of units forming sealant rabbet. Do not proceed with work until unsatisfactory conditions have been corrected.

## **1.09 WARRANTY**

- A. See Section 01 70 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide Installer's warranty to correct defective work within a two year period after Date of Substantial Completion.
- C. Provide manufacturer's 20 year material warranty covering structural adhesion, weather seal and non-staining.
- D. Warranty: Include coverage for installed sealants and accessories which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Compatibility: Provide primers, joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.

### **2.02 SEALANTS**

- A. Silicone Building Sealant for use with Masonry: At all exterior vertical expansion and control joint applicaitons (Manufactured Masonry):
  - 1. Provide manufacturer's standard chemically curing, elastomeric sealant which complies with ASTM C920 requirements, including those for Type S, Grade NS, Class 25, and Uses M, G and A.
  - 2. One Part, Medium Modulus, Silicone Perimeter Sealant: Type S, Grade NS, Class 25. Dow Corning "795" or approved equal. Color to match mortar color as selected by architect.
- B. Silicone Building Sealant For use with Metal: At all metal to metal Joints and Perimeter Seals Around Penetrations:
  - 1. Provide manufacturer's standard chemically curing, silicone sealant which complies with ASTM C 920 requirements, including those for Type S, Grade NS, Class 25, and Uses M, G and A. Provide colors to match adjacent surfaces.
  - 2. One-Component Silicone Sealant: ASTM Specification: C920, Type S, Grade NS, Class 25. For metal to metal, use Dow Corning 790 or 791 or equal. For sealant primer, use Dow Corning 1200 or equal. Verify that sealants and primer are approved by pre-finished metal manufacturer prior to installation.
- C. Joint Sealers for Interior Wet Areas at sinks, toilets, etc.

1. Provide manufacturer's standard chemically curing, silicone sealant which complies with ASTM C 920 requirements, including those for Type OP, Grade NF, Class 25, and Uses I, G and A. Provide colors to match adjacent surfaces.
  2. One-Component Mildew Resistant Silicone Sealant: ASTM Specification: C920, Federal Specification TT-S-001543, Class A. Dow Corning "786" or approved equal.
- E. Concrete Pavement and Sidewalk Joint Sealers:
1. Non-priming, pourable, self-leveling urethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant"; Mameco "Vulken 45"; Woodmont Products "Chem-Calk 550"; Tremco "THC 900" or Pecora "NR-200 Urexpan".

## **2.03 ACCESSORIES**

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter which might impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C 1193.
- C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
  1. Width/depth ratio of 2:1.
  2. Neck dimension no greater than 1/3 of the joint width.
  3. Surface bond area on each side not less than 75 percent of joint width.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

- I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

#### **3.04 CLEANING**

- A. Clean adjacent soiled surfaces.

#### **3.05 PROTECTION OF FINISHED WORK**

- A. Protect sealants until cured.

**END OF SECTION**

## SECTION 08 11 00

### STEEL DOORS AND FRAMES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Steel doors.
- B. Steel frames.

##### 1.02 RELATED SECTIONS

- A. Section 08 14 16 - Flush Wood Doors
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.
- D. Section 09 90 00 - Paints and Coatings.

##### 1.03 REFERENCES

- A. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability; 2002.
- B. ANSI A250.6 - Hardware on Standard Steel Doors (Reinforcement--Application); 1997.
- C. ANSI A250.7 - Nomenclature: Standard Steel Doors and Frames; 1997 (R2002).
- D. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 1998.
- E. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998.
- F. ANSI A250.11 - Recommended Erection Instructions for Steel Frames; 2001.
- G. DHI A115.1G - Installation Guide for Doors and Hardware; 1994.
- H. NFPA 80 - Standard for Fire Doors and Fire Windows; 1999.
- I. SDI 105 - Recommended Erection Instructions for Steel Frames; Steel Door Institute; 1998.
- J. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; Steel Door Institute; 2000.
- K. SDI 124 - Maintenance of Hollow Metal Doors and Frames; Steel Door Institute; 1998.
- L. UL 10B - Standard for Fire Tests of Door Assemblies; Underwriters Laboratories Inc; 1997.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards.
- C. Shop Drawings: Show layout, profiles, product components, anchorages and accessories.
  - 1. Indicate door type, frame, steel, core, material thickness, mortises, reinforcements, exposed fastener locations, openings (glazed, paneled, or louvered), and hardware arrangements.
  - 2. Include schedule identifying each unit, with door marks or numbers referencing drawings.

- D. Certificates: Product certificates signed by the manufacturer certifying material compliance with ANSI A250.8, specified performance characteristics and criteria, and physical requirements.
- E. Warranty documents specified herein.

#### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
  - 1. Certificate: When requested, submit certificate indicating qualification.
- B. Preinstallation Meetings: Conduct meetings to verify project requirements, substrate conditions, manufacturer's installation instructions, and warranty requirements. Comply with Division 1 requirements.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. General: Comply with ANSI A250.8.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery:
  - 1. Manufacturer's original, unopened, undamaged containers, identification labels intact.
  - 2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- D. Storage and Protection:
  - 1. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  - 2. Store doors protected at corners to prevent damage or marring of finish. Store doors in upright position under cover on building site on wood sills or on floors in a manner to prevent rust and damage.
  - 3. Store frames in upright position under cover on building site on wood sills or on floors in a manner to prevent rust and damage.
  - 4. Do not use non-vented plastic or canvas shelters.

#### **1.07 PROJECT CONDITIONS**

- A. Verify actual openings by field measurements before fabrication; show recorded measurements on shop drawings.
- B. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

#### **1.08 WARRANTY**

- A. See Section 01 70 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.
  - 1. Warranty Period: 2 years commencing on Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Steel Craft, Mesker, Republic, Ceco, Curries, Dittco or approved equal
- B. Substitutions: In accordance with Section 01 60 00.
- C. Provide all steel doors and frames from a single manufacturer.



## **2.02 DOOR CONSTRUCTION**

- A. Standard construction (no visible seams on face), of sizes and designs as indicated.
- B. Face: Steel sheet in accordance with ANSI/SDI-100. 18 gauge cold rolled, level, free of scale.
- C. Provide minimum 0.1 oz./Sq/ Ft. zinc coating and baked on rust inhibitive primer at exterior doors.
- D. Core for non rated exterior doors: Polyurethane or polystyrene foam.
- E. Core for rated interior doors: Gypsum core or as determined by manufacturer to achieve the specified rating. Rated doors shall be labeled to indicate compliance with UL rating indicated on the Door Schedule.
- F. Hardware Locations: Unless otherwise specified, conform to recommendations of Steel Door Institute or Door and Hardware Institute for location of locks, hinges, latches, push-pull plates and bars, exit devices, handle sets, closer reinforcing, roller latches, and arm pulls.

## **2.03 FRAMES**

- A. Combination stop frame channel section, rabbeted for doors of type and styles indicated.
- B. Exterior Frames: 14 gauge hot rolled or cold rolled steel with minimum 0.1 oz./Sq. Ft. zinc coating and baked-on rust inhibitive primer.
- C. Interior non-rated Frames: 16 gauge hot rolled or cold rolled steel with rust inhibitive primer.
- D. Interior rated Frames: 16 gauge hot rolled or cold rolled steel with rust inhibitive primer for interior frames. Rated frames shall be labeled to indicate compliance with UL rating indicated on the Door Schedule.
- E. Fully welded construction with face welds ground smooth.
- F. Provide 26 gauge steel boxes, welded to frame, at back of all hardware cutouts.

## **2.04 FINISHES**

- A. Primer: Baked on rust inhibitive.

## **2.05 ACCESSORIES**

- A. Anchors / Fasteners: Supply the proper fastenings and / or anchors to secure frames in each type of structural framing indicated.
- B. Silencers / Mutes: Drill stops to receive a minimum of 3 silencers on strike jamb.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of doors and frames in accordance with manufacturer's installation instructions and technical bulletins.
  - 1. Verify door frame openings are installed plumb, true, and level.
  - 2. Select fasteners of adequate type, number, and quality to perform intended functions.

### **3.02 INSTALLATION**

- A. General:
  - 1. Set frames plumb, square, aligned, without twist at correct elevation.
  - 2. Install frames plumb, straight, and true, rigidly secured in place and properly braced; comply with DHI A115.IG.
  - 3. Comply with Door and Hardware Institute (DHI) installation standards.
  - 4. Comply with ANSI A250.11 and SDI 124.

5. Fire Doors and Frames: Install in accordance with NFPA 80, current edition, unless specified otherwise.
- B. Frame Installation Tolerances:
    1. Plumbness: Plus or minus 1/8" measured through a line intersecting corner of vertical members and the head to the floor.
    2. Squareness: Plus or minus 1/8" measured through a line 90 degrees from one jamb at upper corner to opposite jamb.
    3. Alignment: Plus or minus 1/8" measured on jambs, through a horizontal line parallel to plane of wall.
    4. Twist: Plus or minus 1/8" measured at face corners of jambs, on parallel lines perpendicular to plane of wall.
  - C. Secure anchorages and connections to adjacent construction.
  - D. Install doors and hardware in accordance with manufacturers' templates and instructions.
  - E. Touch-up exposed surfaces scratched or marred during shipment, installation, or handling and field prime scratches or bare edges with a rust inhibitive primer.
  - F. Install glazing materials and silencers.

### **3.03 ADJUSTING AND CLEANING**

- A. Adjust hinge sets, locksets, and other hardware. Lubricate using a suitable lubricant compatible with door and frame coatings.
- B. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions before owner's acceptance.
- C. Remove from project site and legally dispose of construction debris associated with this work.

### **3.04 PROTECTION**

- A. Protect installed products and finished surfaces from damage during construction.

**END OF SECTION**

## SECTION 08 14 16

### FLUSH WOOD DOORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Flush wood doors; fire rated and non-rated for installation in metal frames.

##### 1.02 RELATED SECTIONS

- A. Section 08 11 00 - Steel Doors and Frames: Frames for installation of wood doors.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

##### 1.03 REFERENCES

- A. AHA A135.4 - Basic Hardboard; American Hardboard Association; 1995.
- B. ASTM E 413 - Classification for Rating Sound Insulation; 1987 (Reapproved 1999).
- C. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2003.
- D. ICC (IBC) - International Building Code; 2003.
- E. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 1999.
- F. UBC Std 7-2, Part II - Test Standard for Smoke- and Draft-control Assemblies; International Conference of Building Officials; 1997.
- G. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- H. UL 10B - Standard for Fire Tests of Door Assemblies; 1997.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; 1998.
- J. WDMA NWWDA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association (formerly NWWDA); 1997.
- K. ANSI/HPMA HP - Harwood and Decorative Plywood

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals: Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, identify cutouts for glazing.
- D. Manufacturer's Installation Instructions: Indicate special installation instructions.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.
- B. Perform work in accordance with AWI Quality Standard Section 1300, Custom Grade.

## **1.06 DELIVERY, STORAGE, AND PROTECTION**

- A. Deliver, store, protect, and handle products in accordance with manufacturer's recommendations.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

## **1.07 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated on shop drawings.

## **1.08 PROJECT CONDITIONS**

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

## **PART 2 PRODUCTS**

### **2.01 DOOR TYPES**

- A. Flush Interior Doors: Factory Finished Flush Interior Rated and Non Rated Swing Doors for Installation in Steel Frames: 1 3/4 inches thick; solid core construction equal to VT Industries, Architectural Wood Doors PC-5, 5-Ply Construction, Architectural Wood Veneer Flush Doors.

### **2.02 DOOR CONSTRUCTION**

- A. Face veneer shall be Premium Grade AA Rift Cut White Oak, Slip Match, core shall be particle core; Grade LD-2 per ANSI 208.1 Standards, Vertical and Horizontal edges conforming to AWI Quality Standards, adhesive shall be Type I water repellent bond.

### **2.03 FINISH**

- A. Transparent stain finish consisting of filler, sealer, color coat, catalyzed polurethane finish equal to AWI System TR-6 Catalyzed Polyurethane..

### **2.04 ADHESIVE**

- A. Facing Adhesive: Type I - water resistant.

### **2.05 FABRICATION**

- A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.
- B. Fabricate rated doors in accordance with AWI Quality Standards and Underwriters Laboratories Inc. requirements.
- C. Provide lock blocks at lock edge.
- D. Vertical Exposed Edge of Stiles: Softwood for transparent finish.
- E. Factory machine doors and frames for finish hardware installation in accordance with hardware requirements and dimensions.
- F. Hang each door with three butts.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Condition wood doors to the average prevailing temperature and humidity of the building before hanging.

- C. Verify that opening sizes and tolerances are acceptable.
- D. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

### **3.03 INSTALLATION TOLERANCES**

- A. Maximum Diagonal Distortion (Warp): 1/8 inch measured with straight edge or taut string, corner to corner.
- B. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom.
- C. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge.

### **3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**END OF SECTION**

**SECTION 08 21 10**  
**CUSTOM WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. New Custom Wood Interior Doors.

**1.02 RELATED SECTIONS**

- A. Section 06 20 00 - Finish Carpentry - Framing and trim for wood doors.
- B. Section 08 71 00 - Door Hardware.
- C. Section 09 90 00 - Painting: Shop finishing doors.

**1.03 REFERENCES**

- A. ANSI/HPMA HP - Hardwood and Decorative Plywood.
- B. AWI - Quality Standards of the Architectural Woodwork Institute.
- B. 16 CFR 1201 – Safety Standard for Architectural Glazing Materials
- C. AWI/AWMAC/WI (AWS) – Architectural Woodwork Standards

**1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Provide elevations, sections and details of all types of wood doors including section details at stile and rails and profiles of bars and muntins at divided lites. Illustrate door opening criteria, elevations, sizes, swing, undercuts required, special beveling, blocking for hardware, and ship finishing criteria.
- B. Product Data: Indicate door stile and rail materials and construction, wood species, frame design and frame profile.
- C. Manufacturer's Installation Instructions: Indicate special installation instructions.

**1.05 QUALIFICATIONS**

- A. Manufacturer's Qualifications: Company specializing in manufacturing custom wood doors for a period of at least 10 years.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products in accordance with manufacturer's recommendations.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.

**1.08 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated on shop drawings.

#### **1.09 WARRANTY**

- A. See Section 01 70 00 – Contract Closeout for submission of warranties.
- B. Provide 3-Year warranty against warping, defective materials, and separation of materials.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS: STILE AND RAIL WOOD DOORS**

- A. Cache River Mill & Metalworks, 3401 E. Broadway, North Little Rock, AR Phone: (501)-725-6347
- B. Other Manufacturers will be considered on an individual basis, only before the bid date. Other manufacturers must be approved by the architect before the bid date. Requests for approval of other manufacturers must be made to the architect in writing at least seven calendar days before the bid date.

#### **2.02 DOOR TYPES**

- A. Custom Interior Doors: 2 1/4 inches thick; solid lumber White Oak Wood stile and rail construction; mortise and tenon or doweled and glued joints per elevations, sections and details shown on drawings.

#### **2.03 FABRICATION**

- A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.
- B. Machine doors for finish hardware in accordance with hardware requirements and dimensions.
- C. Fabricate stile and rail exterior doors in accordance with AWI Quality Standards requirements.

#### **2.04 GLAZING**

- A. Each light shall bear the manufacturer's label designating the type and thickness of glass. Provide 1/4" thick safety glazing at doors with lites.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify frame opening conditions are ready to receive wood doors.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

#### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions.
- C. Trim door height by cutting bottom edges to a maximum of 3/4 inch.

#### **3.03 INSTALLATION TOLERANCES**

- A. Maximum Diagonal Distortion (Warp): 1/8 inch measured with straight edge or taught string, corner to corner.
- B. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taught string, top to bottom.
- C. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taught string, edge to edge.

**3.04 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust door for smooth and balanced door movement.

**END OF SECTION**



## SECTION 08 41 13

### ALUMINUM ENTRANCES, STOREFRONT AND CURTAIN WALL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Aluminum-framed storefront and curtain wall systems, complete with reinforcing, fasteners, anchors, and attachment devices.
- B. Aluminum entrance doors, complete with hardware.
- C. Accessories necessary to complete the Work.

##### 1.02 RELATED SECTIONS

- A. Section 05 40 00 – Cold Formed Metal Framing: Metal stud framing for support and attachment of storefront and curtainwall.
- B. Section 06 10 00 – Wood Blocking, Sheathing and Curbing: Wood blocking for installation of aluminum storefront.
- C. Section 07 62 00 – Prefinished Metal Copings, Flashing and Trim.
- D. Section 07 90 00 – Joint Sealers: Perimeter sealant and back-up materials.
- E. Section 08 71 00 – Door Hardware: Hardware items other than specified in this section.
- F. Section 08 80 00 – Glazing: Glass and glazing accessories.

##### 1.03 REFERENCES (Comply with the version year adopted by the Authority Having Jurisdiction)

- A. AA DAF-45 - Designation System for Aluminum Finishes; The Aluminum Association, Inc.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association.
- C. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association (part of AAMA 501).
- D. AAMA 607.1 – Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
- E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association.
- F. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- G. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- H. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- I. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- J. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. General Performance:
  - 1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as

determined by testing of glazed aluminum curtain walls representing those indicated for this project.

2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  3. Failure includes any of these events:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Loosening or weakening of fasteners, attachments, and other components.
    - d. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain wall systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and required design criteria.
1. Design Wind Loads: Comply with requirements of ASCE 7, structural drawings, and the current edition of the Arkansas Fire Prevention Code.
  2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- C. Manufacturer shall determine exact size of curtain wall framing members to assure that system is designed to accommodate wind loading for actual conditions of all openings. If manufacturer determines that larger size members are required than those shown on the drawings, they shall include the larger size members in their bid. No adjustment will be made to the contract sum if manufacturer determines that larger size members are required after the bid.
- D. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintels, without damage to components or deterioration of seals.
- E. Air Infiltration: The test specimen shall be tested in accordance with TAS 202 and ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft<sup>2</sup> (0.3 l/s · m<sup>2</sup>) at a static air pressure differential of 6.2 psf (300 Pa).
- F. Water Resistance: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft.
1. Static:
    - a. The test specimen shall be tested in accordance with TAS 202 and ASTM E 331.
    - b. There shall be no leakage at a minimum static air pressure differential of 15 psf (720 Pa) as defined in AAMA 501.
  2. Dynamic:
    - a. The test specimen shall be tested in accordance with AAMA 501.1.
    - b. There shall be no leakage at an air pressure differential of 15 psf (720 Pa) as defined in AAMA 501.
    - c. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation.
    - d. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
- G. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

- H. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
  - 1. Temperature Change (Range): 120 °F (49 °C), ambient; 180 °F (82 °C), material surfaces.
  - 2. Test Interior Ambient Air Temperature: 75 °F (24 °C).
  - 3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5 .

#### **1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, door hardware, internal drainage details and attachment requirements.
- C. Shop Drawings: Indicate system plans, elevations, sections, dimensions, construction details, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Provide verification samples for each type of exposed finish required, in manufacturer's standard sizes.
- D. Wind Loading: Provide manufacturer's data and installer's verification that proposed system is designed to withstand wind loading as specified or required by code.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in the Owner's name and registered with manufacturer.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum ten years of documented experience.
- B. Perform Work in accordance with AAMA SFM-1 and AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
- C. Manufacturer shall determine exact size of storefront and curtainwall framing members to assure that system is designed to accommodate wind loading for actual size of all openings.
- D. Conform to requirements of The Americans with Disabilities Act and ANSI A117.1.
- E. Source Limitations: Obtain aluminum storefront and curtainwall systems through one source from a single manufacturer.
- F. Product Options:
  - 1. Information on drawings and in specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

#### **1.07 DELIVERY, STORAGE, AND PROTECTION**

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished surfaces as necessary to prevent damage.

- C. Do not use adhesive papers or sprayed coatings which become firmly bonded when exposed to sun.
- D. Do not leave coating residue on any surface.
- E. Replace damaged units.

#### **1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

#### **1.09 PROJECT CONDITIONS**

- A. Field Measurements:
  - 1. Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication.
  - 2. Indicate measurements on shop drawings.

#### **1.10 WARRANTY**

- A. See Section 01 70 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide written warranty in form acceptable to Owner jointly signed by manufacturer, installer and Contractor warranting work to be watertight, free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace aluminum doors, hardware, storefront framing, glazing and components which fail in materials and workmanship within 2 years from date of Substantial Completion. Failure of materials or workmanship shall include, but not be limited to, failures in operation of doors and hardware, excessive leakage or air infiltration, excessive deflections, delamination of panels, deterioration of finish or metal in excess of normal weathering, and defects in accessories, weatherstripping, and other components of the work.

### **PART 2 PRODUCTS**

#### **2.01 ALUMINUM STOREFRONT AND CURTAIN WALL MANUFACTURERS**

- A. Kawneer Company, Inc., [www.kawneer.com](http://www.kawneer.com).
- B. Oldcastle Building Envelope, [www.obe.com](http://www.obe.com).
- C. Substitutions: See Section 01 60 00 - Product Requirements.

#### **2.02 ALUMINUM ENTRANCE DOORS**

- A. Doors: Single Glazed aluminum.
  - 1. 3'-0" x 7'-0" medium stile, single acting doors equal to Kawneer 350 doors, complete with all hardware except cylinders.
    - a. Thickness: 1-3/4 inches.
    - b. Top Rail: 3-1/2 inches wide.
    - c. Vertical Stiles: 3-1/2 inches wide.
    - d. Bottom Rail: 10 inches inches wide.
    - e. Glazing Stops: Square.
    - f. Finish: Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating (Color: Black).
    - g. Weatherstripping: Manufacturer's standard including door bottom sweeps.
  - 2. Hardware for exterior aluminum egress doors.
    - a. Pivots: Manufacturer's standard top, intermediate and bottom heavy-duty offset pivots.

- b. Closers: Norton 1601 with hold-open.
- c. Push Bar: Architects Classic Hardware CP-II Push Bar. Finish to match door.
- d. Pull: Architects Classic Hardware CO-12. Finish to match door.
- e. Threshold: Manufacturer's standard with anchors and clips. Coordinate with offset pivots, closer and floor finish. Maximum 1/2" height.
- f. Weatherstripping: Nylon pile, continuous and replaceable; provide on all exterior doors.
- g. Sill Sweep Strips: Resilient seal type, of nylon pile; provide on all ext. doors.

### **2.03 EXTERIOR ALUMINUM STOREFRONT SYSTEMS**

- A. Aluminum-Framed Storefront: Kawneer Company, Inc; Product Trifab VG 451T (Locations shown on drawing) Factory fabricated, factory finished aluminum framing members and related flashings, anchorage and attachment devices.
  - 1. Trifab VG 451T: 2" x 4-1/2" thermally broken, Center and front glazed system. (Provide Front Glazed system where shown in same plane as Curtainwall System.
  - 2. Color: Clear Anodized
- B. Alu Aluminum-Framed Storefront: Kawneer Company, Inc; Product Trifab VG 601T (Locations shown on drawing) Factory fabricated, factory finished aluminum framing members and related flashings, anchorage and attachment devices.
  - 1. Trifab VG 451T: 2" x 6" thermally broken, Center and front glazed system. (Provide Front Glazed system where shown in same plane as Curtainwall System.
  - 2. Color: Clear Anodized

### **2.04 ALUMINUM CURTAIN WALL SYSTEM**

- A. Aluminum Curtain Wall System: Factory fabricated, factory finished aluminum framing members and related flashings, anchorage and attachment devices and structural steel reinforcing (if required) equal to Kawneer Clearwall (SSIT).
  - 1. 2-1/2" x 7-3/8" thermally broken, with internal steel reinforcing as required in the vertical mullions.
  - 2. 2-1/2" Site line.
  - 3. Outside glazed with metal interfaced insulating glass (interface shop applied with 3M VHB structural glazing tape.
  - 4. Finish: Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating (Color: Black).

### **2.05 STOREFRONT AND CURTAIN WALL MATERIALS**

- A. Extruded Aluminum: ASTM B 221 – 6063-T6 alloy and temper.
- B. Sheet Aluminum: ASTM B 209.
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.
- D. Anchors, Clips and Accessories:
  - 1. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
  - 2. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.
- E. Reinforcing Members:
  - 1. Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with

ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.

2. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.
- F. Perimeter Sealant: Type as specified in Section 07 90 00. For sealants required within fabricated curtain wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- G. Tolerances: References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- I. Glass: As specified in Section 08 80 00.
- J. Glazing Accessories: As specified in Section 08 80 00.
- K. Provide all other materials not specifically described but required for a complete, weathertight system.
- L. Provide all other materials not specifically described but required for proper installation of doors, framing and glazing members.

## **2.06 SYSTEM FABRICATION (GENERAL)**

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members as required for imposed loads in conformance with the current edition of the Arkansas Fire Prevention Code.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
  1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

## **2.07 SYSTEM FABRICATION (STOREFRONT)**

- A. Coordination of Fabrication:
  1. Check actual frame or door openings required in construction work by accurate field measurements before fabrication.
  2. Fabricate units to withstand loads that will be applied when system is in place.
- B. General:
  1. Conceal fasteners wherever possible.
  2. Reinforce work as necessary for performance requirements, and for support to structure.
  3. Separate dissimilar metals and aluminum in contact with concrete utilizing protective coating or preformed separators, which will prevent contact and corrosion.

4. Install glazing in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.

C. Aluminum Framing:

1. Provide members of size, shape and profile indicated, designed to provide for glazing from exterior.
2. Provide manufacturer's standard thermal break between exterior and interior aluminum surfaces.
3. Fabricate frame assemblies with joints straight and tight fitting.
4. Reinforce internally with structural members as necessary to support design loads.
5. Maintain accurate relation of planes and angles, with hairline fit of contacting members.
6. Seal horizontals and direct moisture accumulation to exterior.
7. Provide flashing and other materials used internally or externally that are corrosive resistant, non-staining, non-bleeding and compatible with adjoining materials.
8. Provide manufacturer's extrusions and accessories to accommodate expansion and contraction due to temperature changes without detriment to appearance or performance.

D. Welding:

1. Comply with recommendations of the American Welding Society.
2. Use recommended electrodes and methods to avoid distortion and discoloration.
3. Grind exposed welds smooth and flush with adjacent surfaces; restore mechanical finish.

- E. Flashings: Form from sheet aluminum with same finish as extruded sections. Apply finish after fabrication. Material thickness as required to suit condition without deflection or "oil-canning."

## **2.07 SYSTEM FABRICATION (CURTAIN WALL)**

- A. Take accurate field measurements to verify required dimensions prior to fabrication.

- B. Location of exposed joints is subject to Architect's acceptance.

- C. Fabricate components in accordance with approved shop drawings. Remove burrs and ease edges. Shop fabricate to greatest extent practicable to minimize field cutting, splicing and assembly. Disassemble only to extent necessary for shipping and handling limitations.

D. Steel Components:

1. Clean surfaces after fabrication and immediately prior to application of primer in accord with SSPC-SP2 or SSPC-SP3 at manufacturer's option.
2. Apply specified shop coat primer in accord with manufacturer's instructions to provide 2.0 minimum dry film thickness

- E. Fabricate components true to detail and free from defects impairing appearance, strength or durability. Fabricate custom extrusions indicated and as necessary for complete installation.

- F. Fabricate components to allow for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections will be flush and weather-tight. Ensure slip joints make full, tight contact and are weather-tight.

- G. Reinforce components as required at anchorage and support points, at joints, and at attachment points for interfacing work.

- H. Provide structural reinforcing within framing members where required to maintain rigidity and accommodate design loads.

- I. System design and sealants to accommodate weep and drainage system not visible to the

exterior.

- J. Allow for adequate clearance around perimeter of system to enable proper installation and for thermal movement within system.
- K. Separate dissimilar metals with protective coating or preformed separators to prevent contact and corrosion.

## **2.08 GLAZING**

- A. Glazing to meet requirements in Section 08 80 00.
  - 1. Check actual frame or door openings required in construction work by accurate field measurements before fabrication.
- B. Glazing:
  - 1. Clearwall (SSIT): Outside glazed, with metal interfaced 1" insulating glass (interface shop applied with 3M VHB structural glazing tape). 3M to conduct application review prior to start of each project.
- C. Glazing Gaskets:
  - 1. Gaskets to meet requirements of ASTM C864.
- D. Spacers and Setting Blocks:
  - 1. Manufacturer's standard elastomeric type.
- E. Bond-Breaker Tape:
  - 1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- F. Glazing Sealants:
  - 1. As recommended by manufacturer for joint type.

## **2.09 ACCESSORY MATERIALS**

- A. Bituminous Paint.
  - 1. Cold-applied asphalt-mastic paint.
  - 2. Complies with SSPC-Paint 12 requirements except containing no asbestos.
  - 3. Formulated for 30-mil (0.762 mm) thickness per coat.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other Work.
- B. Verify that wall openings and wood blocking materials are ready to receive work of this section.

### **3.02 INSTALLATION (STOREFRONT)**

- A. Install storefront systems in accordance with manufacturer's instructions.
- B. Tolerances:
  - 1. Limit variations from plumb and level:
    - a. 1/8 inch in 10'-0" vertically.
    - b. 1/8 inch in 20'-0" horizontally.
  - 2. Limit variations from theoretical locations: 1/4 inch for any member at any location.
  - 3. Limit offsets in theoretical end-to-end and edge-to-edge alignment: 1/16 inch from flush



surfaces not more than 2 inches apart or out-of-flush by more than ¼ inch.

- C. Install doors and hardware in accordance with manufacturer's printed instructions. Set thresholds in bed of mastic and secure. Install hardware using templates provided.
- D. Set units plumb, level, and true to line, without warp or rack of frame. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Anchor securely in place, allowing for required construction tolerances, movement, including expansion and contraction, and other irregularities.
- F. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with bituminous paint or preformed separators to prevent contact and corrosion.
- G. Install sill flashings for all sills. Turn up ends and edges; seal to adjacent work to form watertight dam.
- H. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weather-tight construction.
- I. Coordinate installation of perimeter sealant and backing materials between assemblies and adjacent construction in accordance with requirements of Section 07 90 00.
- J. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- K. Install glazing in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- L. Install perimeter sealant in accordance with Section 07 90 00.

### **3.03 INSTALLATION (CURTAIN WALL)**

- A. Install curtain wall systems in accordance with manufacturer's instructions and applicable provisions of AAMA Aluminum Curtain Wall Design Guide Manual.
- B. Align assemblies plumb and level, free of warp or twist, aligning with adjacent Work.
- C. Tolerances:
  - 1. Limit variations from plumb and level:
    - a. 1/8 inch in 20'-0" vertically and horizontally.
    - b. ¼ inch in 40'-0" either direction.
  - 2. Limit offsets in theoretical end-to-end and edge-to-edge alignment:
    - a. 1/16 inch where surfaces are flush or less than ½ inch out of flush and separated by not more than 2 inches.
    - b. 1/8 inch for surfaces separated by more than 2 inches.
  - 3. Step in face: 1/16 inch maximum.
  - 4. Jog in alignment: 1/16 inch maximum.
  - 5. Location: 1/4 inch maximum deviation of any member at any location.
  - 6. Tolerances are not accumulative.
- D. Provide attachments and shims to permanently fasten system to building structure.
- E. Anchor securely in place, allowing for required movement, including expansion and contraction.
- F. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with protective coating or preformed separators to prevent contact and electrolytic action.

- G. Install sill flashings for all sills. Turn up ends and edges; seal to adjacent work to form water tight dam.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of mastic and secure.
- J. Install hardware using templates provided.
- K. Install glazing in accordance with Section 08 80 00, using glazing method required to achieve performance criteria. Glass shall be outside glazed. Glass shall be held in place with extruded aluminum pressure plates anchored to the mullion using stainless steel fasteners that are spaced no more than 9" (228.6 mm) on center.
- L. Install perimeter sealant in accordance with Section 07 90 00.
- M. Water Drainage
  - 1. Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations.
  - 2. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

### **3.04 ADJUSTING**

- A. Test door operating functions. Adjust closing and latching speeds and other operating hardware in accordance with manufacturer's instructions to ensure smooth operation.

### **3.05 CLEANING AND PROTECTION**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Clean surfaces in compliance with manufacturer's recommendations, exercising care to avoid damage; remove excess mastic, mastic smears, foreign materials and other unsightly marks.
- C. Remove excess sealant by method acceptable to sealant manufacturer.
- D. Protect aluminum systems from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.
- E. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
- F. Protect finished work from damage.
- G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
- H. Remove construction debris from project site and legally dispose of debris.

**END OF SECTION**

## **SECTION 08 71 00**

### **DOOR HARDWARE**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Hardware for wood and hollow metal doors.
- B. Thresholds.
- C. Weatherstripping, seals and door gaskets.
- D. Knox Box

##### **1.02 SCOPE**

- A. The finish hardware supplier shall furnish all necessary items for completion for this project, as specified in paragraph 3.05, hardware sets, or as necessary to complete this building, excepting the items specifically excluded.

##### **1.03 WORK NOT INCLUDED**

- A. Window Hardware
- B. Aluminum Door Hardware
- C. Toilet Partition Hardware

##### **1.04 RELATED SECTIONS**

- A. Section 08 11 00 - Steel Doors and Frames.
- B. Section 08 14 16 - Flush Wood Doors
- C. Section 08 21 10 – Custom Wood Doors

##### **1.05 REFERENCES**

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 1998.
- B. BHMA A156.1 - American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc.; 2000 (ANSI/BHMA A156.1).
- C. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; Builders Hardware Manufacturers Association; 1996 (ANSI/BHMA A156.2).
- D. BHMA A156.3 - American National Standard for Exit Devices; Builders Hardware Manufacturers Association; 2001 (ANSI/BHMA A156.3).
- E. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2000 (ANSI/BHMA A156.4).
- F. BHMA A156.5 - American National Standard for Auxiliary Locks & Associated Products; Builders Hardware Manufacturers Association; 2001 (ANSI/BHMA A156.5).
- G. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2001 (ANSI/BHMA A156.6).
- H. BHMA A156.7 - American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association; 1988 (R1997) (ANSI/BHMA A156.7).
- I. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders;

Builders Hardware Manufacturers Association, Inc.; 2000 (ANSI/BHMA A156.8).

- J. BHMA A156.13 - American National Standard for Mortise Locks & Latches; Builders Hardware Manufacturers Association; 2002 (ANSI/BHMA A156.13).
- K. BHMA A156.15 - American National Standard for Closer Holder Release Devices; Builders Hardware Manufacturers Association; 2001 (ANSI/BHMA A156.15).
- L. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2000 (ANSI/BHMA A156.18).
- M. BHMA A156.21 - American National Standard for Thresholds; Builders Hardware Manufacturers Association; 2001 (ANSI/BHMA A156.21).
- N. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; current edition.
- O. DHI A115W Series - Specifications for Wood Door and Frame Preparation for Hardware; Door and Hardware Institute; 2000.
- P. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2001.
- Q. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Wood Flush Doors; Door and Hardware Institute; 1993.
- R. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 1999.
- S. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2000.
- T. UBC Std 7-2, Part II - Test Standard for Smoke- and Draft-control Assemblies; International Conference of Building Officials; 1997.
- U. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- V. ADA - Americans with Disabilities Act.

#### **1.06 SUBMITTALS**

- A. See Section 01 33 00 – Submittals: Submittal and substitution procedures.
- B. Hardware Schedule: Indicate locations and mounting heights of each type of hardware. Include manufacturer's product data for each item to be furnished under this section.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- D. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

#### **1.07 QUALITY ASSURANCE**

- A. The hardware supplier shall submit six (6) typewritten hardware schedules to the architect through the general contractor for approval. Each schedule shall contain the door index listing of the opening on the project and the hardware for said openings. Each item of hardware listed is to be clearly identified by manufacturer, manufacturer's number and finish.
- B. The Architect retains the authority to approve or reject any schedule based upon his knowledge of the supplier's experience and capabilities, the general quality of the products submitted and compliance with the specifications.

- C. If requested, the supplier shall provide working samples of any items he proposed to substitute. Samples will be returned to the jobsite for installation.
- D. The hardware supplier shall forward template information to all related trades within ten (10) days after receipt of approved hardware schedules. Template submission shall be made in accordance with the latest standards as published by The Door and Hardware Institute.
- E. The supplier shall forward wiring diagrams to all affected trades within ten (10) days after receipt of approved hardware schedule.
- F. The hardware supplier shall prepare a packet containing a complete up to date copy of the hardware schedule, two copies of any installation and or maintenance instructions for items provided on the project and two sets of installation and adjustment tools, including dogging keys and emergency keys for any hardware requiring these tools. The maintenance package is to be delivered to the general contractor with the key control system and the master keys.

**1.08 DELIVERY, STORAGE AND HANDLING**

- A. All items of hardware shall be clearly marked with door number, key, symbol, and heading number to correspond with the approved hardware schedule.
- B. The General Contractor will be responsible for providing a dry, clean, locked room of adequate size for storage of hardware.

**1.09 GUARANTEE**

- A. The hardware supplier shall guarantee that all materials furnished under this division will be free from defects and blemishes for a period of one (1) year from date of acceptance. The supplier shall repair or replace at his expense, including labor, when instructed to do so by the Architect and/or Owner any item of finish hardware which may prove to be defective within said period.

**PART 2 – PRODUCTS**

**2.01 MANUFACTURERS**

- A. Product numbers listed in the following specifications are taken from the catalogs of the manufacturers listed as follows:

(V)	Von Duprin, Incorporated	Indianapolis, Indiana
(L)	LCN Closers	Princeton, Illinois
(NG)	National Guard Products	Memphis, Tennessee
(L)	Lund Equipment Company	Bath, Ohio
(B)	Best Lock Corporation	Indianapolis, Indiana
(G)	Glynn-Johnson	Indianapolis, Indiana
(I)	H.B. Ives	Indianapolis, Indiana
(R)	Rockwood Manufacturing	Rockwood Pennsylvania
(F)	Falcon	

Products of the following manufacturers will be considered acceptable provided they are of equivalent weight, function and design.

**BUTTS:**  
Hager, Bommer

**LOCKS:**

**Best Lock, 9K Series with Lever Style – No Substitutions will be accepted.**

**PANIC DEVICES:**

Sargent, Corbin Russwin

**DOOR CLOSERS:**

Norton, Hager

**DOOR TRIM:**

Hager, Burns

**DOOR STOPS AND MISCELLANEOUS HOLDERS:**

Hager, Burns

**THRESHOLDS AND WEATHERSTRIPPING:**

Hager, Reese

**2.02 FINISH**

- A. The finish in general shall be satin chrome (BHMA 626 or BHMA 630 at suppliers option).
- B. Door closers shall be Painted Aluminum (BHMA 689).
- C. Thresholds and weatherstrips shall be mill finish aluminum.

**2.03 FASTENERS**

- A. Where sex nut bolts are specified in paragraph 3.05, furnish sex bolts sized to the thickness of the door.
- B. Wood screws are to be threaded to the head.
- C. Material for fasteners shall be ferrous or non-ferrous matching the product being applied.
- D. Length of fasteners shall be sufficient to afford adequate thread engagement.

**2.04 KEYING**

- A. All locks shall be 6 pin, subject to the existing Best Access System masterkey system, verify keyway with Owner.
- B. Furnish 4 keys per keyed alike set and 2 keys each for all other locks.
- C. Furnish 6 master keys.
- D. The supplier shall prepare a recommended keying schedule and include it in the hardware schedule submitted for approval. Following approval, the supplier shall establish a meeting with the owner or owner's representative to review and gain approval of the final keying system. Confirmation of the meeting and attendees shall be given to the general contractor in writing and four final copies of the hardware schedule containing keying revisions shall be submitted to the general contractor for his files and field use.

**2.05 KNOX BOX**

- A. Provide high security Knox Boxes manufactured by Knox Company, 17672 Armstron Avenue, Irvine, California 92614-5728, 1-800-552-5669, [www.knoxbox.com](http://www.knoxbox.com)
- B. Exterior Building Key Knox Box:
  - 1. 3200 Series Surface Mount.
  - 2. Hinged Door
  - 3. 1/8" thick Stainless Steel lock Cover
  - 4. 1/2" thick solid plate steel door with gasket
  - 5. Polyester Powder Coat Finish

**PART 3 – EXECUTION**

**3.01 INSPECTION**

- A. Condition of opening size shall be verified by the general contractor as to door frames being plumb and of correct tolerances to receive door and hardware.

**3.02 INSTALLATION**

- A. The installer shall be competent and have knowledge of hardware.
- B. Mounting heights for all hardware shall be recommended by The Door and Hardware Institute.

**3.03 ADJUSTMENT**

- A. The installer is to make adjustments as necessary to insure proper operation of all hardware items.
- B. Door opening force: In accordance with the Americans with Disabilities Act (ADA), adjust all door hardware to that the maximum force required for pushing or pulling open a door shall be as follows:
  - 1. Fire doors shall have the minimum opening force allowable by the appropriate administrative authority.
  - 2. Exterior hinged doors: 8.5 LBF (SBS)
  - 3. Interior hinged doors: 5.0 LBF
  - 4. Sliding or folding doors: 5.0 LBF

These forces do not apply to the force required to retract latch bolts or disengage other devices that may hold the door in a closed position.

- C. Door Closers: If door is equipped with a closer, then the sweep period of the closer shall be adjusted so that from an open position to 70°, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- D. The installer shall check the door closer adjustment after testing and balancing of the HVAC system and make any corrections as required. In addition, the door closers are to be checked six months after the date of final completion and adjusted as necessary.

**3.04 PROTECTION**

- A. The General Contractor is responsible for protection of all items for hardware until Owner accepts the project as complete.

### 3.05 HARDWARE SETS

- A. The following is a general listing of the minimum hardware requirements. Any item of hardware normally required by good practice, or as to meet state or local codes, shall be furnished even though it may not be specifically mentioned.

#### HW-1

Each to have:

- B 1 Cylinder - Provide Proper Type and quantity to Operate Locking Devices.  
-Balance of hardware by door supplier.

#### HW-2

Please note: This is a Pair of 2 ¼" thick Doors

Each to have:

- I 8 Butts 5BB1 WT 5 x 6  
R 4 Pull/Push RM3302 72-Inch Pulls, 1 ¼" Dia. (Mount both sides)  
L 2 Closer 1460-H x SNB  
I 2 Kick Plate 10 x DW-1.5" (each side of door)  
I 2 Stops WS406CVX

#### HW-3

Each to have:

- I 6 Butts 5BB1 4.5 x 4.5  
B 1 Storeroom Lock F86-14D  
R 2 Surface Bolts 585-12"  
I 4 Kick Plates 10 x DW-1.5" (each side of door)  
I 2 Stops WS406CVX

#### HW-4

Each to have:

- I 3 Butts 5BB1 4.5 x 4.5  
R 2 Pull/Push RM3302 24-Inch Pulls, 1 ¼" Dia. (Mount both sides)  
L 1 Closer 1460-H x SNB  
I 2 Kick Plate 10 x DW-1.5" (each side of door)  
I 1 Stop WS406CVX

#### HW-5

Each door to have:

- I 3 Butts 5BB1 4.5 x 4.5  
B 1 Storeroom Lock F86-14D  
I 2 Kick Plate 10 x DW-1.5" (each side of door)  
H 1 Stop 236W

#### HW-6

- I 1 Hinge 224HD Dark Bronze  
B 1 Storeroom Lock F86-14D  
L 1 Closer 4040 Cush x SNB  
NG 1 Door Bottom 200N  
NG 1 Set Gasketing 5050  
NG 1 Rain Drip 16 DW + 4"



**HW-7**

I	3	Butts	5BB1-HW 4.5 x 4.5
B	1	Classroom Lock	F84-14D
L	1	Closer	1460 x SNB
I	2	Kick Plate	10 x DW-1.5" (each side of door)
I	1	Stop	WS406CVX
NG	1	Door Bottom	200N
NG	1	Set Gasketing	5050

**HW-8**

Each door to have:

I	3	Butts	5BB1 4.5 x 4.5
B	1	Storeroom Lock	F86-14D
I	2	Kick Plate	10 x DW-1.5" (each side of door)
H	1	Stop	236W

**HW-9**

Each to have:

I	1	Hinge	224HD Dark Bronze
V	1	Panic Device	99L x 996L x 17 x SNB
B	1	Cylinder	
L	1	Closer	1460 x SNB
I	1	Stop	WS406CVX
NG	1	Door Bottom	200N
NG	1	Set Gasketing	5050
NG	1	Rain Drip	16 DW + 4"

**HW-10**

I	3	Butts	5BB1-HW 4.5 x 4.5
B	1	Entrance Lock	F109-14D
L	1	Closer	1460 x SNB
I	2	Kick Plate	10 x DW-1.5" (each side of door)
I	1	Stop	WS406CVX

**HW-11**

I	3	Butts	5BB1-HW 4.5 x 4.5
B	1	Entrance Lock	F82-14D
L	1	Closer	1460 x SNB
I	2	Kick Plate	10 x DW-1.5" (each side of door)
I	1	Stop	WS406CVX
NG	1	Door Bottom	200N
NG	1	Set Gasketing	5050

**HW-12**

Each door to have:

I	3	Butts	5BB1 4.5 x 4.5
B	1	Passage Lock	F75-14D
I	2	Kick Plates	10 x DW-1.5" (each side of door)
H	1	Stop	236W

**HW-13**

Each door to have:

I	3	Butts	5BB1 4.5 x 4.5
B	1	Passage Lock	F75-14D
F	1	Indicator Lock	D-Series D271605
I	2	Kick Plates	10 x DW-1.5" (each side of door)
H	1	Stop	236W

**HW-14**

Each to have:

I	2	Hinges	224HD Dark Bronze
V	1	Panic Device	99L x 996L x 17 x SNB
B	1	Cylinder	
L	2	Closers	1460 x SNB
R	2	Surface Bolts	585-12"
I	2	Stops	WS406CVX
NG	2	Door Bottom	200N
NG	1	Set Gasketing (pair of doors)	5050
NG	1	Door Astragal	

**END OF SECTION**

## SECTION 08 71 50

### AUTOMATIC DOOR OPERATORS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Electro-mechanical swing door operating equipment.
- B. Controls and safety devices.
- C. Accessories.

##### 1.02 RELATED SECTIONS

- A. Section 07 90 00 – Joint Sealers.
- B. Section 08 41 00 – Metal Framed Storefronts.
- C. Section 08 71 00 – Door Hardware.
- D. Section 08 80 00 – Glazing.

##### 1.03 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide manufacturer's printed product information indicating material characteristics, performance criteria and product limitations.
- C. Shop drawings: Show profiles, joining method, location of components, anchorage details, adjacent construction interface, and dimensions as well as all necessary wiring and electrical requirements.
- D. Contract Closeout: Submit the Manufacturer's warranty and performance certifications.
- E. Submit manufacturer's written installation instructions.

##### 1.04 QUALITY ASSURANCE

- A. Swinging door operator shall be CERTIFIED by the manufacturer to meet performance design criteria according to the following test standards.
  - 1. ANSI A156.19.
  - 2. NFPA 101.
  - 3. Underwriter's Laboratories 325 (UL) listed.
  - 4. C-UL Certified (equivalent to CSA certified).
  - 5. ICBO (UBC Standard 10-1).

##### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle product in accordance with manufacturer's recommendations.
- B. All materials shall arrive in the manufacturer's original sealed, labeled containers.

- C. Store materials in a dry, protected, well-vented area. The contractor shall report damaged material immediately to the delivering carrier and note such damage on the carrier's freight bill of lading.
- D. Remove all protective material after installation.

#### **1.06 JOB CONDITIONS**

- A. Verify that other trades are complete before installing the swinging door operator.
- B. Mounting surfaces shall be plumb, straight and secure; substrates shall be of proper dimension and material.
- C. Refer to the construction documents, shop drawings and manufacturer's installation instructions.
- D. Coordinate installation with the glass, glazing and hardware installation.
- E. Observe all appropriate OSHA safety guidelines for this work.

#### **1.07 WARRANTY**

- A. Manufacturer's Standard Warranty: Warranted materials shall be free of defects in material and workmanship for one year after installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Stanley Access Technologies, 65 Scott Swamp Road, Farmington, CT 06032 (800)722-2377 (860)677-2861 Fax: (860)679-6436 <http://www.stanleyworks.com/>
- B. Substitutions: See Section 01600 - Product Requirements.

#### **2.02 AUTOMATIC DOOR OPERATOR**

- A. Automatic Door Operator: Stanley Magic Access TM operator as manufactured by Stanley Magic Access, 65 Scott Swamp Road, Farmington, CT 06032/1-800-722-2377 or approved equal shall be an electro-mechanical system installed in a header to resist dust, dirt and corrosion. Bearings shall be fully lubricated and sealed to minimize wear and friction. Entire operator shall be removable from the header as a unit. All equipment shall operate between temperature extremes of -30 degrees F. and +130 degrees F.
- B. Power Openings: Operator shall open door with a fractional HP DC motor through reduction gears, splined spindle, door arm and linkage assembly. Drive train shall have positive constant engagement. Operator shall stop the door in the open position by electrically reducing the motor voltage and stalling against a 90 degree stop. As a "Low energy" operator opening time shall not be less than 4 seconds.
- C. Spring Closing: Operator shall close door by spring energy (with power assist closing). Closing speed shall be controlled by employing the motor as a dynamic brake. Closing spring shall be pre-loaded for positive closing action at low material stress level. As a "low energy" operator door closing time shall not be less than 4.5 seconds.
- D. Manual Operation: Operator shall function as a manual door closer in the direction of swing with or without electrical power.

- E. Entrapment Protection: Door forces and speeds generated during power opening and manual opening in both directions of swing and spring closing in both directions of swing shall conform to the requirements of A156.19 or A156.10, whichever applies.
- F. Electrical Control: A solid state electronic controller with quick connect plugs shall incorporate the following features:
  - 1. Mode of Operation: To be "low energy" as defined by A156.19. Carpet safety logic circuit that complies with A156.10.
  - 2. Respond to push plates and radio control.
  - 3. Immediate reverse-on-obstruction during opening capability.
  - 4. Open, open check and closing speed adjustment.
  - 5. Adjustable time delays.
  - 6. On/Off [On/Off/Hold Open] switch.
  - 7. Power assist closing.
- G. Header: Shall be 4" wide by 6" high, 6063-T5 aluminum extrusions with structurally integrated end caps. Structural sections shall have a minimum wall thickness of .025". Provide full length removable cover for access to operator and electronic control box.
- H. Linkage Assembly: Shall provide positive control of door through entire swing; shall permit use of butt-hung, center pivot and offset pivot hung doors.
- I. Controls: Recessed, flush mounted Wall Mounted Push plates, and radio controls. Push Plates shall be battery powered. Install two push plates at each door. Install one push plate on the exterior of the building and one push plate on the interior of the building. Locate push plates as directed by the Architect. All push plates shall be flush mounted on the wall. No pedestals will be allowed.

## **2.03 FINISHES**

- A. Exposed to view aluminum shall have a dark bronze anodized finish of AA-M12-C22-A31 to match the finish of the storefront framing and doors.

## **PART 3 EXECUTION**

### **3.01 INSPECTION**

- A. The door installer shall verify that the installation area is dry, clean and free of foreign matter.
- B. Check as-built conditions and verify the manufacturer's details for accuracy to fit the wall assembly prior to fabrication.
- C. Report in writing to the Contractor any detrimental conditions to the proper functioning of the swinging door operator and correct prior to any installation in accordance to the manufacturer's recommendations.

### **3.02 INSTALLATION OF SWINGING DOOR OPERATOR:**

- A. Installation shall be by an installer approved and trained by the manufacturer in strict accordance with the manufacturer's instructions and Fire Marshall's listing requirements.
- B. Comply with the automatic swinging door operator system manufacturer's recommendations and/or installation guide when installing the automatic swing door operator. Set all units plumb, level and true.

- C. Provide all fasteners required for installation of automatic swing door system.
- D. Adjustment and Cleaning: After repeated operation of the completed installation, re-adjust door operators and controls for optimum operating condition and safety. Clean all metal surfaces promptly after installation.
- E. Explain and review the Daily Safety Check Procedure with Owner's Representative.

**3.03 INSTALLATION SCHEDULE OF SWINGING DOOR OPERATOR:**

- A. Provide Swinging Door Operator at the following locations:
  - 1. Door 106A

**END OF SECTION**

## SECTION 08 80 00

### GLAZING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Glass and Glazing for installation in aluminum storefront and curtain wall systems.
- B. Glass and Glazing for installation in wood doors.
- C. Glass and Glazing in Steel Doors and Frames
- D. Mirrors for surface mounting in restrooms.
- E. Glazing accessories.

##### 1.02 RELATED SECTIONS

- A. Section 07 90 00 - Joint Sealers: Sealant and back-up material.
- B. Section 08 11 00 - Steel Doors and Frames
- C. Section 08 14 16 - Factory Finished Flush Wood Doors: Glazing in wood doors.
- D. Section 08 21 10 – Custom Wood Doors: Glazing in Custom Wood Doors
- E. Section 08 41 13 – Aluminum Entrances, Storefront and Curtain Wall: Glazing in aluminum systems.

##### 1.03 REFERENCES

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; 2003.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 1984 (R1994).
- C. ASTM C 864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 1999.
- D. ASTM C 1036 - Standard Specification for Flat Glass; 2001.
- E. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 1997b.
- F. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass; 1996.
- G. ASTM E 773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units; 2001.
- H. ASTM E 774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units; 1997.
- I. ASTM E 1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2002.
- J. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- K. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.
- L. SIGMA TM-3000 and TB-3001 - Recommended Practices for Vertical and Basic Field Glazing of Organically Sealed Insulating Glass Units; Sealed Insulating Glass Manufacturing Association; 1990.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Glass and glazing materials of this Section shall provide continuity of building enclosure:

- B. Select type and thickness of exterior glass to withstand dead loads and positive and negative wind loads acting normal to plane of glass as calculated in accordance with the 2007 Arkansas Fire Prevention Code.
  - 1. Use procedures specified in ASTM E-1300 to determine glass type and thickness.
  - 2. Limit glass deflection to  $l/200$  or flexure limit of glass, whichever is less, with full recovery of glazing materials.
  - 3. Thicknesses listed are minimum.

#### **1.05 SUBMITTALS**

- A. See Section 01 33 00 – Submittals and Substitutions for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Samples: Submit two samples 12 x 12 inch in size of glass units, showing coloration.
- D. Certificates: Certify that products meet or exceed specified requirements.

#### **1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- C. Locate safety glazing in accordance with AFPC Vol. II, Section 2406.

#### **1.07 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### **1.08 WARRANTY**

- A. See Section 01 70 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide a ten (10) year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting.
  - 1. Include coverage for deterioration of coating on coated glass.
- C. Provide a ten (10) year warranty to include coverage for reflective coating on mirrors.

### **PART 2 PRODUCTS**

#### **2.01 FLAT GLASS MATERIALS**

- A. Manufacturers:
  - 1. AFG Industries, Inc: [www.afgglass.com](http://www.afgglass.com).
  - 2. Guardian Industries Corporation: [www.guardian.com](http://www.guardian.com).
  - 3. Pilkington Building Products North America: [www.pilkington.com](http://www.pilkington.com).
  - 4. PPG Industries, Inc: [www.ppg.com](http://www.ppg.com).
  - 5. Visteon Glass Systems: [www.visteon.com/floatglass](http://www.visteon.com/floatglass).
  - 6. Substitutions: Refer to Section 01600 - Product Requirements.
- B. Clear Float Glass (Type FG-A): Clear, annealed.
  - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select). Locate in interior applications only where allowed by code. 1/4 inch thick minimum.
- C. Coated Glass (for insulated glass units only): Low-E coating on second surface equal to PPG "Solarban 60" (heat strengthened if required by manufacturer).



- D. Safety Glass (Type FG-B): Clear; fully tempered with horizontal tempering.
  - 1. Laminated with 0.030 inch thick plastic interlayer; comply with ASTM C 1172
  - 2. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
  - 3. Comply with 16 CFR 1201 test requirements for Category II.
- E. Tempered Glass (Type FG-B): ASTM C1048, HS heat strengthened, FT fully tempered conforming to ANSI Z97.1; 1/4" thick minimum.
  - 1. Locate as required by code in interior locations.
- F. Mirror Glass (Type FG-H): Clear float type, heat strengthened with copper and silver coating, organic overcoating, square and lapped edges, 1/4" thick minimum.
- G. Wired Glass (Type FG-G): Clear, polished both sides.
  - 1. Stainless steel wire in diamond mesh pattern.
  - 2. 1/2 inch grid size.
  - 3. 1/4 inch thick minimum.
  - 4. Locate as required by code.

## **2.02 SEALED INSULATING GLASS UNITS FOR EXTERIOR STOREFRONT AND CURTAIN WALL**

- A. Insulated Glass Units Type SG-A: ASTM E774 and E773; 1 inch thick insulated units, PPG Gray Tint on No. 2 surface and low "E", PPG Solarban 60, on third surface with heat strengthened outboard lite. Provide tempered or safety glass lites where required by code.
- B. All Offices and Labs - Insulated Glass Units Type SG-A: ASTM E774 and E773; 1 inch thick insulated units, PPG Gray Tint on No. 2 surface and low "E", PPG Solarban 60, on third surface with heat strengthened outboard lite. Provide tempered or safety glass lites where required by code.

## **2.03 SEALED INSULATING SPANDREL GLASS MATERIALS (at locations shown on drawings)**

- A. Insulated Spandrel Glass Units: ASTM E774 and E773; 1 inch thick insulated units, Grey Tint on No. 2 Surface, 1/2" mill spacer, inboard lite 1/4" clear float - tempered or safety glass as per code, heat strengthened outboard lite; Grey frit on #3 surface.

## **2.04 GLAZING ACCESSORIES**

- A. Manufacturers:
  - 1. Norton Performance Plastics Corp.
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. Tremco, Inc: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 4. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- C. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- D. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.
- E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; black color.

- F. Mirror Clips: Concealed stainless steel clips.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

### **3.02 PREPARATION**

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealant in accordance with manufacturer's instructions.

### **3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)**

- A. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; achieve full continuous contact.

### **3.04 INSTALLATION - MIRRORS**

- A. Set restroom mirrors with concealed chrome clips. Anchor rigidly to wall construction.
- B. Place plumb and level.
- C. Fit tight to glass perimeter with razor cut edge.

### **3.05 CLEANING**

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

### **3.06 PROTECTION OF FINISHED WORK**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

### **3.07 SCHEDULE**

- A. Glazing in Exterior Aluminum Storefront and Curtain Wall system: 1" insulated panels consisting of 1/4" coated glass (heat strengthened if required by manufacturer) and 1/4" clear float, tempered or safety glass as required by code with a 1/2" air space for a total thickness of 1 inch.
- B. Glazing in exterior aluminum entry doors: 1/4" clear uncoated, laminated safety glass.
- C. Glazing in Steel Doors and Frames: 1/4" clear glass (float, tempered or safety glass as required by code).
- D. Glazing in interior wood doors: 1/4" clear glass (float, tempered, safety or wire glass as required by code).
- E. Restroom Mirrors: 1/4" mirror glass.

**END OF SECTION**

## SECTION 09 21 16

### GYPSUM BOARD ASSEMBLIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Fiberglass reinforced gypsum sheathing.
- B. Gypsum wallboard.
- C. Joint treatment and accessories.
- D. Textured finish system.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 – Wood Framing, Blocking, Sheathing and Curbing: Wood framing and blocking for support of wall-mounted equipment.
- B. Section 07 21 16 – Board and Batt Insulation: Thermal and acoustic insulation.
- C. Section 09 22 16 - Non Load Bearing Metal Stud Framing: Metal framing supporting gypsum board.
- D. Section 09 90 00 - Paints and Coatings.: Paint finish on gypsum board.

##### 1.03 REFERENCES

- A. ASTM C 36/C 36M - Standard Specification for Gypsum Wallboard; 2001.
- B. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002.
- C. ASTM C 514 - Standard Specification for Nails for the Application of Gypsum Board; 2001.
- D. ASTM C 557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 1999.
- E. ASTM C 630/C 630M - Standard Specification for Water-Resistant Gypsum Backing Board; 2000.
- F. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2002.
- G. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2001.
- H. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2002.
- I. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
- J. ASTM E119 - Fire Tests of Building Construction and Materials.
- K. GA-201 - Gypsum Board for Walls and Ceilings.
- L. GA-214 - Recommended Levels of Gypsum Board Finish; Gypsum Association; 1996.
- M. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2000.
- N. GA-253 - Recommended Specifications for the Application of Gypsum Sheathing; Gypsum Association; 1999.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

### **1.05 QUALITY ASSURANCE**

- A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
- B. Applicator Qualifications: Company specializing in performing gypsum board application and finishing, with minimum five years of documented experience.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Gypsum Board:
  - 1. G-P Gypsum Corporation: [www.gp.com](http://www.gp.com).
  - 2. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  - 3. USG Corporation: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 GYPSUM BOARD MATERIALS**

- A. Gypsum Board for walls and ceilings: ASTM C36; Type X, 5/8 inch thick, manufacturers fire rated, U.L. tested gypsum boards, maximum permissible length; ends square cut, tapered edges.
- B. Moisture Resistant Gypsum Board for plumbing walls in Restrooms and all walls in Janitors Closets: ASTM C630; Type X, 5/8 inch thick, manufacturers fire rated, U.L. tested gypsum boards, maximum permissible length; ends square cut, tapered edges.
- C. Fiberglass Matt Faced Reinforced Gypsum Sheathing Board: ASTM C-1177; moisture resistant: 1/2 inch thick, maximum permissible length: ends square cut, water repellent inorganic glass fiber mat face.

### **2.03 ACCESSORIES**

- A. Acoustic Sealant: As specified in Section 07 90 00.
- B. Corner Beads: Galvanized steel.
- C. Edge Trim: U bead, as defined in ASTM C 840.
- D. Joint Materials: ASTM C475; GA 201 and GA 216; reinforcing tape, joint compound, adhesive, and water.
- E. Control Joint - Equal to USG No.093
- F. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
  - 1. Ready-mixed vinyl-based joint compound.
- G. Textured Finish Materials: Latex-based compound; plain.
- H. Screws: ASTM C 1002; self-piercing tapping type.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Verify that site conditions are ready to receive work and opening dimensions are as indicated on

drawings.

### **3.02 GYPSUM BOARD AND SHEATHING INSTALLATION**

- A. Comply with GA-216 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer non-rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing. Install in strict accordance with requirements of UL Assembly.
- C. Fiberglass Reinforced Gypsum Sheathing: Install horizontally, with edges butted tight and ends occurring over firm bearing. Tape all sheathing joints, edges and corners in accordance with manufacturers recommendations.
- D. Installation on Metal Framing: Use corrosion resistant screws for attachment of all gypsum board.

### **3.03 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as directed.
  - 1. Locate gypsum control joints not more than 25 feet apart on walls over 30 feet long. Where gypsum board runs continuous behind intersecting walls, calculate length of wall as total length and not as distance between intersecting walls.
  - 3. Locate joints to align with door or window jambs if possible. Consult with Architect to determine joint locations in open wall locations if not located on drawings.
  - 4. Leave a 1/2" continuous opening between gypsum boards for insertion of surface-mounted joint.
  - 5. Interrupt metal stud tracks at top and bottom of walls with a 1/2" gap and install studs on either side of the gap for attachment of gyp. bd. wherever a control joint is installed.
  - 6. Provide separate supports for each flange of control joint.
  - 7. Provide an adequate acoustical seal or safig insulation behind control joint where sound and/or fire ratings are required.
  - 8. Use one piece joints unless required length exceeds available joint length.
    - a. Cut to length with fine toothed hacksaw.
    - b. Cut ends square, butt together and align to provide neat fit if required length of joint prevents a one piece joint.
    - c. Attach control joint to gypsum board with drywall screws or equivalent, spaced at 12" O.C. Max. along both flanges.
- B. Corner Beads: Install at external corners, using longest practical lengths.
  - 1. Use longest practical length. Screw attach corner beads at 2'-0" o.c. maximum on both sides of each corner; do not rely on crimping alone.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### **3.04 JOINT TREATMENT**

- A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

### **3.05 TEXTURE FINISH**

- A. Apply finish texture coating by means of spraying apparatus or roller in accordance with manufacturer's instructions.
- B. Finish all gypsum board surfaces scheduled to receive paint with light orange peel texture.

### **3.06 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet, non-cumulative in any direction.

### **3.07 FINISH LEVEL SCHEDULE**

- A. Level 1: Above finished ceilings concealed from view.
- B. Level 2: Utility areas and areas behind cabinetry.
- C. Level 3: Walls scheduled to receive wall covering.
- D. Level 4: Walls and ceilings scheduled to receive flat or eggshell paint finish.
- E. Level 5: Walls and ceilings scheduled to receive semi-gloss or gloss paint finish.

**END OF SECTION**

## SECTION 09 22 16

### NON LOAD BEARING METAL STUD FRAMING SYSTEM

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Non load bearing cold formed metal stud wall and miscellaneous framing at interior and exterior locations.
- B. Framing accessories.

##### 1.02 RELATED SECTIONS

- A. Section 05 12 00 - Structural Steel: Steel framing for attachment of metal studs.
- B. Section 05 50 00 - Metal Fabrications: Metal fabrications attached to stud framing.
- C. Section 06 10 00 - Wood Framing, Blocking, Sheathing and Curbing: Rough wood blocking within stud framing.
- D. Section 07 21 16 - Board and Batt Insulation: Insulation within framing members.
- E. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard and sheathing.

##### 1.03 REFERENCES

- A. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- C. ASTM A591 - Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated.
- D. ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board.
- E. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board.
- F. GA 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum Board.
- G. Metal Framing Manufacturers Association (MFMA) - Guidelines for the Use of Metal Framing.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Contractor is responsible for fabrication and erection of steel stud framing to meet the requirements of the drawings and of the 2007 Arkansas Fire Prevention Code.

##### 1.05 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria and limitations.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing

compliance with requirements.

- D. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention, and connection details.
- E. Manufacturer's Data: Submit copies of manufacturer's specifications and installation instructions for each type of steel stud and accessories, including other data as may be required to show compliance with these specifications.
- F. Shop Drawings: Indicate stud dimensions and gauges, connections, general construction details, anchorages and methods of anchorage for exterior wall studs and studs hung from structure above. Provide professional seal and signature of structural engineer licensed in Arkansas.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, and with minimum ten years of documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum five years of experience.

#### **1.07 SYSTEM DESCRIPTION**

- A. Design Requirements: The supplier of metal framing components shall provide connections to the building structure in accordance with the ML/SFA Lightweight Steel Framing Systems Manual.
  - 1. Connections shall conform to the design loads required by the drawings and the Arkansas Fire Prevention Code.
  - 2. Connections shall be based upon information shown on the drawings and specified herein.
  - 3. Maximum deflection of exterior wall framing shall not exceed L/600 for wall framing that serves as backup for masonry veneer.
  - 4. 18 gauge studs are the minimum allowed for wall framing that will form the backup for masonry veneer.
- B. Installation of all cold formed metal framing shall conform to: AISI Specifications for the Design of Cold-Formed Steel Structural Members. Wall bridging shall be designed to provide resistance to minor axis bending and rotation of wall studs. All connections (member to member, and member to structure) shall be installed in accordance with the above standards.
- C. Qualification of Field Welding: Qualify welding process and welding operators in accordance with AWS "Standard Qualification Procedure."

#### **1.08 COORDINATION**

- A. Coordinate with the placement of components within the stud framing system.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Metal Framing:
  - 1. Clark Steel Framing Systems: [www.clarksteel.com](http://www.clarksteel.com).
  - 2. Dale/Incor: [www.daleincor.com](http://www.daleincor.com).
  - 3. Marino-Ware: [www.marinoware.com](http://www.marinoware.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.



## **2.02 FRAMING MATERIALS**

- A. Non Load-Bearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection for wall framing of L/240 at 5 psf for all framing that does not serve as backup for masonry veneer.
  - 1. Studs: C shaped with knurled faces.
  - 2. Runners: U shaped, sized to match studs.
  - 3. Furring: Hat-shaped sections, minimum depth as indicated on drawings.
  - 4. Resilient Channels: "Z" shaped sections designed to limit sound transmission.
- B. System components for exterior walls and shall be sized as follows:
  - a. Exterior studs shall be 6", 18 gauge min. for walls less than 14'-0" unbraced length.
  - b. Exterior studs shall be 6", 16 gauge min. for walls over 14'-0" and less than 16'-0" unbraced length.
  - c. Exterior studs shall be 8", 18 gauge min. for walls over 16'-0" unbraced length.
  - d. Minimum size for exterior wall studs shall be 6", 18 gauge.
- C. System components for interior walls and shall be sized as follows:
  - a. Interior studs shall be 22 gauge min. for non load-bearing walls less than 12'-0" unbraced length.
  - b. Interior studs shall be 20 gauge min. for non load-bearing walls over 12'-0" and less than 16'-0" unbraced length.
  - c. Interior studs shall be 18 gauge min. for non load-bearing walls over 16'-0" unbraced length.
  - d. Minimum size for studs, furring channels and accessories shall be 22 gauge.
- D. Tracks and Runners: Same material and thickness as studs, bent leg retainer.
- E. Fasteners: ASTM C 1002 self-piercing tapping screws.
- F. Anchorage Devices: Power actuated.
- G. Thermal and Acoustic Insulation: As specified in Section 07 21 16.
- H. Acoustic Sealant: As specified in Section 07 90 00.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

## **2.03 FABRICATION**

- A. Fabricate assemblies of framed sections to sizes and profiles required; with framing members fitted, reinforced, bridged and braced in accordance with design requirements.

## **2.04 FINISHES**

- A. Studs: Galvanize to G60 coating class.
- B. Tracks and Headers: Galvanize to G60 coating class.
- C. Accessories: Same finish as framing members.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that conditions are ready to receive work.

- B. Verify that rough-in utilities are in proper location.

### **3.02 ERECTION**

- A. Align and secure top and bottom runners at 24 inches o.c. minimum with power driven fasteners.
- B. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- C. Install studs vertically at 16 inches o.c., or as indicated on drawings to accommodate design requirements.
- D. Align stud web openings horizontally.
- E. Secure studs to tracks using screw fastening method at both flanges.
- F. Stud splicing not allowed.
- G. Fabricate corners using a minimum of three studs.
- H. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- I. Brace stud framing system rigid.
- J. Coordinate erection of studs with requirements of door frames, window frames, and masonry; install supports and attachments.
- K. Coordinate installation of wood bucks, anchors, and wood blocking to be placed within or behind stud framing.
- L. Blocking: Secure wood blocking to studs using self drilling, self tapping screws. Install blocking for support of aluminum storefront.

**END OF SECTION**

**SECTION 09 24 00**  
**PORTLAND CEMENT PLASTER**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies lathing and portland cement based exterior plaster.

**1.2 RELATED WORK**

- A. Section 05 40 00 - Cold-Formed Metal Framing: Steel framing members
- B. Section 09 21 16 – Gypsum Board Assemblies: Exterior Sheathing

**1.3 REFERENCES**

- A. ASTM International (ASTM):
  - A653/A653M-20 ..... Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - A1064/A1064M-18a ..... Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
  - C11-18b ..... Terminology Relating to Gypsum and Related Building Materials and Systems.
  - C91/C91M-18 ..... Masonry Cement
  - C150/C150M-20 ..... Portland Cement
  - C206-14 ..... Finishing Hydrated Lime
  - C207-18 ..... Hydrated Lime for Masonry Purposes
  - C260/C260M-10a(2016) ..... Air Entraining Admixtures for Concrete.
  - C847-18 ..... Metal Lath
  - C897-15(2020) ..... Aggregate for Job-Mixed Portland Cement Based Plasters
  - C926-20 ..... Application of Portland Cement-Based Plaster
  - C932-06(2019) ..... Surface-Applied Bonding Compounds for Exterior Plastering
  - C933-18 ..... Welded Wire Lath
  - C979/C979M-16 ..... Pigments for Integrally Colored Concrete
  - C1002-18 ..... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
  - C1063-19a ..... Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
  - E90-09(2016) ..... Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
  - E119-20 ..... Test Methods for Fire Tests of Building Construction and Materials

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00 – Submittals and Substitutions.
- B. Manufacturer's Literature and Data:
  - 1. Accessories for plaster, each type.
  - 2. Metal plastering bases, each type.
  - 3. Fasteners.
  - 4. Bonding compounds, including application instructions.
  - 5. Admixtures, including mixing and application instructions.
- C. Samples:
  - 1. Accessories for plaster, each type, not less than 6 inches long.
  - 2. Panel showing finish coat, color and specified reveal, 24-inches x 24-inches.
- D. Installers qualifications.

#### **1.5 DELIVERY, STORAGE AND PROTECTION**

- A. Deliver manufactured materials in the manufacturers' original unbroken packages or containers which are labeled plainly with the manufacturers' names and brands.
- B. Keep cementitious materials dry and stored off the ground, under cover, and away from sweating walls and other damp surfaces until ready for use.

#### **1.6 PROJECT CONDITIONS**

- A. Maintain work areas for interior work at a temperature of not less than 40 degrees F for not less than 48 hours prior to application of plaster, during application of plaster and 1 week after plaster has set or until plaster has dried.
- B. Do not apply exterior plaster when the ambient temperature is less than 40 degrees F, or when a drop in temperature below 40 degrees F is expected within 24 hours after application.
- C. Do not apply plaster to frozen surfaces or surfaces containing frost.
- D. Do not use frozen materials in the mix.
- E. Protect plaster coats against freezing for a period of not less than 24 hours after application.

#### **1.7 QUALITY ASSURANCE**

- A. Installers Qualifications: Work is to be performed by installer having a minimum of Ten (10) years' experience for work relating to this Section. Submit installer qualifications.
- B. Mockup: Build 10'x10' (100 square feet) mockup for each substrate and finish texture indicated for cement plastering including accessories.
- C. Approved mockups may become part of completed work.

### **PART 2 - PRODUCTS**

#### **2.1 METAL PLASTERING BASES**

- A. Expanded Lath:

1. ASTM C847, galvanized except as modified by ASTM C1063 and this specification. Self-furring where applied over solid backing.
  2. Flat diamond mesh weighing not less than 1.8 kg per square meter (3.4 pounds per square yard).
- B. Building Paper Backing for Metal Plastering Bases:
1. Water resistant paper backing attached to lath as specified in ASTM C933.

## **2.2 ACCESSORIES FOR CEMENT PLASTER:**

- A. Provide accessories that are roll formed galvanized steel, except that cornerite and strip lath that are formed from steel sheets with manufacturer's standard galvanized coating.
- B. Provide welded wire corner reinforcements of galvanized 1.4 mm (17 gauge) steel wire conforming to ASTM A1064/A1064M.
- C. Control Joints: ASTM C1063, zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanged and removable protective tape on plaster face of control joint.
- D. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A653/A653M, G60 (Z180) zinc coating.
- E. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
- F. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
- G. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
  1. Smallnose cornerbead with expanded flanges; use unless otherwise indicated on construction documents.
  2. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
- H. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
- I. Deep V Reveal: Flannery, Inc. Deep "V" Reveal, Model No. DV 75-150, ¾" D, 1 ½" W, Mill Finish for Field Priming and Painting.

## **2.3 FASTENERS**

- A. Tie, wire, screws, staples, clips, nails, and other fasteners ASTM C1063, except as otherwise specified.
- B. Provide fasteners for securing metal plastering bases having heads, or inserted through washers large enough to engage two (2) strands (two (2) on each side of screw) of the metal plastering base.
- C. For fire rated construction; provide fasteners of type and size as used in fire rated test.
- D. Screws: ASTM C1002.
- E. Expansion Shields: CID A-A-55615, of the Type and Class applicable.

## **2.4 CEMENT**

- A. Portland: ASTM C150/C150M, Type I.
- B. Masonry: ASTM C91/C91M, Type N.

## **2.5 LIME**

- A. ASTM C206, Type S; or ASTM C207, Type S. //

## **2.6 AGGREGATES (SAND)**

- A. ASTM C897, graded as required to suit texture of finish specified.

## **2.7 BONDING AGENT**

- A. ASTM C932.

## **2.8 FACTORY PREPARED FINISH COAT FOR CEMENT PLASTER //(STUCCO)//**

- A. Factory prepared dry blend of materials, integrally colored, designed for exterior finish coat application.
- B. Pigments: ASTM C979/C979M, lime proof mineral oxide.
- C. Particle Size: Not more than 35 percent, by weight of all ingredients, including cement, aggregate, hydrated lime, admixture and coloring pigment is to pass a number 100 sieve.

## **PART 3 - EXECUTION**

### **3.1 METAL PLASTERING BASES (LATH) LOCATIONS**

- A. Where shown use wire lath or stucco mesh.
- B. Where metal plastering bases are used as a base for exterior cement plaster over wall sheathing, provide wire lath or stucco mesh with water resistant backing.

### **3.2 APPLYING METAL PLASTERING BASES**

- A. In accordance with ASTM C1063, except as otherwise specified or indicated on construction documents.
- B. Lath with backing to be applied to produce a paper to paper and metal to metal lap at ends and sides of adjacent sheets, whether full sheets or less than full sheets are provided:
  - 1. Lap backing 50 mm (2 inches) for both horizontal and vertical laps.
  - 2. Install horizontal laps in a ship lap fashion to conduct water to the outside and over flashing or waterproofing.
- C. Do not install continuous metal plastering bases through expansion and control joints. Terminate at each side of joint.
- D. Attach lath directly to masonry and concrete with hardened nails, power actuated drive pins or other approved fasteners. Install fasteners at dimples or crimps only.
- E. Wood plugs are not acceptable.

### **3.3 INSTALLING PLASTERING ACCESSORIES**

- A. Install accessories in accordance with ASTM C1063, except as otherwise specified.
  - 1. Set plastering accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces.
  - 2. Install in one (1) piece, within the limits of the longest commercially available lengths.
- B. Corner Beads: External-corner reinforcement corner bead at exterior corners, as required to establish grounds.
- C. Strip Lath:
  - 1. Install centered over joints between dissimilar materials, such as hollow tile, brick, concrete masonry units, concrete, and joints with expanded lath on framing or furring, where both such

surfaces are required to be plastered and are in contact with each other in same plane, except where expansion joints and casing beads are required.

2. Wire tie or fasten strip lath to base along both edges at not over 152 mm (6 inches) on centers.

D. Casing Beads:

1. Provide at locations where shown on construction documents and at following locations where plaster terminates to provide finish trim:
  - a. Against non-plastered surfaces such as masonry, concrete, and wood.
  - b. Against trim of steel frames and trim of other materials and equipment, except where trim overlaps plaster.
  - c. Around perimeter of openings except where edge is covered by flanges. Locate to conform to dimensions shown on shop drawings.
  - d. Where plaster for new walls or furring (vertical or horizontal) terminates against existing construction.
  - e. Both sides of expansion and control joints unless shown otherwise on construction documents.
2. Provide at perimeter angles between walls and ceilings so as to provide floating angle (unrestrained) construction in accordance with ASTM C1063.

E. Cornerites:

1. Provide at interior corners of walls, partitions, and other vertical surfaces to be plastered, except where lath is carried around angle.
2. Fasten only as necessary to retain position during plastering.
3. Omit cornerites at junction of new plastered walls with existing plastered walls at locations where casing beads are specified.

F. Control Joints:

1. Where control joints are placed parallel to framing members, install joints within 101 mm (4 inches) of the framing member.
2. Install control joints only to the edges of abutting sheets of lath so that the lath is not continuous or tied across the joint.
3. Extend joints the full width and height of the wall or length of soffit/ceiling plaster membrane .

### **3.4 PORTLAND CEMENT BASED PLASTER**

- A. Provide portland cement based plaster where cement plaster is shown and specified, and as follows:
  1. Three-Coat work is to be used over all metal plastering bases, with or without solid backing.
- B. Proportion, mix and apply plaster in accordance with ASTM C926, except as otherwise specified.
  1. Provide air entrained plaster for all exterior work.
  2. Provide coloring pigments for finish coat when integral color other than white is specified.
  3. Color:
    - a. Provide natural cement color exterior plaster to be painted.
  4. Finish coat is to have a textured finish to match EIFS.

**END OF SECTION**



## SECTION 09 30 19

### FLOOR TILE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Porcelain paver floor finish using the thinset application method.
- B. Waterproofing Membranes at Restrooms
- C. Adhesives, grout and sealant for control joints.

##### 1.02 RELATED SECTIONS

- A. Section 03 35 00 - Concrete Floor Finishing.
- B. Section 07 90 00 - Joint Sealers: Mildew resistant sealant.
- C. Section 09 21 16 - Gypsum Board Assemblies: Wall surface for installation of base.
- D. Section 09 31 13 – Wall Tile

##### 1.03 REFERENCES

- A. ANSI A108.4 - Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive.
- B. ANSI A108.10 - Installation of Grout in Tilework.
- C. ANSI A118.4 - Modified Dry-Set Cement Mortar.
- D. ANSI A118.6 - Ceramic Tile Grouts.
- E. ANSI A136.1 - Organic Adhesives for Installation of Ceramic Tile.
- F. ANSI A137.1 - Standard Specifications for Ceramic Tile.
- G. TCA (Tile Council of America) - Handbook for Ceramic Tile Installation.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Indicate tile colors, grout colors, textures and setting details.
- C. Manufacturer's Instructions: Provide instructions for using adhesives and grouts.
- D. Tile Samples: Submit 2 samples of each tile and textures specified. Samples are to match size of tile specified. Submit actual samples of full range of manufacturers grout and matching sealant colors.
- E. Grout Samples: Submit Manufacturers full range of Grout colors.

- F. Substitutions for products specified under this section must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least seven calendar days before the bid date.

#### **1.05 MAINTENANCE DATA**

- A. Submit under provisions of Section 01 70 00.
- B. Maintenance Data: Include recommended cleaning methods, cleaning materials and stain removal methods for both tile and grout.

#### **1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with ANSI A137.1.
- B. Provide a 6 foot x 6 foot mock-up of the porcelain tile pavers indicating pattern and variance of color specified. Mock-up may remain as a portion of the work.

#### **1.07 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum ten years documented experience.

#### **1.08 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, protect and handle products to site in accordance with manufacturer's printed instructions
- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### **1.09 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install adhesives in an unventilated environment.
- B. Maintain 50 degrees F minimum during installation of adhesive and grout materials.

#### **1.10 EXTRA MATERIALS**

- A. Provide 100 square feet of each floor tile specified.

### **PART 2 PRODUCTS**

#### **2.01 TILE MANUFACTURERS**

- A. Refer to drawings for listed manufacturers.
- B. Substitutions for products specified under this section must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least seven calendar days before the bid date.

## **2.02 PRODUCTS: FLOOR TILE**

- A. TF
1. Manufacturer: Daltile
  2. Description/Number: Volume 1.0
  3. Color: Degrees Silver VL71
  4. Size: 12" x 24" x 5/16" thk
  5. Finish: Matte
  6. Grout Joint Width: 3/16"
  7. Installation Pattern: refer to drawings

## **2.02 ADHESIVE MATERIALS**

- A. Manufacturer: LATICRETE;
- B. Product: Epoxy Adhesive: ANSI 118.4 Thinset bond type. Multimax Lite

## **2.03 GROUT MATERIALS**

- A. Floor Tile Grout: LATICRETE SPECTRALOCK PRO Grout – Premium or approved equal, Non-Staining, No Sealing Required, meets or exceeds ANSI A118.3, color as selected by architect.
- B. Sealant: Sealant for floor tile control joints shall match grout color.

## **2.04 WATERPROOFING AND CRACK ISOLATION MEMBRANE**

- A. Waterproofing and Crack Isolation Membrane: MAPEI "Mapelastic" flexible cement based waterproofing and crack isolation membrane to be used under tile at all cracks in concrete floor over 1/16-inch wide. The use of Mapeband™ preformed accessories is mandatory at all angle interfaces, see manufacturer's installation instructions.

## **2.05 ACCESSORIES**

- A. Thresholds at all Restrooms Doorways or where tile meets Burnished Concrete:
- Genotek: Edge Reducer
  - Finish: TBD
  - Height: as required
- B. MAPEI Mapeband™ preformed accessories to be used in conjunction with MAPEI "Mapelastic" flexible cement based waterproofing and crack isolation membrane.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work.

### **3.02 PREPARATION**

- A. Protect surrounding work from damage or disfiguration.
- B. Vacuum clean surfaces and damp mop.

- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

### **3.03 INSTALLATION - THINSET METHOD**

- A. Install adhesive, tile, and grout in accordance with manufacturer's instructions and most recent issue of the TCA Handbook.
- B. Lay tile to pattern indicated on drawings to be provided by architect.
- C. Cut and fit tile tight to penetrations through tile. Form corners neatly. Form internal angles square and external angles bullnosed.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Sound tile after setting. Replace hollow sounding units.
- F. Allow tile to set for a minimum of 48 hours prior to grouting.
- G. Grout tile joints.
- H. Upon completion of grouting operations, saw cut control joints through tile corresponding to concrete floor slab control joints.
- I. Install sealant in control joints to match color of tile grout.

### **3.04 INSTALLATION - THINSET METHOD WITH WATERPROOFING MEMBRANE**

- A. Install MAPEI "Mapelastic" flexible cement based waterproofing and crack isolation membrane over 1/16-inch cracks or greater per manufacturer's instructions and TCA Handbook recommendations.
- B. Install Mapeband™ preformed accessories at all angle interfaces, see manufacturer's installation instructions.
- C. Install adhesive, tile and thresholds in accordance with manufacturer's instructions and most recent issue of the TCA Handbook. Place thresholds at exposed tile edges.
- D. Cut and fit tile tight to penetrations through tile. Form corners neatly. Form internal angles square and external angles bullnosed.
- E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Allow tile to set for a minimum of 48 hours prior to grouting.
- H. Grout tile joints.
- I. Upon completion of grouting operations, saw cut control joints through tile corresponding to concrete floor slab control joints.

### **3.05 CLEANING**

- A. Clean tile and grout surfaces.
- B. Clean adjacent surfaces soiled by tile and grout installation.

**3.06 PROTECTION OF FINISHED WORK**

- A. Protect finished Work under provisions of Section 01 50 00.
- B. Do not permit traffic over finished floor surface for 4 days after installation.
- C. Provide protective covering over finished floor surfaces prior to final acceptance.

**END OF SECTION**

## SECTION 09 31 13

### WALL TILE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Porcelain Wall tile finish using the thinset application method.

##### 1.02 RELATED SECTIONS

- A. Section 07 90 00 - Joint Sealers: Mildew resistant sealant.
- B. Section 09 21 16 - Gypsum Board Assemblies.
- C. Section 09 30 19 - Floor Tile.

##### 1.03 REFERENCES

- A. ANSI A108.4 - Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive.
- B. ANSI A108.9 - Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.
- C. ANSI A108.10 - Installation of Grout in Tilework.
- D. ANSI A118.6 - Ceramic Tile Grouts.
- E. ANSI A118.4 - Modified Dry-Set Cement Mortar.
- F. ANSI A137.1 - Standard Specifications for Ceramic Tile.
- G. TCA (Tile Council of America) - Handbook for Ceramic Tile Installation.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Indicate tile colors and grout colors.
- C. Manufacturer's Instructions: Provide instructions for using adhesives and grouts.
- D. Tile Samples: provide two samples of each color and texture of each tile type specified in size specified.
- E. Grout Samples: Submit Manufacturers full range of Grout colors.
- F. Substitutions for products specified under this section must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least seven calendar days before the bid date.

##### 1.05 MAINTENANCE DATA

- A. Submit under provisions of Section 01 33 00.

- B. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

#### **1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with ANSI A137.1.
- B. Conform to latest issue of the TCA Handbook.

#### **1.07 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum ten years documented experience.

#### **1.08 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, protect and handle products in accordance with manufacturer's instructions.
- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### **1.09 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install adhesives in an unventilated environment.
- B. Maintain 50 degrees F minimum during installation of adhesive and grout materials.

#### **1.10 EXTRA MATERIALS**

- A. Provide 50 sq ft of each size, color and surface finish of wall tile specified.

### **PART 2 PRODUCTS**

#### **2.01 TILE MANUFACTURERS**

- A. Daltile | [daltile.com](http://daltile.com)
- B. Substitutions for products specified under this section must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least seven calendar days before the bid date.

#### **2.02 MATERIALS**

- A. TW-1
  1. Manufacturer: Daltile
  2. Description/Number: Volume 1.0
  3. Color: Degrees Silver VL71
  4. Size: 12" x 24" x 5/16" thk
  5. Finish: Matte

6. Grout Joint Width: 3/16"
  7. Installation Pattern: refer to drawings
- B. TW-2
1. Manufacturer: Daltile
  2. Description/Number: Volume 1.0
  3. Color: Naval VL67
  4. Size: 12" x 24" x 5/16" thk
  5. Finish: Textured
  6. Grout Joint Width: 3/16"
  7. Installation Pattern: refer to drawings

### **2.03 ADHESIVE MATERIALS**

- A. Manufacturer: LATICRETE
- B. Product: Epoxy Adhesive: ANSI 118.4 Thinset bond type. Multimax Lite

### **2.04 GROUT MATERIALS**

- A. Wall Tile Grout: LATICRETE SPECTRALOCK PRO Grout – Premium or approved equal, Non-Staining, No Sealing Required, meets or exceeds ANSI A118.3, color as selected by architect.

### **2.04 ACCESSORIES**

- A. Finishing and Edge protection profile equal to Schuler at all tile exterior and interior corners.
  - a. Finish: Satin Anodized
  - b. Height: as required
  - c. Outside Corner: Schluter® - FINEC
  - d. Outside Edge: Schuler- JOLLY

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work.

### **3.02 PREPARATION**

- A. Protect surrounding work from damage or disfiguration.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

### **3.03 INSTALLATION - THINSET METHOD**

- A. Install adhesive tile and grout in accordance with manufacturer's instructions and TCA Handbook.
- B. Lay tile to pattern indicated on drawings.



- C. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Form internal angles square and external angles bullnosed.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Allow tile to set for a minimum of 48 hours prior to grouting.
- H. Grout tile joints.

**3.04 CLEANING**

- A. Clean tile and grout surfaces.
- B. Clean adjacent surfaces soiled by tile and grout installation.

**END OF SECTION**

## SECTION 09 51 13

### SUSPENDED ACOUSTICAL CEILINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

##### 1.02 RELATED SECTIONS

- A. Section 23 37 00 - Air Inlets and Outlets: Air diffusion devices in ceiling.
- B. Section 26 50 00 - Lighting: Light fixtures in ceiling system.

##### 1.03 REFERENCES

- A. ASTM C 635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2000.
- B. ASTM C 636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 1996.
- C. ASTM E 580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint; 2002.
- D. ASTM E 1264 - Standard Classification for Acoustical Ceiling Products; 1998.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data on ceiling tile and suspension system components.

##### 1.05 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

##### 1.06 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

##### 1.07 PROJECT CONDITIONS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustical units after interior wet work is dry.

##### 1.08 EXTRA MATERIALS

- A. See Section 01 60 00 – Material and Equipment, for additional provisions.
- B. Provide 200 sq ft of each type of acoustical unit for Owner's use in maintenance of project.

## PART 2 PRODUCTS

### 2.02 ACOUSTICAL UNITS

- A. Manufacturers:
1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com). - Specified
  2. USG: [www.usg.com](http://www.usg.com) – Specified for Vinyl Faced Tile
  3. Substitutions: See Section 01 33 00 - Submittals
- B. Suspended Acoustical Tile:
- SAT-1** Armstrong Ultima Ceiling #1922 with DuraBrite™ surface:
1. Size: 24 X 24 inches.
  2. Thickness: 3/4 inches.
  3. Composition: Wet Formed Mineral fiber.
  4. Edge: Tegular Chamfered for 9/16" Grid
  5. Surface Color: White
  6. Light Reflectance: Actual LR 0.88 according to ASTM E 1477 Requirements
- C. **SAT-2** Vinyl Faced Gypsum Lay-In Panels , ASTM E1264, equal to USG Sheetrock Brand Lay-In Ceiling Panel ClimaPlus, Vinyl. (Vinyl Faced Gypsum Lay-In Panel).
1. Size: 24 X 24 inches.
  2. Thickness: 1/2 inch.
  3. Composition: Gypsum.
  4. Edge: Square.
  5. Surface Color: White.
  6. Surface Finish: Factory-applied vinyl plastic film.
  7. Texture: Fine

### 2.02 SUSPENSION SYSTEM

- A. Manufacturers:
1. Armstrong World Industries, Inc: [www.ceilings.com](http://www.ceilings.com).
  2. USG: [www.usg.com](http://www.usg.com).
  3. Chicago Metallic Corporation: [www.chicagometallic.com](http://www.chicagometallic.com).
  4. Substitutions: See Section 01 33 00 - Submittals.
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, and perimeter moldings as required.
- C. Exposed Steel Suspension System for **SAT-1**: Formed steel, commercial quality cold rolled with galvanized coating; intermediate-duty.
1. Profile: Tee; 9/16 inch wide face.
  2. Construction: Double web.
  3. Finish: White painted.
  4. Product: Suprafine by Armstrong or approved equal.
- D. Exposed All Aluminum Suspension System for **SAT-2**: Formed steel, commercial quality, intermediate-duty, conforming to the following:
1. Profile: Tee; 15/16 inch wide face.
  2. Profile: Wall Angle; 15/16 inch wide face.
  3. Finish: White painted.
  4. Equal to Donn Brand Suspension System AX as manufactured by USG or Approved Equal.

## **2.03 ACCESSORIES**

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
  - 1. Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### **3.02 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
  - 2. Overlap and rivet corners.

### **3.03 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
  - 1. Cut to fit irregular grid and perimeter edge trim.

### **3.04 ERECTION TOLERANCES**

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

**END OF SECTION**

## **SECTION 09 65 00**

### **RESILIENT BASE**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Resilient base.

##### **1.02 RELATED SECTIONS**

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board for installation of base.

##### **1.03 REFERENCES** (Comply with the version year adopted by the Authority Having Jurisdiction)

- A. ASTM E84 - Surface Burning Characteristics of Building Materials.
- B. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- C. ASTM E662 – Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- D. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- E. ASTM F925 – Standard Test Method for Resistance to Chemicals of Resilient Flooring
- F. ASTM F970 – Standard Test Method for Static Load Limit
- G. ASTM F1514 – Standard Test Method for Measuring Heat Stability of Resilient Flooring by Color Change.
- H. ASTM F1515 – Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change.
- I. ASTM F 1861 - Standard Specification for Resilient Wall Base.
- J. ASTM F1914 – Standard Test Method for Short-Term Indentation and Residual Indentation of Resilient Floor Covering.
- K. ASTM D2047 -Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.

##### **1.04 SUBMITTALS**

- A. See Section 01 33 00- Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's Base and Colors specified.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

##### **1.05 DELIVERY, STORAGE, AND PROTECTION**

- A. Protect roll materials from damage by storing on end.

- B. Deliver, store, protect and handle products in accordance with manufacturer's recommendations

### **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- B. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

### **1.07 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Provide 30 linear feet of base for each type and color.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS - BASE**

- A. Resilient Base:
  - 1. RB1
    - a. Manufacturer: Tarkett
    - b. Type: Johnsonite Millwork Wall Finish System
    - c. Profile: Reveal MM-XX-F6
    - d. Color: 460 Cotton
  - 2. RB2
    - a. Manufacturer: Tarkett
    - b. Type: Johnsonite Traditional Vinyl 1/8"
    - c. Profile: Traditional Vinyl 4" 1/8
    - d. Color: 40 Black
  - 3. RB3
    - a. Manufacturer: Tarkett
    - b. Type: Johnsonite Millwork Wall Finish System
    - c. Profile: Reveal MM-XX-F6
    - d. Color: 92 Blue Lagoon
  - 4. RB4
    - a. Manufacturer: Tarkett
    - b. Type: Johnsonite Millwork Wall Finish System
    - c. Profile: Reveal MM-XX-F8
    - d. Color: 40 Black

- B. Length: Coiled roll sections, one continuous piece to be used for each wall.
- C. Premolded external corners and end stops not accepted.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that wall surfaces are smooth and flat within tolerances specified in Section 09 21 16, are dust-free, and are ready to receive resilient base.
- B. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting.
- C. Verify floor surfaces are free of substances that may impair adhesion of new adhesive and finish materials.

#### **3.02 INSTALLATION - BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.
- E. Apply resilient base to walls, columns, pilasters, casework and cabinet in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- F. Do not stretch resilient base during installation

#### **3.03 CLEANING AND PROTECTION**

- A. Comply with Manufacturer's written instructions for cleaning and protection of resilient products.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Damp-mop surfaces to remove marks and soil.
- D. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction periods.

#### **3.04 PROTECTION OF FINISHED WORK**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**



## **SECTION 09 68 00**

### **MODULAR CARPET**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Carpet material and installation placed with glue down method. The scope of this work includes the carpeting, complete, including carpet, adhesive, seaming, anchorage, edge treatment, and accessories, as indicated. Refer to Finish Floor Plan and Schedule for carpet locations.

##### **1.02 RELATED SECTIONS**

- A. Section 03 35 00 - Concrete Floor Finishing
- B. Section 09 65 00 - Resilient Base

##### **1.03 REFERENCES**

- A. ASTM D 2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2002.
- B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
- C. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2003.
- D. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 1996.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2000.

##### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Submit manufacturer's technical product data, including test laboratory reports, installation instructions, and maintenance instructions.
- C. Maintenance Materials: Deliver usable scrap materials to Owner's designated storage space as directed, properly packed/protected and identified.
- D. Samples: Submit two complete sets of color samples for each carpet material specified.

##### **1.05 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing specified carpet with minimum ten (10) years documented experience.
- B. Installer: Use thoroughly trained and experienced carpet installers who are completely familiar with the materials specified and the manufacturer's recommended methods of installation for the specified materials. The Installer Company shall possess a documented record of five (5) years specializing in the installation of commercial carpet, and shall be approved specifically by the specified manufacturer.

##### **1.06 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for flame/smoke rating requirements in accordance with ASTM E84.
- B. Conform to NFPA 253 and ASTM E648 Class I for flooring radiant panel test.
- C. Conform to ASTM D2859 for surface flammability ignition test.

##### **1.07 ENVIRONMENTAL REQUIREMENTS**

- A. Deliver all materials to the installation site in the manufacturer's original packaging and in good condition. Packaging to contain manufacturer's name and marks, identification number, shipping and handling instructions and related information.
- B. Delivered and stored materials must be available for inspection as required by the owner, architect, general contractor, and/or the manufacturer.
- C. Sub-floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document. Sub-floor preparation shall meet all conditions as specified in J+J Flooring's Modular Carpet installation instructions.
- D. Sub-floor preparation will include, as required, the removal and repair of the existing floor surface. It is required that the floor of a renovation project be inspected before the bid date.
- E. All materials, including adhesives, are to be delivered to the site of installation at a minimum of 48 hours prior to the start of installation and stored in a clean and dry room that measures above 65°F and below 95°F and measures between 10% and 65% relative humidity (RH). To maintain temperature and relative humidity, permanent heating and air conditioning systems (HVAC) must be in operation. Stack rolls horizontally and no higher than two rolls high on a flat surface. After work is completed, the ambient room temperature should remain at 65°F and relative humidity between 10% and 65% for 48 hours. These materials and related adhesives shall be protected from the direct flow of heat from heating fixtures and appliances such as hot-air registers, radiators, or other. Site conditions shall include those specified in the carpet manufacturer' installation manual and shall also include sufficient heat, light, and power required for effective and efficient working condition.
- F. Once the temperature and relative humidity in area for installation have been stabilized, loose lay the carpet within the installation area and allow it to precondition for 48 hours prior to installation. Carpet installation shall not commence until painting and finishing work is complete and ceiling and overhead work is tested, approved, and completed. Traffic shall be closed during the installation of the flooring products. Verify concrete slabs are dry per the standards for bond and moisture tests listed in the manufacturer's installation manual.

#### **1.08 MAINTENANCE DATA**

- A. Submit under provisions of Section 01 33 00.
- B. Maintenance Data: Include maintenance procedures, recommended maintenance materials and equipment, and suggested schedule for cleaning.

#### **1.09 EXTRA MATERIALS**

- A. Provide 100 sq.ft. (or 25 tiles) of carpeting of each type, color, and pattern specified.
- B. See Section 01 60 00 - Product Requirements, for additional requirements.

### **PART 2 PRODUCTS**

#### **2.01 MODULAR CARPET**

- A. Carpet Types
  - 1. C1: Equal to J+J Flooring | Series: Dapper 7913
    - a. Color: Facing 3424
    - b. Construction: Patterned Loop
    - c. Fiber Type: Encore® SD Ultima®
    - d. Dye Method: 100% Solution Dyed
    - e. Tufted Yarn Weight: 21 oz. per square yard
    - f. Gauge: 1/12"

- g. Rows per CM: 4.72
  - h. Primary Backing: Nexus® Modular
  - i. Tile Size: 12" x 48"
  - j. Total Thickness: .250 inches
- C. Installation Pattern: Refer to Finish Floor Plan and Schedule for installation methods.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Adhesive: Commercialon® Premium Modular Pressure Sensitive Adhesive, a premium modular flooring adhesive specifically formulated for bonding J+J Flooring's Nexus® Modular PVC backed carpet to the floor.
- C. Thresholds where Carpet meets Burnished Concrete:
  - Genotek: Round Edge Trim
  - Finish: TBD
  - Height: as required

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine and verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F 710; obtain instructions if test results are not within limits recommended by carpet manufacturer and adhesive materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.
- F. We require that the carpet be inspected prior to installation for proper style, color and potential defects. No claims will be honored if the carpet is installed with visible defects. Should there be a problem, call 800.241.4586, ext. 8210.

### 3.02 PREPARATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. SURFACE PREPARATION- Dust, dirt, debris and noncompatible adhesive must be removed before the installation begins. Surfaces must be smooth and level with all holes and cracks filled with Portland cement-based patch reinforced with polymers or primed with Commercialon Premium Sealer.
- C. LATEX OR OLD ADHESIVES - Must be mechanically scraped down to a bare residue flat with the concrete substrate or covered with a skim coat of Portland cement-based patch reinforced with polymers. Any old adhesive residue must also be covered with Commercialon Premium Sealer. Note: Failure to remove or seal old latex or cut back adhesive may cause installation failure, plasticizer migration, shifting, buckling or edge curling; these conditions will not be covered under warranty.
- D. CONCRETE MOISTURE TESTING and pH Testing - Substrate surfaces must be tested

for moisture emission. It is the responsibility of the owner or owner's representative to perform moisture testing prior to starting the installation. ASTM-F2170-2 relative humidity probe moisture testing or ASTM-F1869 calcium chloride testing can be performed on the concrete to determine the surface moisture emission rate. Acceptable relative humidity probe testing results are up to 90% RH. An acceptable result for calcium chloride moisture testing is up to 5 lbs per 1,000 SF per 24 hours. Alkalinity tests should also be performed per ASTM-F710. The maximum acceptable pH is 9.0. Carpet prefers relative humidity probe moisture testing over calcium chloride testing, as the results are more accurate and reliable. For test results that determine RH test readings of 90%-97%, moisture emission rates of 5 lbs - 8 lbs, or pH readings of 9.0 - 11.00, Commercialon Premium Sealer is required.

### **3.03 INSTALLATION – GENERAL**

- A. Install flooring in strict accordance with the finish drawings, manufacturer's instructions, and CRI Carpet Installation Standard. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- B. FULL SPREAD ADHESIVE SYSTEM- J+J Flooring requires a full spread adhesive system for installation of Nexus Modular (carpet tile). Fully spread Commercialon® Premium Modular Pressure Sensitive Adhesive using a 1/32 x 1/16 x 1/16 “U” or “V” notch trowel or spread using a 3/8” foam paint roller. Keep the roller saturated and wet with adhesive throughout the installation in order to maintain a constant spread rate. Allow to completely dry so adhesive does not transfer when touched. The spread rate for Commercialon Premium Modular Adhesive is approximately 120 sq. yds. per four gallon bucket. Nexus® Modular Spray Adhesive is available in a 14 lbs cylinder (coverage is approx. 165 sq yds). Note: Inadequate amounts of adhesive can cause modules to shift and move and will not be covered under warranty. Warranty coverage requires the use of Commercialon Premium Modular Adhesive. J+J Flooring will not be responsible for the adhesive bond where other adhesives have been used.
- C. TILE PLACEMENT - Arrows are embossed or printed on the module backing to show pile direction. To ensure proper alignment, check spacing every ten modules. Measure ten modules; proper spacing should be within ¼ inch. Continue to check spacing every ten modules throughout the entire installation.
- D. PALLET AND BUNDLE SEQUENCING - It is very important to install carpet modules in the order they were manufactured; this is easily accomplished by selecting pallets in sequential order and following the numbers located on each bundle. Typically, an installation will begin with the lowest bundle numbers and progress through the highest numbers until the project is complete. Installing modules by bundle sequence will assure the most even uniform look possible. (For layout and installation instructions refer to J+J Flooring Carpet Installation Handbook or CRI 104 Standards.)
- E. FLATWIRE CABLE / TRENCH HEADERS - Cable should be centered under modules and no adhesive used unless approved by the manufacturer. Trench headers require a control grid of adhesive on either side of header panels to prevent movement. It is highly recommended that these areas be installed ashlar.
- F. FINISHED INSTALLATION- Roll entire job with 75-100 lb. roller after completion of installation.

### **3.04 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces, using commercial machine with rotating agitator or beater nozzles. Remove spots, and replace carpet where spots cannot be removed. Remove protruding face yarn using sharp scissors.
- C. Remove excess debris and unusable scraps.

- D. LOOP PILE CONSTRUCTION--Carpet modules with loop pile constructions may experience yarn blossoming at the edges, which is consistent with this type of construction. Clipping or shearing the yarn edges can remedy this condition.

**END OF SECTION**

## SECTION 09 72 16

### WALL COVERINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Vinyl wall covering.

##### 1.02 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Assemblies

##### 1.03 REFERENCES

- A. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM F793 - Classification of Wall covering by Durability Characteristics.
- C. FS L-P-1040 - Plastic Sheets and Strips, Polyvinyl Fluoride.
- D. NFPA 255 - Test of Surface Burning Characteristics of Building Materials.
- E. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- F. G.S.A. Federal Specification CCC-W-408D, Type II Materials – Washability, Scrubbability, abrasion Resistance, Stain Resistance.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- D. Submit two 6" x 9" samples of each type of wallcovering specified with product name, pattern and color written on the back of each sample.
- D. Substitutions for products specified under this section must be presented as Requested Substitutions in writing to the Architect no later than ten (10) working days prior to the Bid Date, and shall be considered and/or formally approved or rejected by the Architect before the Bid Date.

##### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Applicator: Company specializing in performing the work of this section with minimum five years documented experience.

## **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or vinyl covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive wall covering.

## **1.07 EXTRA MATERIALS**

- A. Provide 30 linear feet of each color of wall covering.
- B. Package and label each roll by manufacturer, color and pattern, and store where directed.

## **PART 2 PRODUCTS**

### **2.01 VINYL WALL COVERING**

- A. Refer to Drawings for Wall Covering locations.
- B. **WX2:** Type II Medium Duty Vinyl Wallcovering Distributor: MDC
  - 1. Manufacturer: MDC
  - 2. Collection: Malta Linen
  - 2. Pattern Number: Navy Slate BBML21
  - 3. Backing: Osnaburg
  - 4. Total Weight: 20 oz. / linear yard
  - 4. Roll Width: 54 inches
  - 5. Pattern Match: Random Reversible
  - 6. Fire Rating: Class "A"
- C. Substitutions for products specified under this section must be presented as Requested Substitutions in writing to the Architect no later than seven (7) working days prior to the Bid Date, and shall be considered and/or formally approved or rejected by the Architect before the Bid Date.

### **2.02 INSTALLATION MATERIALS**

- A. Primer and Sealer: Type recommended by wall covering and adhesive manufacturer to suit application to substrate.
- B. Adhesive: Premium Grade, Full Strength, Heavy Duty Clear, Strippable, Mildew Resistant Type recommended by wall covering manufacturer to suit application to substrate.
- C. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are sized and ready to receive work, and conform to requirements of the wall covering manufacturer.

- B. Verify flatness tolerance of surfaces does not vary more than 1/4 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

### **3.02 PREPARATION**

- A. Fill cracks and smooth irregularities with filler; sand smooth.
- B. Sand glossy surfaces; seal marks which may bleed with shellac.
- C. Remove electrical, telephone, and other wall plates, covers and grilles.
- D. Apply one coat of wall size to substrate surfaces. Allow to dry.
- E. Vacuum clean surfaces free of loose particles.

### **3.03 INSTALLATION**

- A. Apply adhesive and wall covering in accordance with each manufacturer's printed instructions.
- B. Apply adhesive to fabric surface immediately prior to application of wall covering.
- C. Use wall covering in roll number sequence.
- D. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
- E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface. Butt edges tight.
- F. Horizontal seams are not acceptable.
- G. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
- H. Install wall covering before installation of bases, cabinets, hardware, or items attached to or spaced slightly from wall surface. Do not install wall covering more than 1/4 inch below top of resilient base.
- I. Remove excess wet adhesive from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

### **3.04 CLEANING**

- A. Clean wall coverings of excess adhesive, dust, dirt and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this Section.

### **3.05 PROTECTION OF FINISHED WORK**

- A. Protect finished Work under provisions of Section 01 50 00.
- B. Provide protective coverings as required to prevent damage to wall coverings.

**END OF SECTION**



## SECTION 09 84 33

### SOUND ABSORBING WALL UNITS

#### PART 1 GENERAL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.01 SECTION INCLUDES

- A. Custom fabricated acoustic wall panels.

##### 1.02 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Assemblies

##### 1.03 REFERENCES

- A. ASTM International:
- B. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

##### 1.04 SYSTEM DESCRIPTION

- A. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
  - 2. Flamespread: 25 maximum.
  - 3. Smoke Developed: 250 maximum.

##### 1.05 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples for verification: For each type of acoustic unit, showing all components and with required finishes, in manufacturer's standard size unless otherwise indicated as follows:
  - 1. Sample size: not less than 12" x 12" square, including a corner
  - 2. Exposed Accessories: full size sample
- E. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Panels larger than 24" x 24": provide 3 panels for attic stock
  - 2. Panels smaller than 24" x 24": provide 5 panels of attic stock in each color way.

3. Accessories and mounting devices: full size units equal to 5%, but no fewer than 5 units.
- F. Test Reports: Certified test reports showing compliance with specified performance requirements.
1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

#### **1.06 DELIVERY, STORAGE & HANDLING**

- A. General: Comply with Division 01 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

#### **1.07 PROJECT CONDITIONS**

- A. Temperatures
1. Maintain substrate surface and ambient temperatures above 55 degrees F, unless required otherwise by manufacturer's instructions.
  2. Do not apply adhesive when substrate surface temperature or ambient temperature is below 55 degrees F.
  3. Maintain these conditions 72 hours before, during, and after installation of vinyl wallcovering.
- B. Lighting: Provide not less than 80 foot candles per square foot minimum, measured mid-height on the surfaces to receive wallcoverings.
- C. Wall Condition
1. The wall surface should be clean, dry, structurally sound, and free of mildew, grease, dust, or other stains.
  2. Remove any existing wallcovering and adhesive.
  3. Plaster and masonry wall surfaces should not exceed 5.5% moisture when measured by a BD-8 Delmhorst moisture meter. Gypsum board wall surfaces should not exceed 16% moisture.
  4. Room humidity should not exceed 90%.
  5. Wall surfaces should be primed with a quality wallcovering primer as approved by manufacturer. Wall surfaces with significant color variation should be primed with a good quality pigmented wallcovering primer.
  6. New plaster should age 60-90 days before painting or installing wallcovering.

### **PART 2 - PRODUCTS**

#### **2.01 ACOUSTICAL WALL PANELS**

- A. Manufacturer: Frsch Acoustic Solution
1. All Acoustical Wall Panels shall be the product of one distributor.

#### **2.02 MANUFACTURED UNITS**

- A. Acoustic Panel with Linear Wood Slats XW1 and XC2:
  - 1. Manufacturer: Fräsch
  - 2. Product: Stratawood
    - 1. Construction: 9 mm 100% PET, MDF, Wood Veneer
    - 2. Thickness: 22 MM, .87" inches
    - 3. Size: 24 inch x 96 inch panel.
    - 4. Pattern: as indicated on drawings.
    - 5. Edge Detail: Square
    - 6. Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
      - a. 22mm (.87") Panel: 0.55, minimum.
    - 7. Mounting Accessories:
      - a. Adhesive as recommended by manufacturer.
      - b. Flannery Extrusion: Side J Trim (HWL-EXT-SDTM-22MM-J-BL) as indicated on drawings for locations.
      - c. Flannery Extrusion: Center H Trim (HWL-EXT-SDTM-22MM-H-BL) as indicated on drawings for locations.

### **2.03 FABRICATION**

- A. General: Utility knife, panel saw or oscillating knife on CNC machine

## **PART 3 - EXECUTION**

### **3.01 CONSTRUCTION WASTE MANAGEMENT**

- A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

### **3.02 MANUFACTURER'S INSTALLATION INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

### **3.03 EXAMINATION**

- A. Site Verification of Conditions: Verify that substrate or supporting structure, which has been previously installed under other sections, is acceptable for product installation in accordance with manufacturer's instructions.
- B. Hard Side:
  - 1. Verify that stud spacing is 16 inches (406 mm) on center, maximum, for panels installed over open studs.
  - 2. Do not install panels until unsatisfactory conditions are corrected.

### **3.04 CLEANING**

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.

- B. Keep site free from accumulation of waste and debris.

**END OF SECTION**

## SECTION 09 90 00

### PAINTS AND COATINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. See Schedule - Surfaces to be Finished at end of Section.

##### 1.02 RELATED SECTIONS

- A. Section 05 12 00- Structural Steel: Shop-primed items to be painted.
- B. Section 05 31 33 - Steel Roof Deck; Shop-primed items to be painted.
- C. section 05 50 00 - Metal Fabrications: Shop-primed items to be painted.
- D. Section 06 12 50 - Tongue and Groove Wood Decking: Wood ceiling and wood roof decking (to be factory finished or site stained and finished at contractor's option).
- E. section 06 18 10 – Glued Laminated Structural units: Laminated wood beams (to be factory finished or site stained and finished at contractor's option).
- F. Section 06 20 00 - Finish Carpentry: Woodwork to be finished.
- G. Section 06 41 00 - Custom Wood Cabinets: Woodwork to be finished.
- H. Section 08 11 00 - Steel Doors and Frames: Shop-primed items to be painted.
- I. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board to be painted.

##### 1.03 REFERENCES

- A. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2000.
- B. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Reapproved 1997).
- C. NACE (IMP) - Industrial Maintenance Painting; NACE International; Edition date unknown.
- D. SSPC (PM1) - Steel Structures Painting Manual, Vol. 1, Good Painting Practice; Society for Protective Coatings; Fourth Edition.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide data on all finishing products.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures.
- D. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.

## **1.06 DELIVERY, STORAGE, AND PROTECTION**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

## **1.07 ENVIRONMENTAL REQUIREMENTS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## **1.08 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply 5 gallons of each color; store where directed.
- C. Label each container with color in addition to the manufacturer's label.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Provide paints, enamels, stains, varnishes, and admixtures of first line quality as manufactured by Sherwin Williams, Pratt and Lambert, Glidden, Benjamin Moore, or Pittsburgh Paints.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 ACCESSORY MATERIALS**

- A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

### **3.02 PREPARATION**

- A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim,

escutcheons, and fittings prior to preparing surfaces or finishing.

- B. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- G. Interior Wood Items to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- H. Interior Wood Items to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- I. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- J. Metal Frames and Doors to be Painted: Prime metal door top and bottom edge surfaces.

### **3.03 APPLICATION**

- A. Apply products in accordance with manufacturer's instructions.
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand wood surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

### **3.04 CLEANING**

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

### **3.05 SCHEDULE - SURFACES TO BE FINISHED**

- A. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically noted.
  - 2. Fire rating labels, equipment serial numbers and capacity labels.
  - 3. Stainless steel items.
- B. Paint the surfaces described below under Schedule - Paint Systems.

### 3.06 SCHEDULE - PAINT SYSTEMS

- A. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically noted.
  - 2. Fire rating labels, equipment serial numbers and capacity labels.
  - 3. Stainless steel items.
- B. Exposed Steel Structure (Columns, Beams, Channels, Angles, Braces, Lintels, Steel Decking, etc.):
  - 1. First Coat: Exterior alkyd Rust inhibitive primer equal to SW Kem Bond HS Universal Metal Primer.
  - 2. Second and Third Coats: Exterior alkyd semi-gloss enamel equal to SW Industrial Enamel B55Z600 series.
- C. Exposed Factory Primed Metal (metal doors, access doors, etc.):
  - 1. Touch-Up: Exterior alkyd Rust inhibitive primer equal to SW Kem Bond HS Universal Metal Primer.
  - 2. Second and Third Coats: Exterior alkyd semi-gloss enamel equal to SW Industrial Enamel B55Z600 series.
- D. Gypsum Board Walls:
  - 1. First Coat: Latex wall primer equal to SW PrepRite Classic Latex Primer B28W101 mixed with joint compound to create light orange peel texture.
  - 2. Second and Third Coats: Interior acrylic latex enamel equal to SW ProClassic Waterborne Acrylic B31 series – Satin Finish.
- E. Gypsum Board Ceilings:
  - 1. First Coat: Latex wall primer equal to SW PrepRite Latex Primer B28W200 mixed with joint compound to create light orange peel texture.
  - 2. Second and Third Coats: Interior acrylic latex enamel equal to SW ProMar 200 Latex Flat, B30W200 Series –Flat Finish.
- F. Hollow Metal Doors and Frames:
  - 1. Touch-Up: Exterior alkyd Rust inhibitive primer equal to SW Kem Bond HS Universal Metal Primer.
  - 2. Second and Third Coats: Exterior alkyd semi-gloss enamel equal to SW Industrial Enamel B55Z600 series.
- G. Interior Wood Trim, Paneling, Wood Bases and Millwork to receive transparent finish:
  - 1. First Coat: Wipe On Stain equal to Sherwin Williams Sherwood BAC Wiping Stain – Custom Color
  - 2. Second Coat: Sherwin Williams Lacquer Sealer
  - 3. Third and Fourth Coats: Sherwin Williams Sher-Wood Catalyzed Lacquer
- H. Exposed Exterior Glu-Lam Columns
  - 1. 3 Coats: Helmsman Spar Urethane – Satin Finish.
- I. Custom Wood Doors
  - 1. First Coat: Wipe On Stain equal to Sherwin Williams Sherwood BAC Wiping Stain – Custom Color
  - 2. Second Coat: Sherwin Williams Lacquer Sealer
  - 3. Third and Fourth Coats: Sherwin Williams Sher-Wood Catalyzed Lacquer
- J. Exterior Stucco:
  - 1. First Coat: Exterior acrylic concrete and masonry primer equal to SW Loxon Concrete and Masonry Primer LX02W0050
  - 2. Second and Third Coats: Exterior latex equal to SW Super Paint A-89– Satin Finish.



- K. Exterior Wood Siding:
  - 1. First Coat: Exterior transparent oil based wood stain and preservative equal to SW SuperDeck® Exterior Transparent Wood Stain-250.
- L. Exterior PVC trim:
  - 1. First Coat: Exterior acrylic latex wood primer equal to SW A-100 Exterior Latex Wood Primer B42W41.
  - 2. Second and Third Coats: Exterior acrylic latex equal to SW Duration Exterior Latex Acrylic Coating K32 series – Semi-Gloss Finish.

**END OF SECTION**

## SECTION 09 90 10

### CORNER PROTECTION

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Solid Vinyl Corner Guards.
- B. Stainless Steel Corner Guards.

##### 1.02 RELATED SECTIONS

- A. Section 09 21 16 - Gypsum Board Systems
- B. Section 09 90 00 - Paints and Coatings

##### 1.03 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
- B. FS L-P-1040 - Plastic Sheets and Strips (Polyvinyl Fluoride); Federal Specifications and Standards; Revision B, 1977.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide data on corner guards and adhesive.
- C. Samples: Submit two complete sets of samples of full range of colors, finish, and texture options.
- D. Manufacturer's Installation Instructions: Indicate special procedures.
- E. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience.

##### 1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Inspect materials upon arrival at site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

##### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

##### 1.08 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply 2 extra full height corner guards; store where directed.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURER**

- A. InPro Corporation; Product: 1-1/2" X .080" Tape-On Rigid Vinyl Corner Guards.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 MATERIALS**

- A. CG1: Vinyl Outside Corner Guards: Refer to Finish Floor Plan for outside corners that shall receive 1-1/2" x 1-1/2" x full height (minus height of scheduled base) tape-on textured vinyl outside corner guards.
- B. CG2: Stainless Steel Outside Corner Guards: Refer to Finish Floor Plan for outside corners that shall receive 1-1/2" x 1-1/2" x full height (minus height of scheduled base) tape-on.
- C. Corner Guards shall be full height from top of base to ceiling.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work, and conform to requirements of the corner guard manufacturer.
- B. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

### **3.02 PREPARATION**

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Vacuum clean surfaces free of loose particles.

### **3.03 INSTALLATION**

- A. Apply corner guards in accordance with manufacturer's instructions.
- B. Horizontal seams are not acceptable.
- C. Install corner guards after installation of base.
- D. Install corner guards full height from top of base to ceiling.

### **3.04 SCHEDULE**

- A. Refer to the Drawings (Finish Plans) for locations.

**END OF SECTION**

## SECTION 10 11 00

### VISUAL DISPLAY BOARDS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Markerboards, and Tackboards.
- B. Trim and accessories.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Wood Framing, Blocking, Sheathing and Curbing: Wood blocking in walls for attachment of Visual Display Boards.
- B. Section 09 21 16 - Gypsum Board Assemblies: Wall surfaces.

##### 1.03 REFERENCES

- A. AHA A135.4 - Basic Hardboard; American Hardboard Association; 1995.
- B. ANSI A208.1 - American National Standard for Particleboard; 1999.
- C. ASTM A 424 - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2000.
- D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
- E. ASTM F 793 - Standard Classification of Wallcovering by Durability Characteristics; 1993 (Reapproved 1998).
- F. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, tackboard surface covering, and trim.
- D. Manufacturer's printed installation instructions.
- E. Maintenance Data: Include data on regular cleaning, stain removal, and maintenance.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

##### 1.06 WARRANTY

- A. See Section 01 33 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Visual Display Boards:
  - 1. Claridge Products and Equipment, Inc; Product Series 5 markerboards:  
[www.claridgeproducts.com](http://www.claridgeproducts.com).
  - 2. Substitutions: Refer to Section 01 60 00 - Product Requirements.

### **2.02 VISUAL DISPLAY BOARDS**

- A. Markerboards: Porcelain enamel on steel, laminated to core equal to Claridge "LCS" writing surface.
  - 1. Color: As selected from manufacturer's full range.
  - 2. Metal Face Sheet Thickness: 0.024 inch (24 gage).
  - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
  - 4. Backing: Aluminum foil, laminated to core.
  - 5. Size: As indicated on drawings.
  - 6. Frame: Extruded aluminum, with concealed fasteners.
  - 7. Frame Finish: Anodized, natural.
  - 8. Accessories: Provide full length chalk tray and map rail.
- B. Mounting Brackets: Concealed

### **2.03 MATERIALS**

- A. Porcelain Enameled Steel Sheet: ASTM A 424, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Cores: AHA A135.4, Class 1 - Tempered, S2S (smooth two sides).
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

### **2.04 ACCESSORIES**

- A. Grip-A-Strip display rails: Equal to "Grip-A-Strip" by Advantus Corp. [www.advantus.com](http://www.advantus.com).
  - 1. Finish: Satin Aluminum
  - 2. Mounting: Concealed Mounting Brackets
  - 3. Length: As indicated on drawings
- B. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- C. Marker Tray: Aluminum, manufacturer's standard profile one piece full length of chalkboard, molded ends; concealed fasteners, same finish as frame.
- D. Mounting Brackets: Concealed.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

### **3.02 INSTALLATION**

- A. Install boards in accordance with manufacturer's instructions.

- B. See Section 06 10 00 for placement of concealed supports in wall construction.
- C. Install with top of chalk tray at 30 inches above finished floor.
- D. Secure units level and plumb.
- E. Butt Joints: Install with tight hairline joints.

**3.03 CLEANING**

- A. Clean board surfaces in accordance with manufacturer's instructions.

**3.04 SCHEDULE**

- A. Refer to Drawings for schedule and location of visual display boards.

**END OF SECTION**

## SECTION 10 16 50

### PHENOLIC TOILET COMPARTMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Phenolic core toilet compartments
- B. Urinal screens; Floor-Anchored.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 –Blocking, Sheathing and Curbing: Concealed wood blocking for partition support.
- B. Section 10 80 10 - Toilet Accessories
- C. Section 09 30 19 - Floor Tile
- D. Section 09 31 13 - Wall Tile

##### 1.03 REFERENCES

- A. ANSI A208.1 - American National Standard for Particleboard; 1999.
- B. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2000.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2000.
- D. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Shop Drawings
  - 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show locations of centerlines of toilet fixtures.
  - 4. Show locations of floor drains.
- C. Product Data:
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- D. Samples: Submit two samples of partition panels, 4 x 4 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

##### 1.05 COORDINATION

- A. Coordinate the work with placement of support framing and anchors in wall.

## **1.06 QUALITY ASSURANCE**

- A. Manufacturer: Provide products manufactured by a company with a minimum of 10 years successful experience manufacturing similar products.
- B. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.
- C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.

## **1.07 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

## **1.07 WARRANTY**

A. Manufacturer's Warranty: Manufacturer's standard 10 year warranty for materials and workmanship. Manufacturer's standard 10 year guarantee against defects in material and workmanship for door hardware, frame and mounting brackets

## **PART 2 PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: **75** or less.
  - 2. Smoke-Developed Index: 450 or less.

### **2.02 PHENOLIC CORE TOILET COMPARTMENTS**

- A. Alpaco Toilet Compartments: Black core phenolic, Alpaco Classic - floor anchored, overhead braced with pedestal legs.
- B. Urinal Screens: Black phenolic, wall hung
- C. Design Criteria:
  - 1. Accessibility: Design compartments indicated on drawings to comply with ICC A117.1 and ADA Standards.
  - 2. Black Core Phenolic Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, Class B, when tested in accordance with ASTM E84.
  - 3. Fabrication:
  - 4. Fabricate toilet compartment components to sizes indicated.



5. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.
6. Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
7. Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.

### **2.03 COMPONENTS**

- A. Door Construction: : Phenolic-resin impregnated, wood-based product core with melamine-impregnated decorative surface papers and transparent, protective topcoat; NEMA LD 3 Compact Laminate.
  1. Finish: Matte.
  2. Black Core Phenolic Color:
  3. Privacy: provide interlocking doors and pilasters with integral Zero Sightline System routed edges
- B. Alpaco Classic Door, Panel, and Pilaster Dimensions:
  1. Thickness: 1/2 inch (13 mm).
  2. Door and Panel Height: 76-3/4 inches (1950 mm).
  3. Pilaster Height: 78-3/4 inches (2000 mm).
- C. Alpaco Classic and Alpaco Elegance Panel or Pilaster Pedestal Legs: Brushed stainless steel, adjustable in height plus or minus to 1 inch (25 mm) to support panel 9 inches (229 mm) above finished floor.
  1. Alpaco Classic Head Rails: Extruded aluminum headrail, octagonal in cross-section, powder -coated black.

### **2.04 MATERIALS**

- A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless Steel Castings: ASTM A743/A743M.
- C. Zamac: ASTM B86, commercial zinc-alloy die castings, chrome plated.
- D. Phenolic Panels: Monolithic core of phenolic resin, reinforced with cellulose fibers, manufactured under high pressure and at high temperatures, with melamine-impregnated decorative surface papers; NEMA LD 3, Compact Laminate.

### **2.05 2.05 HARDWARE AND ACCESSORIES**

- A. Brackets
  1. (Fittings): Continuous Type: Manufacturer's standard design; stainless steel
- B. Alpaco Door Hardware:
  1. Hinges: Brushed stainless steel barrel hinges.
  2. Latch and Keeper: Brushed stainless steel latch with occupancy indicator.
  3. Coat Hook: Brushed stainless steel. Manufacturer's Alpaco coat hook with rubber bumper; one per compartment, mounted on door.
  4. Door Pull: Brushed stainless steel. Provide door pull for outswinging doors. Provide on both sides of doors designated as accessible.
  5. Door Bumper: Brushed stainless steel. Provide rubber-tipped door bumpers at outswinging doors.
- C. Attachments, Screws, and Bolts: Stainless steel, tamper-resistant type.
  1. For Attaching Panels and Pilasters to Brackets: Sex-type through-bolts and nuts, tamper-resistant.
- D. Toilet Partition Suspension Members: See Section 05 50 00

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

### **3.02 INSTALLATION**

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
  - 1. Verify blocking and supports in walls have been installed properly at points of attachment.
  - 2. Verify location does not interfere with door swings or use of fixtures.
  - 3. Use fasteners and anchors suitable for substrate and project conditions
  - 4. Install units rigid, straight, plumb, and level.
  - 5. Conceal evidence of drilling, cutting, and fitting to room finish.
  - 6. Test for proper operation.
  - 7. Verify that gaps between fascia panels and doors are blocked and ensure privacy.
- B. Attach panel brackets securely to walls using anchor devices.
- C. Attach panels and pilasters to brackets. **Locate head rail joints at pilaster centerlines.**
- D. Field touch-up of scratches or damaged finish not permitted. Replace damaged or scratched materials with new materials.

### **3.03 ERECTION TOLERANCES**

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

### **3.04 ADJUSTING**

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

### **3.05 CLEANING**

- A. SEE SECTION 017000 - EXECUTION AND CLOSEOUT REQUIREMENTS FOR ADDITIONAL REQUIREMENTS.
- B. CLEAN PARTITION AND SCREEN SURFACES WITH MATERIALS AND CLEANSERS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

**END OF SECTION**

## SECTION 10 26 00

### IMPACT-RESISTANT WALL PROTECTION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Impact-resistant wall coverings.

##### 1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include sections, details, and attachments to other work.
- C. Samples: For each type of unit and for each color and texture required.
- D. Maintenance data.

##### 1.03 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

##### 1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

##### 2.02 MATERIALS

- A. Plastic Sheet Wall Covering Material: Semirigid, high-impact-resistant PVC or acrylic-modified vinyl plastic sheet with integral color throughout.
- B. Fasteners: Nonmagnetic stainless steel; security-type where exposed to view.

## **2.03 IMPACT-RESISTANT WALL COVERINGS**

- A. Semirigid, Impact-Resistant Sheet Wall Covering FRP: Fabricated from plastic sheet wall covering material.
  - 1. Manufacturer:
    - a. Marlite.
  - 2. Size: 48 by 96 inches for sheet.
    - a. All walls in Janitor 104 and Janitor 121.
    - b. As noted on the drawings behind all emergency shower and eyewash systems.
  - 3. Finish: Smooth
  - 4. Color: S 100 S/2/S White
  - 5. Sheet Thickness: 0.093 inch.
  - 6. Color and Texture: See Owner's Finish Specifications
  - 7. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color at all seams and exposed panel edges.
  - 8. Mounting: Adhesive.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
- C. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- D. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

**END OF SECTION**

## SECTION 10 44 20

### METAL LETTERS AND CAST BRONZE PLAQUE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Exterior cast metal letters.
- B. Interior flat cut metal letters.
- C. Cast Bronze Plaque.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 – Wood Framing, Blocking, Sheathing and Curbing: In-wall blocking for mounting interior letters and plaque.
- B. Section 09 21 16 - Gypsum Board Assemblies: Substrate for mounting letters and plaque.

##### 1.03 REFERENCES

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 1998.

##### 1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals and Substitutions, for submittal procedures.
- B. Shop Drawings: Indicate letter and plaque styles, lettering font and background colors.
- D. Manufacturer's Installation Instructions: Include installation template and attachment devices.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURER

- A. Gemini Incorporated, [www.signletters.com](http://www.signletters.com).
- B. Substitutions: In accordance with Section 01 60 00 - Product Requirements.

##### 2.02 EXTERIOR CAST METAL LETTERS

- A. Material: Cast Aluminum
  - 1. Depth: 1 inch
  - 2. Height: 12 inches.
  - 3. Profile: Flat face.
- B. Character Style:
  - 1. Finish: Brushed.
  - 2. Font: PALATINO SEMIBOLD
  - 3. Case: Upper Case Only
  - 4. Mounting: Concealed Studs.
- C. Text:
  - 1. ARKANSAS FOREST HEALTH RESEARCH CENTER
- D. Logo: 3/8" thick powder coated steel mounted to wall with studs.

1. UAM Historic A&M interlocked Logo.



### **2.03 INTERIOR FLAT CUT METAL LETTERS FOR WALL MOUNTING**

- A. Material: Cast Aluminum
  1. Depth: 1" inch.
  2. Height: 12 inches.
  3. Profile: Flat face.
- B. Character Style:
  1. Finish: Painted Aluminum.
  2. Font: PALATINO SEMIBOLD
  3. Case: Upper Case Only
  4. Mounting: Concealed Studs.
- C. Text: refer to drawings, and coordinate with owner for final text and letter count.

### **2.04 CAST BRONZE PLAQUE**

- A. Cast bronze plaque shall be 24" wide by 36" tall with manufacturers standard double line beveled edge border, textured background and concealed stud mounting.
- B. Plaque text shall be similar to the example pictured on page 10 44 20-4, except that the names may be different. The text may be reconfigured to accommodate the dimensions of the actual plaque. The text shall be as large as possible while still conforming to the overall plaque size. Approval by owner of the plaque layout and lettering is required before manufacturing plaque. Manufacturer to provide mock-up for owner's approval.

### **2.06 ACCESSORIES**

- A. Provide mounting templates for all letters and plaque.
- B. Silicone Adhesive.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install signs after walls are finished, in location s as directed by the Architect or Owner.

# **ARKANSAS FOREST HEALTH RESEARCH CENTER**



**The University of Arkansas  
at Monticello**

**Dedicated May 14, 2026**

**Governor: Sarah Huckabee-Sanders**

**President: Dr. Donald R. Bobbitt**

**Chancellor: Peggy Doss**

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<b>Kevin Crass</b>	<b>Scott Ford</b>

**Architects: SCM Architects, PLLC**

**General Contractor: Clark**

## SECTION 10 52 00

### FIRE EXTINGUISHERS AND CABINETS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Fire extinguishers
- B. Fire extinguisher cabinets.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry: Wood framing and blocking for attachment of fire extinguisher cabinets.
- B. Section 09 22 16 - Non-Load Bearing Metal Stud Framing System: Metal stud framing for attachment of fire extinguisher cabinets.
- C. Section 09 21 16 - Gypsum Board Assemblies: Adjacent wall finish.

##### 1.03 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. J.L. Industries, Inc; Product 1027F17: [www.jlindustries.com](http://www.jlindustries.com).
- B. Substitutions: See Section 01 60 00 - Product Requirements.

##### 2.02 FIRE EXTINGUISHERS

- A. Dry Chemical Type: Heavy duty steel tank, with pressure gage.
  - 1. J.L. Industries "Cosmic 10E"
  - 2. Type A, B, C.
  - 3. Size 10 lb.
  - 4. Size and classification as scheduled.
  - 5. Finish: Baked enamel, color as selected.

##### 2.02 FIRE EXTINGUISHER CABINETS

- A. Aluminum, semi-recessed – indicated as FEC on floor plans.
  - 1. J.L. Industries "Academy" 1027F17 or equal.
  - 2. Metal: Formed aluminum
  - 3. Cabinet Configuration: Semi-recessed type.
  - 4. Exterior nominal dimensions of 13 7/8 inch wide x 27 3/8 inch high x 6 1/2 inch deep.
  - 5. Trim: Returned to wall surface, with 3 inch projection and 1-1/2 inch wide face.
  - 6. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim with rounded corners
- B. Door: Full Glass



- C. Door Glazing: Glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.
- D. Finish of Cabinet Exterior Trim and Door: Anodized to clear aluminum color.
- E. Finish of Cabinet Interior: Aluminum.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level.
- C. Secure rigidly in place.

**END OF SECTION**

## **SECTION 10 53 00**

### **PRE-ENGINEERED METAL CANOPIES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Pre-engineered metal canopies.

##### **1.03 REFERENCES**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 1998.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2002.

##### **1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittals: Submittal procedures.
- B. Product Data: Manufacturer's catalog data, detail sheets, and specifications.
- C. Shop Drawings: Layout and erection drawings showing canopy framing, deck panels, cross sections, and trim details, clearly indicating proper assembly.
- D. Structural Design Calculations: Complete structural design calculations stamped by design engineer. Provide professional seal and signature by Professional Engineer registered to practice in the State of Arkansas certifying design of systems is in accordance with applicable building code.
- E. Samples: Color selection samples consisting of actual coating material or anodizing process on aluminum extrusions.
- F. Qualifications: Letter certifying specified qualifications.
- G. Manufacturer's installation instructions.

##### **1.05 QUALITY ASSURANCE**

- A. Design Engineer Qualifications: Structural engineer registered to practice in the State in which the Project is located.
- B. Manufacturer Qualifications: Minimum ten years experience in producing pre-engineered hanger rod canopies.
- C. Installer Qualifications: Minimum five years experience in erecting canopies of the type specified.

##### **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Comply with manufacturer's requirements.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Acceptable Manufacturer: Mapes Industries, Inc., Lincoln, Nebraska. Phone: 1-888-273-1132
- B. Approved Equal.
- C. Provide all canopies from a single manufacturer.

### **2.02 PRE-ENGINEERED CANOPY**

- A. Canopy: Mapes Super Lumideck Flat Soffit Pre-Engineered Metal Canopy, as manufactured by Mapes Industries, Inc. or approved equal.
  - 1. Structural Performance: Capable of withstanding design loads specified by applicable building code.
  - 2. Drainage: Self-draining from deck into intermediate trough and directed to the rear gutter for ground level discharge via designated downspouts. All drainage items to be provided by manufacturer.

### **2.03 MATERIALS**

- A. Decking shall consist of "Flat Soffit" decking.
- B. Intermediate frame members shall be extruded aluminum, alloy 6063-T6 in profile and thickness shown in current Mapes brochures.
- C. Hanger Rod Supports shall be design engineered per application
- D. Fascia shall be 8" extruded "J" style minimum .078" aluminum.
- E. Gutter and downspout to be .032 prefinished aluminum. Match finish of canopy.

### **2.04 FINISHES**

- A. Premium Finish: Color as selected by architect.

### **2.05 FABRICATION**

- A. Ship canopies in preassembled sections for ease of installation.
- B. All connections shall be mechanically assembled utilizing 3/16" fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
- C. Decking shall be Flat Soffit.
- D. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and directed to the rear gutter for ground level discharge via designated downspouts. Connect downspouts to subsurface drainage system.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Confirm that surrounding area is ready for the canopy installation.

- B. Verify that existing wall construction can support loads imposed on it by canopy.
- C. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Mapes Industries.
- D. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area completed.

### **3.02 INSTALLATION**

- A. Installation shall be in strict accordance with manufacturer's shop drawings. Particular attention should be given to protecting the finish during handling and erection. After installation, entire system shall be left in a clean condition.

### **3.03 CLEANING**

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

### **3.04 PROTECTION**

- A. Protect finished aluminum surfaces from damage due to subsequent construction operations.

**END OF SECTION**

## SECTION 10 80 10

### TOILET ACCESSORIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Toilet Room Accessories.

##### 1.02 RELATED SECTIONS

- A. Section 06 10 00 - Wood Blocking, Sheathing and Curbing.
- B. Section 09 22 16 - Non-Load Bearing Metal Stud Framing System.
- C. Section 09 21 16 - Gypsum Board Assemblies.
- D. Section 10 16 50 - Solid Plastic Toilet Compartments.

##### 1.03 REFERENCES

- A. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; US Architectural and Transportation Barriers Compliance Board; 2002.
- B. ASTM A 240/A 240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2002a.
- C. ASTM A 554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 1998.
- D. ASTM C 1036 - Standard Specification for Flat Glass; 2001.
- E. ASTM F 446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 1985 (Reapproved 1999).

##### 1.04 SUBMITTALS

- A. See Section 01 33 00- Submittals and Substitutions, for submittal procedures.
- B. Product Data: Manufacturer's product data for products specified, indicating selected options and accessories.
- C. Quality Assurance Submittals:
  - 1. Manufacturer's printed installation instructions for each specified product.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum ten years of documented experience producing products of the types specified in this section.
- B. Regulatory Requirements: Conform to ADAAG requirements.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Factory-apply strippable protective vinyl coating to sight-exposed surfaces after finishing of products; ship products in manufacturer's standard protective packaging.
- B. Storage and Protection: Store products in manufacturer's protective packaging until installation.

##### 1.07 SEQUENCING

- A. Supply locating and sizing templates, and other requirements, to fabricators and installers of products referenced in RELATED SECTIONS Article for building in products of this section.
- B. Supply reinforcing and anchoring devices required for installation of products of this section to fabricators and installers of products referenced in RELATED SECTIONS Article.

## **1.08 WARRANTY**

- A. See Section 01 70 00 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's standard warranty against defects in product workmanship and materials.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Bobrick is specified to establish a standard. Other manufacturers offering equivalent products are acceptable.
- B. Substitutions: Section 01 60 00- Product Requirements.

### **2.02 MATERIALS**

- A. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, 18-8 alloy.
- B. Sheet Steel; ASTM A366
- C. Tubing: ASTM A269, stainless steel.
- D. Fasteners, Screws, and bolts: Stainless steel, tamper-proof, and security type.

### **2.03 FABRICATION**

- A. Weld and grind joints of fabricated components, smooth.
- B. Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.
- C. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with 1-1/2 inches clear of wall surface. Knurl grip surfaces.
- D. Shop assemble components and package complete with anchors and fittings.
- E. Provide steel anchor plates, adapters and anchor components for installation.

### **2.04 KEYING**

- A. Supply two keys for each accessory to Owner.
- B. Master key all accessories.

### **2.05 FINISH**

- A. Stainless Steel: No. 4 satin luster finish.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of Conditions:
  - 1. Prepared openings are sized and located in accordance with shop drawings.
  - 2. Reinforcement and anchoring devices are correct type and are located in accordance with shop drawings.
- B. Installer's Examination:
  - 1. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
  - 2. Transmit two copies of installer's report to Steelman Connell Moseley Architects PA within 24 hours of receipt.
  - 3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.

4. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.02 INSTALLATION**

- A. Install toilet accessories plumb and level in accordance with shop drawings and manufacturer's printed installation instructions.
- B. Locate toilet accessories at heights specified by Americans with Disabilities Act (ADA).

### **3.03 CLEANING**

- A. Remove manufacturer's protective vinyl coating from sight-exposed surfaces 24 hours before final inspection.
- B. Clean surfaces in accordance with manufacturer's recommendations.

### **3.04 PROTECTION OF INSTALLED PRODUCTS**

- A. Protect products from damage caused by subsequent construction activities.
- B. Field repair of damaged product finishes is prohibited; replace products having damaged finishes caused by subsequent construction activities.

### **3.05 SCHEDULE - (REFER TO DRAWINGS FOR SCHEDULE)**

**END OF SECTION**

## SECTION 11 00 00

### INSTALLATION OF OWNER PROVIDED EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Equipment provided by owner and installed by contractor.

##### 1.02 REFERENCES

- A. NFPA 70- National Electrical Code; National Fire Protection Association; 2011.
- B. UL (EAUED) – Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

##### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

##### 1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Coordinate with owner the schedule of delivery for equipment provided by owner.
- B. Coordinate size of access and route to place of installation.

##### 1.06 PROJECT CONDITIONS

- A. Coordinate the work with location and placement of utilities. Coordinate characteristics of utilities with requirements of food service equipment.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

#### PART 2 PRODUCTS

##### 2.01 EQUIPMENT

- A. Equipment Schedule: Refer to Schedules on Enlarged Plans in the Drawings.
- B. Installation Accessories: Provide all rough-in hardware, supports and connections, attachment devices, and accessories required for installation of owner provided equipment.

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Verify that electric power, gas and plumbing are available and of the correct characteristics.

##### 3.02 INSTALLATION

- A. Obtain data and specification information from owner for each piece of equipment to verify that all utility rough-in and wall blocking have been installed at the proper locations.
- B. Install items in accordance with manufacturers' instructions.



### **3.03 EXISTING EQUIPMENT**

- A. Obtain from Owner, move, store, and re-install equipment , ready for utility connection.
- B. Clean existing equipment to be re-used.

### **3.04 ADJUSTING**

- A. Adjust equipment and apparatus to ensure proper working order and conditions.

### **3.05 CLEANING**

- A. Remove masking or protective covering from stainless steel and other finished surfaces.

### **3.06 PROTECTION OF FINISHED WORK**

- A. Remove protective coverings from prefinished work.

**END OF SECTION**

## SECTION 11 10 00

### CONTRACTOR PROVIDED AND INSTALLED EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Lab equipment provided and installed by the Contractor.

##### 1.02 REFERENCES

- A. NFPA 70- National Electrical Code; National Fire Protection Association; current edition.
- B. UL (EAUED) – Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 Submittals.
- B. Product Data: Provide data on equipment; indicate configuration, sizes, materials, finishes, locations, and utility connections and locations.

Contractor shall submit a manufacturer's catalog cut sheet of each specified item of equipment, arranged in sequence, with each sheet preceded by a typewritten page providing item number, name, quantity, make, model, accessories, pertinent service information, and any special modifications or requirements thereto.

- C. Certificates: Certify that products of this section meet or exceed UL.
- D. Operation Data: Provide operating data for the specified equipment.
- E. Maintenance Data: Provide periodic maintenance requirement schedules.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

##### 1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

##### 1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a manner to prevent damage.
- B. Coordinate size of access and route to place of installation.

##### 1.06 PROJECT CONDITIONS

- A. Coordinate the work with location and placement of utilities. Coordinate characteristics of utilities with requirements of equipment.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

## 1.07 WARRANTY

- A. See Section 01 70 00 Contract Closeout for additional warranty requirements.
- B. Correct defective work of this section within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for replacement or repair of scheduled equipment, including disconnection and removal of defective unit, and connection of replacement unit.

## PART 2 PRODUCTS

### 2.01 EQUIPMENT

- A. Equipment Schedule: Refer to the Drawings, Enlarged Plan sheets and Equipment Schedules for equipment plan and schedule.
- B. Refer to Drawings for detailed description of equipment on the Drawing schedules. References to manufacturer's name, make, model number, etc. are listed in these specifications to establish a standard of quality and are not to be construed as limiting or controlling the selection of manufacturers. The Contractor may propose approved equal equipment for substitutions by supplying full data and an illustration sheet on each item to the Architect at least 7 days before the bid date. Consideration of the quality and acceptability of the proposed substitutions shall ultimately be determined by the Owner's qualified representatives.
- C. It is intended that the plans and specifications shall complement each other with the result that any item of equipment or work noted on one and not the other, because of an obvious omission, but which is, nevertheless, required for the function of the equipment and the facility, shall be interpreted as being required by both (plans and specs) and shall be performed as fully as if it were described and delineated in both. Upon noting any discrepancy, omission, or ambiguity in any contract document, the Contractor shall notify the Architect no later than four (4) days before the bid opening date, and if there is some basis in fact for correction or clarification, the Architect shall issue an Addendum correcting the matter.
- D. Installation Accessories: Provide all rough-in hardware, supports and connections, attachment devices, and accessories required for complete installation.
- E. Refer to the Equipment Schedules in the Drawings for delineation of the following:
  - 1. Equipment to be provided and installed under this construction contract by the General Contractor.
  - 2. Equipment to be provided by the Owner and installed by the General Contractor.
- F. The General Contractor is responsible for all rough-in and final connections to equipment for water, waste, and gas supply lines for all equipment on the Equipment Schedule.
- G. Equipment designated on the Equipment Schedule as 'By MEP' is to be provided and installed by the General Contractor under this contract. General Contractor is responsible for all rough-in and final connections of water, waste and gas supply lines, as well as ventilation required items.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that electric power, gas and plumbing are available and of the correct characteristics.

### 3.02 INSTALLATION

- A. The Contractor shall be responsible for delivering, unloading, uncrating, setting-in-place, leveling and/or anchoring all equipment to floor, wall or ceiling as specified and as noted on the food service plan and/or detail drawings.
- B. Install items in accordance with manufacturers' instructions.
- C. The Contractor shall provide suitable pipe chases and do all necessary drilling, punching and cutting of his equipment accordingly, providing access for all connections to be performed by various trades.

### **3.03 ADJUSTING**

- A. Adjust equipment and apparatus to ensure proper working order and conditions.

### **3.04 CLEANING**

- A. Upon completion of the installation of the equipment, the Contractor shall ascertain that the equipment is cleaned, polished and left ready for use.
- B. Remove masking or protective covering from stainless steel and other finished surfaces.

### **3.05 DEMONSTRATION AND INSTRUCTIONS**

- A. Test equipment prior to demonstration. Demonstrate operation of components scheduled.
- B. At completion of work, provide qualified and trained personnel to demonstrate operation of each item of equipment and instruct Owner in operating procedures and maintenance.

### **3.06 PROTECTION OF FINISHED WORK**

- A. Remove protective coverings from prefinished work.

**END OF SECTION**

## SECTION 11 41 00

### COMBINATION WALK-IN COOLER/FREEZER UNIT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Indoor two compartment Walk-In Cooler/Freezer Unit.
- B. Refrigeration equipment.
- C. Remote Roof Top Condensing Units

##### 1.02 REFERENCES

- A. NFPA 70- National Electrical Code; National Fire Protection Association; 2011.
- B. NSF 7 – Food Service Refrigerators and Storage Freezers
- C. UL – Electrical Appliances and Utilization Equipment Directory.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on equipment; indicate configuration, sizes, materials, finishes, locations, and utility connections and locations.
- C. Certificates: Certify that products of this section meet or exceed UL.
- D. Operation Data: Provide operating data for the specified equipment with service and lubrication schedules..
- E. Maintenance Data: Provide periodic maintenance requirement schedules.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

##### 1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Wrap and crate finished components and assemblies at factory to prevent damage or marring of surfaces during shipment and handling.
- B. Do not deliver materials or assemblies to site until installation spaces are ready to receive units.
- C. Coordinate size of access and route to place of installation.

## **1.06 PROJECT CONDITIONS**

- A. Verify field measurements prior to fabrication.
- B. Coordinate the work with location and placement of utilities. Coordinate characteristics of utilities with requirements of food service equipment.
- C. Coordinate with concrete work for placement of floor panels and electrical service.
- D. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

## **1.07 WARRANTY**

- A. See Section 01 70 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work of this section within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for replacement or repair of scheduled equipment, refrigerant and compressors, including disconnection and removal of defective unit, and connection of replacement unit.
- D. Provide service and maintenance of refrigeration unit for one year from Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 EQUIPMENT**

- A. Manufacturers:
  - 1. Thermal Rite.
  - 2. Bally Refrigerated Structures.
  - 3. Kolpak.
  - 4. Master-Bilt Refrigeration Solutions.
- B. Substitutions: Refer to Section 01 60 00 - Product Requirements.

### **2.02 WALK-IN COOLER/FREEZER UNIT COMPONENTS**

- A. Walk in freezer:
  - 1. Exterior width: 8'-0"
  - 2. Exterior depth: 8'-0"
  - 3. Exterior height: 8'-7"
  - 4. Wall thickness: 4"
  - 5. Ceiling thickness: 4"
  - 6. Floor thickness: 4" (with integral ramp at door)
  - 7. Wall finish: Acrylume embossed 26 ga. interior & exterior
  - 8. Ceiling finish: Acrylume embossed 26 ga. interior & exterior
  - 9. Interior floor finish: Acrylume smooth .050 (cart floor)
  - 10. Exterior floor finish: Acrylume embossed 26 ga.
  - 11. Door; 36" X 78" hinged flush freezer door with closer and gasket
  - 12. Door jambs: Heated
  - 13. Light: Vapor Proof LED Light Fixture

- B. Walk in cooler:
1. Exterior width: 8'-0" (does not include divider between freezer and cooler)
  2. Exterior depth: 8'-0" (includes divider between freezer and cooler)
  3. Exterior height: 8'-7"
  4. Wall thickness: 4"
  5. Ceiling thickness: 4"
  6. Floor thickness: 4" (with integral ramp at door)
  7. Wall finish: Acrylume embossed 26 ga. interior & exterior
  8. Celing finish: Acrylume embossed 26 ga. interior & exterior
  9. Exterior floor finish: Acrylume embossed 26 ga.
  10. Door; 36" X 78" hinged flush cooler door with closer and gasket
  11. Light: vapor proof LED Light Fixture
- C. Sheet Steel: aluminum-zinc alloy coating; .026 inch thick, stucco-embossed surface.
- D. Aluminum: ASTM B209 alloy, 10 ga thick, smooth surface.
- E. Insulation: Polyurethane foamed-in-place, desity 2.2 lb/cu.ft, K factor of 0.12.
- F. Accessories: Threshold, closure plates, bolts, screws, and washers; non-corrosive.
- G. Sealant: Silicone base, fungus resistance type as specified in Section 07 90 00 Joint Sealers.
- H. Door Gaskets: Resilient neoprene; electric heated at freezer doors; grease and oil resistant, replaceable and adjustable, concealed magnetic strip to maintain air tight seal.
- I. Hardware: Cast brass, nylon bearing self-closing hinges, cylinder latch with provision for padlocking and inside safety release mechanism.
- J. Light fixtures: Vapor tight, incandescent with 150 watt lamp, operating toggle switch on exterior wall of unit with pilot light, wired in rigid conduit.
- K. Kick panel: Diamond-plate kick panels covering the bottom 32" on interior and exterior.
- L. Alarm System: Audio-Visual Alarm with digital temperature readout Hi set point only.

### **2.03 FABRICATION**

- A. Wall Panels: Comprised of the following:
1. Exterior Sheet: .026 inch sheet steel
  2. Interior Sheet: .026 inch sheet steel
  3. Core: Insulation bonded to exterior and interior sheets
  4. Panel Width: 48 inches, one piece floor to ceiling
  5. Panel Assembly: Tongue and groove edges, integral cam action locking clamps spaced not over 46"
- B. Ceiling Panels: Same construction as walls.
- C. Floor Panels: Comprised of the following:
1. Top Sheet: .050 ga aluminum
  2. Bottom Sheet: 26 ga aluminum
  3. Core: Insulation bonded to exterior and interior sheets
  4. Panel Width: 48 inches, one piece wall to wall
  5. Panel Assembly: Tongue and groove edges, integral cam action locking clamps spaced not over 46"
- D. Insulation Thickness: 4 inches
- E. Doors: Overlap type for 36x78 inch opening, construction as for walls but with edges closed; 4 inch thick insulation; flexible gasket containing magnetic strip on four edges.

## 2.04 COOLING SYSTEMS

- A. Cooling System: Direct expansion refrigerant, air cooled; remote located condensing unit, evaporator, self contained with valves, controls, switches, timers, and wiring. Size and capacity to maintain environment specified; electric defrost. Field-installed refrigerant piping shall be provided and installed by the mechanical contractor.
1. Walk-in Cooler Cooling System Basis of Design:
    - a. Condensing Unit: ThermalRite MOH009X62CFM Medium Temp R404a Air-Cooled Hermetic Remote Outdoor Condensing Unit with microchannel condenser.
    - b. Unit Ratings:
      - i. 6,958 BTUH @ 95 DegF Ambient
      - ii. 35 DegF Design Room Temperature
      - iii. 0.75 HP
      - iv. 208-230v/1/60 Electrical
      - v. 6.9 RLA
      - vi. 37 LRA
      - vii. 15 MCA
      - viii. 15 MOPD
      - ix. 28.25"l x 23.75"w x 17.25"h
      - x. 144 pounds
  2. Standard Features:
    - a. Expansion Valve
    - b. Solenoid Valve
    - c. Defrost Timer
    - d. Liquid Line Filte/Drier
    - e. Sight Glass
    - f. Temperature Control
    - g. Pressure Control
  3. Optional Features to be provided:
    - a. Head Pressure Control
    - b. Weatherproof Housing
    - c. Crankcase Heater
  4. Unit Cooler: ThermalRite LCA672AEQRC6B with electric expansion valve, mounted CDDC controller, and ECM fan motors.
  5. Unit Ratings:
    - a. 6,958 BTUH
    - b. 120v/1/60 Electrical
    - c. 2 A
    - d. 45.5"l x 14.875"w x 15"h
    - e. 45 pounds
  6. Walk-in Freezer Cooling System Basis of Design:
    - a. Condensing Unit: ThermalRite MOH025L62CFLT Low Temp R404a Air-Cooled Hermetic Remote Outdoor Condensing Unit with microchannel condenser.
    - b. Unit Ratings:
      - i. 8,300 BTUH @ 95 DegF Ambient
      - ii. -10 DegF Design Room Temperature
      - i. 2.5 HP
      - ii. 208-230v/1/60 Electrical
      - iii. 15 RLA
      - iv. 87 LRA
      - v. 29 MCA
      - vi. 40 MOPD
      - vii. 28.25"l x 37.75"w x 17.25"h
      - viii. 222 pounds



7. Standard Features:
  - a. Expansion Valve
  - b. Solenoid Valve
  - c. Defrost Timer
  - d. Liquid Line Filte/Drier
  - e. Sight Glass
  - f. Temperature Control
  - g. Pressure Control
8. Optional Features to be provided:
  - a. Head Pressure Control
  - b. Weatherproof Housing
  - c. Crankcase Heater
9. Unit Cooler: ThermalRite LCE676BEQRC6B with electric expansion valve, mounted CDDC controller, and ECM fan motors.
10. Unit Ratings:
  - a. 7,600 BTUH
  - b. 120v/1/60 Electrical
  - c. 1.1 A
  - d. 45.5"l x 14.875"w x 15"h
  - e. 45 pounds

## **2.05 FACTORY FINISHING**

- A. Exterior and Interior Cladding: Stucco-embossed galvanized steel with white polyester painted finish.
- B. Hardware: Satin Aluminum.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify surfaces, prepared openings, and roughed-in utilities are ready to receive work and opening dimensions are as instructed by manufacturer.

### **3.02 INSTALLATION**

- A. Refer to kitchen equipment details and structural foundation details showing 4" concrete slab on top of floor panels.
- B. Set floor panels in place in recessed slab and align. Connect to floor drains. Seal joints continuously and lock panels tightly together.
- C. Assemble wall panels; lock in place with cam locks. Brace securely until ceiling panels are installed.
- D. Install ceiling panels; lock into wall panels.
- E. Install sill plate at door opening and heated thresholds.
- F. Hang doors. Adjust to operate smoothly.
- G. Locate condensing units for each freezer and refrigerator as indicated on Mechanical drawings. Support evaporator coil on roof truss structure and make connections as required for utilities and services. Wire-in alarm unit and door and threshold heaters. Connect units to valved water piping. Run condensate line to nearest drain.
- H. Install ceiling trim and ceiling fascia and end closure plates between freezer/refrigerator and adjacent wall.

- I. Seal joints and services through walls with sealant to provide moisture and vapor seal.

### **3.03 ADJUSTING**

- A. Test and adjust control equipment to meet specified performance requirements.
- B. Operate walk-in freezer/thaw/cooler and test full range of functions over continuous 48 hour period, recording physical data on operating equipment. Continuously record temperature and humidity.
- C. Test each unit for air tightness.
- D. Adjust and re-test units not meeting specified requirements.
- E. Submit three copies of written quality control test report.

### **3.04 CLEANING**

- A. Remove temporary protection fo prefinished surfaces.
- B. Wash and clean floor, walls and ceiling inside unit and exposed surfaces on outside. Clean fixtures and fittings.

### **3.05 DEMONSTRATION AND INSTRUCTIONS**

- A. Test equipment prior to demonstration. Demonstrate operation of components scheduled.
- B. At completion of work, provide qualified and trained personnel to demonstrate operation of each item of equipment and instruct Owner in operating procedures and maintenance.

### **3.06 PROTECTION OF FINISHED WORK**

- A. Protect finished work from adjacent construction operations.

**END OF SECTION**

## SECTION 12 31 00

### STEEL LABORATORY CASEWORK AND RELATED PRODUCTS

#### PART 1 — DESCRIPTION OF WORK

##### 1.1 SUMMARY AND SCOPE

- A. Section Includes:
1. Steel casework specification standard, furnish all cabinets and casework, including tops, ledges, supporting structures, and miscellaneous items of equipment as listed in these specifications, equipment schedules, and drawings. Include delivery to the building, set in place, level, and scribe to walls and floors as required. Furnish and install all filler panels, knee space panels and scribes as shown on drawings.
  2. Furnish service strip supports where specified, and set in place, service tunnels, service turrets, supporting structures and reagent racks of the type shown on the drawings.
  3. Remove of all debris, dirt and rubbish accumulated as a result of the installation of the laboratory furniture to an onsite container provided by others, leaving the premises broom clean and orderly.
- B. Related Divisions:
1. Divisions 5 & 6: Behind-the-Wall Blocking and Studs
  2. Division 9: Base Molding
  3. Division 26: Electrical Fittings and Connections
- C. Related Publications:
1. SEFA 3 - Scientific Equipment and Furniture Association
  2. SEFA 8 - Scientific Equipment and Furniture Association
  3. NFPA 30 - National Fire Protection Association
  4. NFPA-45 - National Fire Protection Association
  5. UL - Underwriters Laboratories
  6. ASTM D522 - Bending Test

##### 1.2 BASIS OF WORK

- A. It is the intent of this specification to use steel casework manufactured according to the standards used by **VWR**, (a delivery channel of Avantor) as the standard of construction for laboratory furniture. The construction standards of this product line shall provide the basis for quality and functional installation.
- B. Supply all equipment in accordance with this specification.
- C. General Contractors should secure a list of approved laboratory furniture manufacturers from the architect as a protection against non-conformance to these specifications.
- D. Participants in the quotation process have the option of clarifying deviations to the specified design, construction, or materials. Without such clarifications, sealed quotations to the owner or owner representative will be construed as being in total conformance to the requirements of the specification.
- E. The owner/owner's representative reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures the owner greater integrity of product.

### **1.3 QUALITY ASSURANCE**

- A. The steel laboratory furniture contractor shall also provide worktops and fume hoods all manufactured or shipped from the same geographic location to assure proper staging, shipment and single source responsibility.
- B. General Performance: Provide certification that furniture shall meet the performance requirements described in SEFA 8.
- C. Finish Performance: Provide independent test lab certification that furniture shall meet the performance requirements described in section 2.05 of these specifications.

### **1.4 SUBMITTALS**

- A. Manufacturer's Data: Submit manufacturer's data and installation instructions for each type of casework.
- B. Samples:  
Samples from non-specified manufacturers will be required and reviewed per specification.
- C. Shop Drawings:  
Submit shop drawings for furniture assemblies showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fittings.
  - 1. Coordinate shop drawings with other work involved
  - 2. Provide roughing-in drawings for mechanical and electrical services when required

## **PART 2 — PRODUCTS**

### **2.1 MANUFACTURERS**

- A. The basis of this specification is steel casework manufactured according to the standards used by **VWR**, a delivery channel of Avantor. The specified design is pre-finished Steel Casework. All laboratory equipment covered by the specification shall be the product of one manufacturer and be fabricated at one geographic location to assure shipping continuity and single-source responsibility.
- B. Substitutions: See Section 01 33 00 – Submittals
  - 1. Pre-approved manufacturers include Ravensberg, Inc. (St. Louis, Mo.)

### **2.2 CABINET MATERIAL:**

- A. Steel:  
Cabinet bodies, drawer bodies, shelves, drawer heads and door assemblies shall be fabricated from cold rolled steel.

### **2.3 DRAWER AND DOOR STYLE:**

- A. Inset – Square Edge  
Drawers and doors, when closed, shall be recessed to create an overall flush face with 1/8" reveals. The outer drawer and door head shall have a channel formation on all four sides to eliminate sharp raw edges of steel. The top front corners of the door shall be welded and ground smooth.

## 2.4 MATERIALS

### A. General Requirements:

It is the intent of this specification to provide a high quality steel cabinet specifically designed for the laboratory environment.

### B. Steel:

#### 1. Cold Rolled Steel:

Cold rolled sheet steel shall be prime grade 12, 14, 16, 18 and 20 gauge U.S. Standard; roller leveled, and shall be treated at the mill to be free of scale, ragged edges, deep scratches or other injurious effects.

### C. Finish: As selected from the manufacturer's standard range of colors.

### D. Hardware and Trim:

#### 1. Drawer and Door Pulls:

a. Drawer and door pulls shall be recessed into the face of the door or drawer.

#### 2. Sliding Door Pulls:

Sliding door pulls shall be Aluminum-Recessed – Pull Style 9. Finger holes or slots machined into doors will not be acceptable.

#### 3. Hinges:

a. As provided by the casework manufacturer.

#### 4. Drawer Slide:

a. As provided by the casework manufacturer.

## 2.5 CONSTRUCTION

### A. Steel Cabinet Construction:

#### 1. General:

a. The steel furniture shall be of modern design and shall be constructed in accordance with the best practices of the Scientific Laboratory Equipment Industry. First class quality casework shall be insured by the use of proper machinery, tools, dies, fixtures and skilled workmanship to meet the intended quality and quantity for the project.

b. All cabinet bodies shall be flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcements.

c. All cabinets shall have a cleanable smooth interior. Bottoms shall be formed down on sides and back to create easily cleanable corners with no burrs or sharp edges.

## 2.6 WORKSURFACES

### A. Materials:

#### 1. Phenolic Resin equal to Toplab Plus by Trespa:

a. Refer to drawings for thicknesses and locations.

## **PART 3 — EXECUTION**

### **3.1 INSTALLATION**

- A. Preparation:  
Prior to beginning installation of casework, check and verify that no irregularities exist that would affect quality of execution of work specified.
- B. Coordination:  
Coordinate the work of the Section with the schedule and other requirements of other work being prepared in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.
- C. Performance:
  - 1. Casework:
    - a. Set casework components plumb, square, and straight with no distortion and securely anchor to building structure. Shim as required using concealed shims.
    - b. Bolt continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.
    - c. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.
    - d. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8".
  - 2. Worksurfaces:
    - a. Where required due to field conditions, scribe to abutting surfaces.
    - b. Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure the joints in the field, where practical, in the same manner as in the factory.
    - c. Secure worksurfaces to casework and equipment components with materials and procedures recommended by the manufacturer.
- D. Adjust and Clean:
  - 1. Repair or remove and replace defective work, as directed by owner and/or his representative upon completion of installation.
  - 2. Adjust doors, drawers and other moving or operating parts to function smoothly.
  - 3. Clean shop finished casework; touch up as required.
  - 4. Clean worksurfaces and leave them free of all grease and streaks.
  - 5. Casework to be left broom clean and orderly.
- E. Protection:
  - 1. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.
  - 2. Advise owner and/or his representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

### **3.2 SCHEDULE**

- A. Refer to the drawings for complete casework schedule and locations.

**END OF SECTION**

## SECTION 12 34 00

### WOOD LABORATORY CASEWORK

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Wood cabinets and bases.
- B. Counter tops
- C. Casework hardware.
- D. Shelving.
- E. Service fittings and outlets.

##### **1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

- A. Section 15000 - Mechanical: Plumbing service fittings.
- B. Section 16000 - Electrical: Electrical service outlets.

##### **1.03 RELATED SECTIONS**

- A. Section 06 10 00 - Rough Carpentry: Wood framing and blocking for attachment of casework.
- B. Section 06 41 00 - Custom Wood Cabinets: Cabinets other than Laboratory Casework.
- C. Section 15000 - Mechanical: Furnishing, installing and connecting of service lines within the casework, etc.. and connecting of exposed service lines through, under or along backs of working surfaces for utility service fittings.
- D. Section 16000 - Electrical: Furnishing, installing and connecting of service lines within the casework, etc.. and connecting of exposed service lines through, under or along backs of working surfaces for utility service fittings.

##### **1.04 REFERENCES**

- A. AWI - Quality Standards.
- B. HPMA (Hardwood Plywood Manufacturer's Association) HP - American Standard for Hardwood and Decorative Plywood.
- C. NHLA - National Hardwood Lumber Association.
- D. ANSI/BHMA A156.9 - Cabinet Hardware.
- E. ASTM C1036 - Flat Glass.
- F. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

- G. NEMA (National Electrical Manufacturers Association) LD3 - High Pressure Decorative Laminates.

**1.05 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate casework locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required and all equipment.
- C. Product Data: Provide component dimensions, configurations, construction details, joint details, and attachments, utility and service requirements and locations.
- D. Finish Samples: Submit two samples, minimum size 3 x 6 inches of finish of manufacturers full line of wood finishes, epoxy resin top colors and finish of metal components.
- E. Manufacturer's Installation Instructions: Indicate special installation requirements.

**1.06 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Accept casework and equipment on site. Inspect on arrival for damage.
- C. Coordinate size of access and route to place of installation.

**1.08 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated on shop drawings.

**1.09 WARRANTY**

- A. Provide manufacturer's 3 year warranty on material and workmanship.

**1.10 COORDINATION**

- A. Coordinate work under provisions of Section 01 30 00.
- B. Coordinate casework installation with size, location and installation of service utilities.

**1.11 SUBSTITUTIONS**

- A. Substitutions for products specified under this section must be approved by the architect before the bid date. Requests for substitutions must be made to the architect in writing at least seven calendar days before the bid date.



## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Leonard Peterson & Co., Inc., 400 Webster Road, Auburn, AL.
- B. Substitution request must be submitted to the Architect at least seven (7) days before the bid.

### **2.02 MATERIALS**

- A. Exposed Hardwood: Red Oak, moisture content of 4 1/2%.
- B. Exposed Panels: 3/4" thick 7 ply compliant with ANSI/HPVA HP-1 2009 with Grade A plain sliced Red Oak with Solid Oak Banding.
- C. Interior Panels: 3/4" thick, clear hardwood Grade "A" veneer face, Grade 2 back with Oak veneer each side. All interior shelves should be 7 ply hardwood plywood, oak banded with Oak veneer each side and oak banding.
- D. Float Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select 1/8 inch thick minimum.
- E. Table Tops, Counter Tops, Back Splash and Side Splash: 1" (25 mm) thick, modified epoxy resin with optimum physical and chemical resistance. Uniform epoxy resin mixture throughout the thickness of the top. The top should not be dependent on a surface coating for chemical or stain resistance. Color: non-glaring black. Exposed edges: radiused with drip groove on the under surface. Back splash to be 4" (101mm) high.
- F. Sinks and Drain Troughs: Molded epoxy resin, non-glaring black, high resistance to mechanical and thermal shock.
  - 1. Sink: Coved inside corners and pitched bottom to drain.
  - 2. Drain Trough: Seamless junction between sides and bottom, not less than 3/4" radius and 1/8" per foot pitch to drain or discharge end.
- G. Service Fittings and Accessories:
  - 1. Materials: Water faucets and valve bodies shall be cast red brass alloy or bronze with chromium plated finish.
  - 2. Water Fittings: Four armed forged brass handles with plastic colored service buttons. Provide with renewable unit containing all operating parts subject to wear. Renewable unit to contain an integral volume control device.
  - 3. Ground Key Valve Hose Cocks: Forged body with 10 serration hose end. Tapered type forged brass handle plug with colored service index button. Grind, lap and seal valves.
  - 4. Gooseneck Type Outlet: Gooseneck type with built in vacuum breaker and separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.

5. Remote Control Valves: As previously specified with aluminum extension rods, escutcheon plates, brass forged handles and colored service index button.
6. Tank Nipples: Provide with locking nut and washer for all fixtures where fittings are anchored to equipment.
7. Sink Outlets: Molded epoxy resin with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2" I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically called for.
8. Vacuum Breakers: "Nidel" or "Watts" unless otherwise specified. Vacuum breakers are required on all water fittings.
9. Aerator Outlets: Provide for all gooseneck water faucets not furnished with serrated hose connectors.
10. Waste Lines: Furnished by others.
11. Traps: Furnished by others.
12. Electrical Fittings: 20 amp., 125 volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.

### **2.03 HARDWARE**

- A. Drawer and door pulls: Bar Type made of extruded aluminum 4-1/2" long and 1/2" wide having dull brushed finish. Pull attached with two (2) No. 10 flat head machine screws countersunk on 4" centers. Pulls provided for all hinged doors and drawers. (Plastic pulls or a design not compatible for use by the handicapped is not acceptable.)
- B. Latching Handles: Made of dull chrome plated die cast zinc alloy approximately 4-1/4" in length in streamlined design. Handle operates with one-quarter turn. Paired door cases have latching handle on right door and dummy matching handle on left door. A 3-point latching system provides positive engagement at top and bottom of door with 5/16" diameter tapered epoxy coated steel rods engaging in case top and bottom and latch plate engaging behind left door or into side wall of case depending upon design. Latching handles are provided on all case doors over 48" high.
- C. Hinges: Butt style, 5-knuckle, institutional type of dull finished stainless steel, 2-1/2" by 3-1/8", unequal winged, tight pinned and with wing thickness of .081". Each hinge is secured by seven plated No. 7 flat head screws. (Surface mounted hinges shall not be acceptable.)

Doors hung with paired hinges are capable of supporting 175 pounds at 12" from pivot point of hinges with no distortion of hinges or degradation of casework. Hinged doors up to 48" high furnished with 1 pair of hinges. Hinged doors over 48" high furnished with 1-1/2 pair of hinges.

- D. Drawer Slides: 100 lb. rated capacity, full extension, zinc plated, linear ball bearing made of cold rolled steel. Drawers removable without the use of tools.

- E. Shelf support clips: double pin type made of vinyl having anti-tipping seismic feature. Each clip capable of supporting 200 pounds. Clips engage into holes drilled into cabinet end panels or partitions.
- F. Catches: spring loaded, nylon roller type, designed for quiet operation provided for hinged doors. Cabinets with locked paired doors have elbow catches inside left-hand doors. Cabinet and case doors provided with 2 catches, one at top and one at bottom, where elbow catches are not finished.
- G. Base molding (when called for or specified): pliable black vinyl, 1/8" thick by 4" high with top edge rounded. Molding secured with self-stick or applied waterproof adhesives. Formed stainless steel caps are fastened to exposed corners. Exposed cabinet work provided with base molding unless otherwise specified.
- H. Leg shoes: molded black vinyl 2-1/2" high. Legs attached to floor provided with shoes, and furnished with semi-concealed plated metal angle clips for securement.
- I. Drawer and hinged door locks (except tall case doors): dead bolt style, heavy-duty, five-tumbler, of non-ferrous metal and master-keyed having 3/8" bolt throw and single bitted style keyway. Barrel and back plate of locks are riveted together; lock bolts are non-removal. Locks with cams held in place with machine screws or nuts are not acceptable. Locks are secured to rear of drawer and door fronts with flat head screws. Each lock furnished with one non-ferrous key when keyed alike and two non-ferrous keys when keyed differently. Locks furnished as indicated on details or as is standard with catalog descriptions unless otherwise specified. Latching handles shall be provided with locks where required. Locks shall be keyed to same master key as locks provided for other drawer and hinged door cabinets.
- J. Number plates: oval-shaped and made of non-ferrous metal with black numerals. Plates secured with brads (self-stick number plates are not acceptable). Number plates furnished only when specified.
- K. Glides: black nylon, minimum 1-3/4" diameter and adjustable on 3/8" diameter x 1-1/2" plated stem. Glides provide on table legs not attached to floors.
- L. Support rods, 3/4" diameter aluminum with the upper ends rounded and the lower ends tapered to fit support rod plates. Support rod plates made of aluminum secured into table top with heavy brass nut. Cross bars made of 3/4" diameter aluminum with rounded ends, and provide with clamps for attachment to support rods.
- M. Label holders: Furnished in brushed stainless steel attached to drawer heads or doors with screws. Label holders have a 1" x 2" label opening.

## **2.04 FABRICATION**

- A. Base Cabinets: Multiple doweled 3/4" thick oak veneer end panels, screwed and glued into top frame members, intermediate rails and bottoms. Dado 1/4" thick back panels into end panels and bottom. 3/4" thick cup board bottoms with 3/4" x 1/8" oak hardwood edging. Provide 3/4" thick oak veneer adjustable shelves at all base cabinets. Provide 3" x 3/4" thick intermediate rails with 3/4" x 1/8" thick oak hardwood edging. Glue intermediate rails to end panels with multiple dowels.

- B. Drawers: Sides 15/32", 11 ply birch plywood. Drawer Front: 3/4" thick with oak veneer face. Attach drawer front to sides with glued dove tailed joint. Set 1/4" thick hardboard bottom into 1/4" deep grooves on all four sides, glue.
- C. Open Leg Tables: 2 1/2" square oak hardwood legs with 1/4" radiused corners. Secure legs to apron frame with corner bolt and 14 gauge metal corner brace. Provide 3/4" thick oak veneer apron rails with groove at top for securing table top fasteners. Table tops to be molded epoxy resin 1" thick with 2" overhang. Provide leg stretchers where required with mortise and tenon joint at legs and secured by 4" long through hole.
- D. Full Height Cases: Provide 3/4" thick oak veneer end panels tops and bottoms with 3/4" x 1/8" oak hardwood edging. Secure top and bottom into end panels with multiple hardwood dowels and glue. Provide glazed doors with 3 1/4" x 1" thick solid oak framing, mortised, tenoned and glued. Set glass into door frame and secure with solid oak stop. Hang doors with 1 1/2 pair of 2 1/2" offset institutional hinges. Provide 2 1/2" deep x 4" high toe kick with oak veneer face. Shelves are to be 3/4" thick oak veneer with 3/4" x 1/8" oak edging, all shelves to be adjustable except middle shelf which is joined to end panels for rigidity of unit.
- E. Wall Hung Swinging Door Cases: Same construction as full height cases except cabinet doors are to be hung on 1 pair of 2 1/2" offset institutional hinges.
- F. Cut and drill counter tops, backs and other components for service outlets and fixtures.
- G. Install fixtures and fittings built into or part of casework. Provide access panels for maintenance of utility service and mechanical and electrical components.

## **2.05 FINISHES**

- A. Preparation: Sand all surfaces to remove loose fibers, abrasions, raised grain, etc.. Remove all dust prior to finishing.
- B. Exterior Finish:
  1. First Coat - Stain
  2. Second Coat - Sealer coat, then sand.
  3. Third Coat - Sealer coat.
  4. Fourth Coat - Double pass of chemical resistant synthetic varnish with semi-gloss finish.
- C. Interior Finish:
  1. First & Second Coat - Resinous wood sealer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions under provisions of Section 01039.
- B. Verify adequacy of support framing and anchors.

### **3.02 INSTALLATION**

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered.

- C. Set casework items plumb and square, securely anchored to building structure.
- D. Scribe to abutting surfaces and align adjoining components. Apply matching filler pieces where casework abuts dissimilar construction.
- E. Close ends of units, splash aprons, shelves and bases with sealant.
- F. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

### **3.03 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

### **3.04 CLEANING**

- A. Clean work under provisions of 01 70 00.
- B. Clean casework, counters, shelves, glass, legs, hardware, fittings and fixtures.

### **3.05 PROTECTION OF FINISHED WORK**

- A. Protect finished Work under provisions of Section 01 50 00.
- B. Do not permit finished casework to be exposed to continued construction activity.

**END OF SECTION**

## SECTION 12 52 00

### MOTORIZED WINDOW SHADES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Motorized, roll-up fabric interior window shades including motor operator, controls, and mounting hardware.

##### 1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.
- B. Section 06 20 00 – Finish Carpentry
- C. Section 09 21 16 - Gypsum Board Assemblies.
- D. Division 26 - Electrical: Electrical supply, conduit, and wiring for motorized window shades.

##### 1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.
- C. UL GREENGUARD Gold.
- D. US Green Building Council.
- E. ANSI/WCMA A100.1-2022.
- F. Window Covering Safety Council Best for Kids™.

##### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Source Quality Control Reporting:
- B. Product Data: Manufacturer's data sheets on each product specified, including:
  - 1. Preparation instructions and recommendations.
  - 2. Installation and maintenance instructions.
  - 3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes, and operating instructions.
  - 4. Storage and handling requirements and recommendations.
  - 5. Mounting details and installation methods.
  - 6. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual, and lighting control systems as applicable.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams, and relationship to adjacent work.
- D. LEED Submittals: Provide documentation of how the requirements of credit will be met.

- E. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.
- F. Selection Samples: For each finish product specified, one complete set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
- G. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.
- H. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware, and controls.
- I. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- J. Standard manufacturer's defect warranty: Standard manufacturer's warranty documents

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years' experience in manufacturing products comparable to those specified in this section.
- B. Shading system shall be UL listed. Provide documentation and proper labeling.
- C. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use. Show complete manufacturer data (name, location, contact) and certification from manufacturer that the fabrics sourced for this project comply with the test data provided.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.
- D. Store products in manufacturer's unopened packaging until ready for installation.

## **1.7 SEQUENCING**

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## **1.8 PROJECT CONDITIONS**

- A. Install roller shades after finish work and ambient temperature, humidity, and ventilation conditions are maintained at levels recommended for project upon completion.

## 1.9 WARRANTY

- A. Hardware and Shade Fabric: Standard twenty-five-year limited warranty.
- B. Motors and Controls: Standard five-year limited warranty.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Draper, Inc., which is located at: 411 S. Pearl P. O. Box 425; Spiceland, IN 47385-0425. ASD. Toll Free Tel: 800-238-7999; Tel: 765-987-7999; Fax: 866-637-5611; Web:[www.draperinc.com](http://www.draperinc.com).
- B. Substitutions: Must be submitted to the Architect seven days before the bid date for approval.

### 2.2 MOTORIZED WINDOW SHADES

- A. Type: UL listed, motorized, vertical roll-up, fabric window shade with motors, controls, mounting brackets, and other components necessary for complete installation; Motorized FlexShade® I/O AC as manufactured by Draper, Inc.
  - 1. Endcaps and ceiling/wall headbox.
  - 2. Ceiling pocket.
- B. Shade Motor and Control System.
  - 1. Motorized FlexShade I/O AC.
    - a. IntelliFlex I/O AC Motor: 120V AC, single phase, 60 HZ, 3-wire, 6nm or 15nm, at the manufacturer's discretion, instantly reversible, lifetime lubricated smart motor. Tubular motor concealed inside each shade roller tube. Equipped with internal thermal overload protector, and electric brake. Thermal protection: 4 minutes.
      - 1) Rated current: 1.0 Amps. Motors drawing greater than 1.0 amps shall not be acceptable without prior approval by Architect responsible for electrical design of project.
      - 2) Speed: 28RPM. All motors within a discrete control zone must operate at same speed.
      - 3) Sound level: 42dBA.
      - 4) UL Listing: UL325 & CSA C22.2 No. 247. Motors not listed as part of an entire shade assembly and control system shall not be acceptable.
      - 5) Encoded motors with two-way communication to network control devices. Motor/control networks that do not support two-way communication shall not be acceptable.
      - 6) Limits: Intermediate stopping points and presets.
    - b. IntelliFlex I/O Network Devices.
      - 1) Network Device Connector. Connects IntelliFlex I/O devices into a network. Distributes power and communications between devices. One provided with each IntelliFlex I/O motor and network device. Approved for use in plenum spaces. LED Indicators indicate network status. Includes built-in terminating resistor, and network bypass switch for troubleshooting. Material: ABS plastic. Operating temperature: Ambient. Dimensions: 3 3/8" x 2" x 1 1/16" (90 x 31 x 27mm). Mounting hardware provided. Indoor use only.
        - a) NDC1. Connects a single device.
        - b) NDC3. Connects up to 3 devices.
    - c. IntelliFlex I/O User Input Devices.
      - 1) Single Zone Wall Switch. Allows user to move roller shades to any



position with a single touch. Swipe gestures must be recognized to move shades to fully open or closed positions. Power provided through IntelliFlex I/O network using a single Ethernet cable for power and communication. Switch shall be capable of controlling any number of shades on an IntelliFlex I/O network using onboard programming buttons without rewiring or the use of external configuration devices. Must allow unlimited number of preset alignment positions. Push button switches not permitted.

- C. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
- D. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
- E. Endcap covers to match fascia/headbox finish.
- F. Brackets: 1/8-inch-thick stamped steel, black powder coat, idler height adjuster, field adjustable to wall or ceiling mount.
  - 1. Mounted to wall.
- G. Coupling system: Couplings to join motorized shade rollers to allow operation by single motor. FlexShade Coupling System as manufactured by Draper, Inc. Provide endcaps to receive couplers and support multiple shades.
  - 1. Standard straight coupler.
  - 2. Angled coupler.
- H. Shade slat: Slat encased in heat-seamed hem.
  - 1. Closed pocket elliptical slat: 1" (25mm) aluminum elliptical slat inside of a 1 5/8" (41mm) pocket with heat sealed ends.
  - 2. Open pocket elliptical slat: 1" (25mm) aluminum elliptical slat with plastic ends inside of a 1 5/8" (41mm) pocket.
  - 3. Small flat exposed hem bar: 7/8" x 5/16" (22mm x 8mm) aluminum rectangular hem bar with plastic end caps. Powder coated in black, bronze, ivory, white or clear anodized.
  - 4. Large flat exposed hem bar: 1½" x 5/16" (38mm x 8mm) aluminum rectangular hem bar with plastic end caps. Powder coated in black, bronze, ivory, white or clear anodized.
  - 5. Round exposed hem bar: Small (5/8" (16mm)) and Large (13/16" (21mm)) aluminum with plastic end caps. Powder coated in black, bronze, ivory, white or clear anodized.
- I. Fascia: L shaped aluminum extrusion to conceal shade roller and hardware.
  - 1. Attachment: Snaps onto end caps without requiring exposed fasteners of any kind.
    - Fascia can be mounted continuously across two or more shade bands.
      - a. Shape: Square Fascia Panel.
  - 2. Finish: Selected from Manufacturers standard range.
  - 3. Finish: Custom powder coat as selected by the Architect.
- J. Headbox, Pocket Style: Aluminum fabrication with removable closure, endcaps, and U-shaped pocket:
  - 1. Finish: Selected from Manufacturers standard range.
- K. Type D Shade pocket: Rectangular pocket designed for recessed ceiling installation of window shades.
  - 1. Material: Extruded aluminum alloy with white finish.

2. Size: 5 inches (127 mm) by 5-5/8 inches (137 mm) high.
  3. Closure Panel:
  4. Pocket ends: Welded one-piece aluminum sections connecting to and matching pockets.
- L. Wall Clip with Closure panel: For site constructed ceiling recesses, provide removable closure panel to minimize slot for shade passage but allowing access to shade for maintenance.
1. Material: Aluminum alloy with white finish.
  2. Tile Lip: Provide wall clip with 7/8-inch tile lip (22 mm).
  3. Closure width: 1-1/2 inches (38 mm).
  4. Provide continuous wall clip, 1-3/4 (44 mm) by 3/16 inch (5 mm), for snap-in attachment of closure panel without fasteners.

## 2.3 FABRIC

- A. Light-Filtering Fabrics
1. PVC Coated Fiberglass
    - a. Basketweave
      - 1) SheerWeave® Series SW2500 by Phifer®: 500 denier fiberglass, vinyl coated and woven into a 2 x 2 basket weave. Fire rating: California U.S. Title 19 (small scale), NFPA 701 TM#1 (small scale), NFPA 101 (Class A Rating), IBC Section 803.1.1 (Class A Rating), BS 5867 Part 2 Type B Performance, NFPA 701 TM#2 (large scale), CAN/ULC-S 109 (large and small scale), CAN/CGSB2-4.162-M80. Bacteria and fungal resistance: ASTM E 2180, ASTM G21, ASTM G22, AATCC30 Part 3, ASTM D 3273, UL GREENGUARD® Mold and Bacteria Standard ASTM 6329; includes Microban® antimicrobial additives. Environmental certification: Certified to UL GREENGUARD and GREENGUARD Gold® standards for low chemical emissions into indoor air during product usage. Safe use: RoHS/Directive 2002/95/EC, US Consumer Product Safety Commission Section 101 and ANSI/WCMA A 100.1-2007 for lead content and REACH (EC 1907/2006) compliant. 1 percent open, .024 inches thick. 16.39 oz/square yard.
- B. Color and pattern: As selected by Architect from manufacturer's standard range.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.
- B. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.
- C. Coordinate requirements for power supply conduit, and wiring required for window shade motors and controls.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- C. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
  - 1. Fascias.
  - 2. Closure panels.
  - 3. Endcaps
- D. Install headbox, side channels, and sill channel with sealant specified in Section 07 90 00 - Joint Protection.
- E. Position shades level, plumb, and at proper height relative to adjacent construction. Secure with fasteners recommended by manufacturer.

### **3.4 TESTING AND DEMONSTRATION**

- A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

### **3.5 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

### **3.6 SCHEDULES**

- A. Provide Motorized Window Shades at all exterior windows in Conference Space 101. Refer to the drawings for size and location of windows.

**END OF SECTION**

**SECTION 12 52 10**  
**MANUAL WINDOW SHADES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface Mounted, Manually Operated Window Shades.
- B. Hardware and Accessories.

**1.02 RELATED SECTIONS**

- A. Section 06 10 00 - Wood Framing, Blocking, Sheathing and Curbing: Wood blocking in walls for attachment of shades.
- B. Section 09 21 16 - Gypsum Board Systems: Wall substrate.

**1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on shades describing size, finish, details of function, attachment methods.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, control system, accessories, and assembly details.
- D. Samples: Provide actual samples of manufacturers fabric selections.

**1.04 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated on shop drawings.

**1.05 COORDINATION**

- A. Coordinate the work with the placement of concealed wood blocking and reinforcement to receive anchor attachments.
- B. Coordinate the work of this section with the installation of metal framed storefront system specified in Section 08 41 00.
- C. Coordinate the work of this section with installation of lay-in ceiling system specified in Section 09 51 13.

**PART 2 PRODUCTS**

**2.01 MANUFACTURER**

- A. Draper Inc., 411 South Pearl Street, Spiceland, IN 47385, (800) 238-7999, [www.draperinc.com](http://www.draperinc.com)
- B. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 WINDOW SHADES**

- A. Exposed, surface mounted, manually operated window shades shall be equal to Draper FlexShade or equal single roller shades with light blocking Flocke fabric. See schedule at end of Section for location.

## **2.02 MANUAL CONTROL**

- A. Control for window shades shall be by suspended stainless steel bead chain clutch with integral stops for both upper and lower limits.

## **2.03 HOUSING**

- B. Dark bronze aluminum fascia. No endcaps or bottom closure panels are required.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify site conditions are ready to receive the work of this section.
- B. Verify exact location of switches and accessories for installation.

### **3.02 PREPARATION**

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and electrical rough-in measurements as required.

### **3.03 INSTALLATION**

- A. Install shades and accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to wall or ceiling structure.

### **3.04 SCHEDULE**

- A. Install window shades on all exterior windows in Labs 107, 109, 110, 112, Offices 117, 118, 119, Research Labs 125, 128,133.
- B. Window shades will not be required on any exterior windows in Vestibule 106 and Vestibule 114
- C. Window shades will not be required on any interior windows.

**END OF SECTION**

INDEX OF SPECIFICATIONS  
DIVISION 21 FIRE PROTECTION

SECTION	SECTION TITLE
210000	FIRE PROTECTION SPRINKLER SYSTEM

## SECTION 210000

### FIRE PROTECTION SPRINKLER SYSTEM

#### PART 1 GENERAL

##### 1.01. SUMMARY

- A. Provide a complete and working wet pipe sprinkler system as indicated herein and/or shown on drawings. Provide labor, materials, and perform all operations required and reasonably implied in the provision of the wet pipe sprinkler system. Contractor shall arrange all permits and inspections and pay all associated fees.
- B. The Contractor shall design a fire protection sprinkler system based on NFPA requirements for occupancy.
- C. Contractor shall be responsible for provision of all other phases in the contract documents such as mechanical, structural, electrical and architectural systems and shall design to facilitate all features of the building while complying with NFPA.
- D. Any conflict between the governing authority and the plans and specifications shall be called to the attention of the Engineer.
- E. Coordinate closely with fire alarm and electrical power systems for special use areas such as elevators and electrical equipment rooms.

##### 1.02. PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

##### 1.03. SUBMITTALS

- A. Product Data: For the following:
  - 1. Piping materials, including dielectric fittings and flexible connections and sprinkler specialty fittings.
  - 2. Pipe hangers and supports.
  - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
  - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
  - 5. Monitors.
  - 6. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- E. Welding certificates.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

#### 1.04. QUALITY ASSURANCE

- A. Installer Qualifications and Responsibilities:
  - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
  - 2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 14, "Standpipe and Hose Systems."

#### 1.05. COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

#### 1.06. EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.



## PART 2 PRODUCTS

### 2.01. STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3.
  - 2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
  - 3. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795.
  - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Threaded-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe; with factory- or field-threaded ends.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3.
  - 2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
  - 3. Steel Threaded Couplings: ASTM A 865.
- D. Plain-End, Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30; or ASTM A 795 and ASME B36.10M, Schedule 30 wrought-steel pipe.
  - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed threaded ends.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3.
  - 2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe.
  - 3. Steel Threaded Couplings: ASTM A 865.

- F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.
  - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- G. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller.
  - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
- H. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.
  - 1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
  - 2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

## 2.02. DIELECTRIC FITTINGS

- A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.
- B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
- C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
- D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
- E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.
- F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.

## 2.03. FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig working-pressure rating and ends according to the following:

1. NPS 2 and Smaller: Threaded.
  2. NPS 2-1/2 and Larger: Flanged.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

#### 2.04. SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

#### 2.05. LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Gate Valves with Wall Indicator Posts:
1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
  2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends
- D. Butterfly Valves: UL 1091.
1. NPS 2 and Smaller: Bronze body with threaded ends.
  2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged ends.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged ends.

- F. Gate Valves: UL 262, OS&Y type.
  - 1. NPS 2 and Smaller: Bronze body with threaded ends.
  - 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
- G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
  - 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
  - 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
  - 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged ends.

#### 2.06. UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

#### 2.07. SPECIALTY VALVES

- A. Pressure-Regulating Valves: UL 1468, brass or bronze, NPS 1-1/2 and NPS 2-1/2, 400-psig minimum rating. Include female NPS inlet and outt, adjustable setting feature, and straight or 90-degree-angle pattern design as indicated. Finish: Rough metal.
- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

#### 2.08. SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Automatic Sprinklers: With heat-responsive element complying with the following:
  - 1. UL 1626, for residential applications.
  - 2. UL 1767, for early-suppression, fast-response applications.
- C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
  - 1. Open Sprinklers: UL 199, without heat-responsive element.
    - a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

- b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.
- D. Sprinkler Finishes: Chrome plated, bronze, and painted.
- E. Special Coatings: Wax, lead, and corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  - 1. Ceiling Mounting: Plastic, white finish, one piece, flat.
  - 2. Sidewall Mounting: Plastic, white finish, one piece, flat.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

### PART 3 EXECUTION

#### 3.01. PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

#### 3.02. EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.03. PIPING APPLICATIONS, GENERAL

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

#### 3.04. JOINT CONSTRUCTION

- A. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- B. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with

both piping materials.

1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
3. NPS 5 and Larger: Use dielectric flange insulation kits.

### 3.05. INTERIOR PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- D. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- E. Install sprinkler piping with drains for complete system drainage.
- F. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- G. Hangers and Supports: Comply with NFPA 13 for hanger materials.
  1. Install sprinkler system piping according to NFPA 13.
- H. Fill wet-pipe sprinkler system piping with water.
- I. Install alarm devices in piping systems.

### 3.06. VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

### 3.07. SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.08. MONITOR INSTALLATION

- A. Install monitor bases securely attached to building substrate.

3.09. CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Electrical Connections: Power wiring is specified in Division 16 (22).
- C. Connect alarm devices to fire alarm.
- D. Ground equipment according to Division 22 Section "Grounding and Bonding."
- E. Connect wiring according to Division 22 Section "Conductors and Cables."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.10. LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 23 Section "Mechanical Identification."

3.11. FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Energize circuits to electrical equipment and devices.
  - 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 5. Coordinate with fire alarm tests. Operate as required.
  - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.12. CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

3.13. DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION



## INDEX OF SPECIFICATIONS

### DIVISION 22 PLUMBING

#### PART 1 -

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220030	ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT
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220086	PIPING INSULATION
220090	SUPPORTS, HANGERS AND ANCHORS
220110	BASIC PLUMBING VALUES
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SECTION 22 00 00 -  
PLUMBING BASICS

PART 1 GENERAL

1.01. SCOPE:

- A. Install all fixtures as shown on the plans. Field verify exact locations.
- B. Provide all equipment and specialties shown on the plans or specified herein.
- C. Provide all necessary support, trim and accessories required.
- D. All fixtures indicated to be ADA compliant and shall be installed in full compliance with ADA guidelines.

1.02. Fixtures shall be equal to those scheduled on the Drawings.

1.03. All items furnished under this section shall be submitted for approval prior to ordering.

1.04. Fixtures shall meet all applicable code requirements and all authorities having jurisdiction.

PART 2 PRODUCTS

2.01. GENERAL:

- A. Fixtures shall be non-absorbent throughout and free from waves, kiln marks or discoloration.
- B. All surfaces coming in contact with walls, floors or other flat surfaces shall be flat.
- C. All enameled iron ware shall be acid-resisting.

2.02. TRIM:

- A. All exposed finished metal parts shall be chromium-plated; except, rough-bodied parts shall be nickel-plated.
- B. All supplies shall be IPS brass; except, where otherwise specified.
- C. All fixtures will be provided with supply stop.
- D. Traps for lavatories and sinks shall be chrome-plated cast brass P-traps with clean-out.
- E. Provide cast brass, chrome-plated, set screw type, escutcheons on supply and waste piping.
- F. All trim for ADA fixtures shall be ADA-compliant.

2.03. CLEAN OUTS:

- A. Caulking plugs: Cast iron cleanouts for caulking into soil pipe hub with straight threaded, plated raised hex head plug having tapered shoulder that seats against seal.
- B. Wall cleanouts for dry wall or block construction shall be cast iron caulking ferrule for soil pipe hub, plated cast iron raised head plug with seal, tapped for machine screw, and stainless steel round access cover plate secured to plug by counter-sunk brass screw.
- C. Wall cleanouts for plaster for tile wall construction shall be cast iron caulking ferrule for soil pipe hub, plated cast iron raised head plug with seal, tapped for machine screw, and cast Nickel alloy round flush access cover with polished top, anchor lugs, and cover plate secured to plug by counter-sunk brass screw.
- D. Floor cleanouts shall be adjustable cast iron floor cleanout, coated cast iron internal cleanout plug with seal, polished nickel alloy rim and round scoriated cover plate, secured to plug by counter-sunk screw. Provide recessed top where cleanout occurs in tile floor. Provide cleanout marker when cleanout occurs in carpet.
- E. Cleanouts to grade shall be cast iron cleanout, plated cast iron counter-sunk plug with seal, adjustable head and heavy-duty loose set round scoriated tractor cover.

2.04. WATER HEATERS:

- A. Provide tank water heaters with ASTM rated T&P valve. T&P valve shall discharge per authority having jurisdiction, full size to outside the building or to an indirect waste receptor by means of an air gap.
- B. Provide tank water heater with drain pan per authority having jurisdiction.
- C. Provide tank water heater with Thermal Expansion tank per authority having jurisdiction.

PART 3 EXECUTION

- 3.01. All fixtures subject to damage prior to completion of building shall be protected in an approved manner. Job must be turned over to Owner with all fixtures clean and free from damage.
- 3.02. All wall-hung water closets and urinals shall be supported on chair carriers.
- 3.03. Unless specified to be furnished with chair carrier, wall-hung lavatories, sinks, and other fixtures, shall be secured to wall with back-up plate and threaded rods. Contractor shall provide all backing, reinforcing, hangers, bolts, anchors and brackets required.
- 3.04. Fixtures mounted and on uneven surfaces shall be bedded in an approved manner as per fixture manufacturer, owner, and engineer.
- 3.05. All hot and cold water supplies to plumbing fixtures or to shower heads shall have a drop-ear fitting secured to prevent movement.
- 3.06. AMERICANS WITH DISABILITIES ACT
  - A. All plumbing facilities shall be installed in compliance with the requirements of the Americans with Disabilities Act. Requirements include the following:

1. Water closet flush controls shall be mounted on the wide side of the toilet area.
  2. Tub controls shall be mounted on the end wall on the entry side of the tub centerline.
  3. Shower controls on stalls up to 36" wide shall be mounted on the side wall opposite the seat on the entry side of the shower centerline, and on stalls up to 60" wide shall be mounted on the back wall on the right side of the centerline.
  4. Hot water piping and traps on fixtures supplied with hot water shall be insulated.
  5. All controls and operating mechanisms shall be operable with one hand and without tight grasping, pinching, or twisting of the wrist.
- B. Fixture and controls mounting heights, clear knee space, access clearances, etc. shall comply with ADA required dimensions, and as on details or schedules when shown.
- 3.07. Do not route piping through electrical or electronic enclosures, or above electrical gear located in other areas unless unavoidable. Install drip pan under piping which must be run through electrical spaces. Installation to be per National Electrical Code and as approved by local authority.

END OF SECTION

SECTION 22 0015  
FIRESTOPPING AND SMOKE STOPPING

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes:
  - 1. Through-penetration firestopping in fire rated construction.
- B. Scope:
  - 1. The scope of the work shall include the mechanical systems, HVAC piping and ductwork, plumbing piping, fire protection piping, and other systems installed by the contractor.

1.02. 1.02 REFERENCES

- A. Underwriters Laboratories
  - 1. U.L. Fire Resistant Directory
    - a. Through-penetration firestop devices (XHCR)
    - b. Fire resistance ratings (BXUV)
    - c. Through-penetration firestop systems (XHEZ)
    - d. Fill, void, or cavity material (XHHW)
- B. American Society for Testing and Materials Standards:
  - 1. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.03. 1.03 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.
- B. Barriers: Time rated fire walls, time rated ceiling/floor assemblies, and structural floors.
- C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
- E. System: Specific products and applications, classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

- F. Sleeve: Metal fabrication or pipe section extending through thickness off barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

#### 1.04. SYSTEM DESCRIPTION

##### A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

#### 1.05. SUBMITTALS

- A. Submit in accordance with general conditions unless otherwise indicated.
- B. Product data: Manufacturer's specifications and technical data including the following:
  1. Detailed specification of construction and fabrication
  2. Manufacturer's installation instructions.
- C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.
  1. Details of each proposed assembly identifying intended products and applicable UL System number, or UL classified devices.
  2. Manufacturer or manufacturers' representative shall provide qualified engineering judgements and drawings relating to non-standard applications as needed.
- D. Quality control submittals:
  1. Statement of qualifications.
- E. Applicators' qualifications statement:
  1. List past projects indicating required experience.

#### 1.06. QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- B. Applicator: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

#### 1.07. REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

#### 1.08. ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for 3 days after installation of materials.
- C. Provide ventilation in areas to receive solvent cured materials.
- D. Furnish forced air ventilation during installation if required by manufacturer.
- E. Keep flammable materials away from sparks or flame.
- F. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
- G. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

#### 1.09. SEQUENCING

- A. Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.

#### 1.10. QUALITY ASSURANCE

- A. Installer's qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:
  - 1. Acceptable to or licensed by manufacturer, State or local authority where applicable.
  - 2. At least 2 years experience with systems.
  - 3. Successfully completed at least 5 comparable scale projects using this system.
- B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.
- C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

### 1.11. DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
  - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
  - 2. Coordinate delivery with scheduled installation date, allow minimum storage at site.
- B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instruction.

### 1.12. PROJECT CONDITIONS

- A. Existing conditions:
  - 1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
  - 2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

### 1.13. GUARANTEE

- A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

## PART 2 PRODUCTS

### 2.01. THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

- A. Systems or devices listed in the U.L. Fire Resistance Director under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.
  - 1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.
  - 2. Acceptable manufacturers and products: Those listed in the U.L. Fire Resistance directory for the U.L. System involved and as further defined in Part 3.06 of this section.
  - 3. All firestopping products must be from a single manufacturer. All trades shall use products from the same manufacturer.



4. Products shall be 3M firestopping products and systems or equal.

#### 2.02. SMOKE-STOPPING AT SMOKE PARTITIONS

- A. Through-Penetration Smoke-Stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.
- B. Construction-Gap Smoke-Stopping: Any system complying with the requirements for construction-gap firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

#### 2.03. MATERIALS

- A. Firestopping Material: Single or multiple component silicone elastomeric rubber type foam compound mixed with incombustible non-asbestos ceramic fibers.
- B. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

#### 2.04. 2.04 ACCESSORIES

- A. Fill, void or cavity materials: As classified under category XHHW in the U.L. Fire Resistance Directory.
- B. Forming materials: As classified under Category XHKU in the U.L. Fire Resistance Directory.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
  2. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02. SURFACE PREPARATION

- A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

#### 3.03. INSTALLATION

- A. Apply primer and materials in accordance with manufacturer's instructions.

- B. Install penetration seal materials in accordance with printed instruction of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction.
- C. Seal holes or voids made by penetrations to ensure an effective smoke barrier.
- D. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.
- E. Apply firestopping material in sufficient thickness to achieve rating and to a uniform density and texture.
- F. Protect materials from damage on surfaces subject to traffic.
- G. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
- H. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges - installed in accordance with fire damper manufacturer's recommendations.
- I. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable tray, bus duct or other items, close unused portions of opening with firestopping material tested for the application. See U.L. Fire Resistance Directory.
- J. Install smoke stopping as specified for firestopping.
- K. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical 12 inch wide fiber dams for full thickness and height of air cavity at maximum 15 foot intervals.
- L. Dam material to remain.

#### 3.04. FIELD QUALITY CONTROL

- A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

#### 3.05. ADJUSTING AND CLEANING

- A. Clean adjacent surfaces of firestopping materials.
- B. Clean up spills of liquid components.
- C. Neatly cut and trim materials as required.
- D. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.06. PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.07. SYSTEMS AND APPLICATION

- A. The installation shall be as required by manufacturer for type of construction, Type of U.L. systems, type of penetration, and type of fire stopping system.

END OF SECTION

## SECTION 220030

### ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 SUMMARY:

- A. This section specifies the basic requirements for electrical components which are to be provided for operation of mechanical equipment. These components include, but are not limited to, motors, starters, and disconnect switches when indicated, furnished as an integral part of packaged mechanical equipment, or furnished separately for mechanical equipment.
- B. Furnish all motor controllers and contactors, not furnished as part of a motor control center, for proper operation of all motors.
- C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specification sections and scheduled on the drawings.

##### 1.02 REFERENCES:

- A. NEMA Standards MG 1: Motors and Generators.
- B. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment.
- D. NEMA Standard KS 1: Enclosed Switches.
- E. National Electric Code (NFPA 70).

##### 1.03 SUBMITTALS:

- A. Separate submittal is not required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

##### 1.04 QUALITY ASSURANCE:

- A. Electrical components and materials shall be UL labeled.
- B. The electrical work shall comply with the National Electric Code.

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS:

- A. Equipment shall be by same manufacturer, except those items furnished by an equipment manufacturer as an integral part of his equipment. Where possible the equipment shall be by the same manufacturer specified by electrical.

- 2.02 MOTORS: The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are included in the individual equipment specifications.
- A. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
  - B. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
  - C. 2-speed motors shall have 2 separate windings on poly-phase motors.
  - D. Temperature Rating: Rated for 40 degrees C (104 degree F). environment with maximum 90 degree C (194 degree F) rise for continuous duty at full load (Class B insulation).
  - E. Starting Capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly spaced starts per hour for manually controlled motors.
  - F. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
  - G. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
    - 1. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
    - 2. Bearings:
      - a. Ball or roller bearings with inner and outer shaft seals.
      - b. Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
      - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
      - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
    - 3. Enclosure Type:
      - a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
      - b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
      - c. Weather protected Type I for outdoor use, Type II where not housed.
    - 4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
    - 5. Noise Rating: "Quiet".
    - 6. Efficiency:

- a. Motor shall comply with the efficiency requirements of the Energy Independence and Security Act of 2007.
  - b. Motors smaller than 1 HP shall have minimum full load efficiencies levels per NEMA Standards.
  - c. Motors 1 HP and larger shall be premium efficiency.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

### 2.03 STARTERS, ELECTRICAL DEVICES, AND WIRING:

#### A. Motor Starter Characteristics:

- 1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R or NEMA 12 with conduit hubs installed by contractor, or units in hazardous locations which shall have NEC proper class and division.
- 2. Type and size of starter shall conform to adopted standards and recommended practices of the National Electric Code and Underwriters' Laboratories.

#### B. Manual Switches: Manual switches shall have:

- 1. Pilot lights and extra positions for multi-speed motors.
- 2. Overload protection: Melting alloy type thermal overload relays.
- 3. Manual starters / switches are to be used on fractional horsepower motors only.

#### C. Magnetic Starters:

- 1. Momentary contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
- 2. Trip-free thermal overload relays, each phase.
- 3. Interlocks, witches and similar devices as required for coordination with control requirements of controls sections.
- 4. Built-in 120 volt control circuit transformer, with 2 primary and one secondary fuse, where service exceeds 240 volts. Fuses sized to carry holding coil circuit and other connected devices.
- 5. Externally operated manual reset.
- 6. Under-voltage release or protection (3-wire control).
- 7. Branch circuit protection shall meet type 2 coordination protection.
- 8. A hand-off-auto selector switch shall be provided in addition to start-stop buttons for all devices being controlled automatically.
- 9. Phase loss relay.

- a. Provide protective relays with DPDT 600V rated contacts, locking potentiometer undervoltage adjustment, and LED indicating light at each starter for motors greater than 5 HP. Equal to Square D Class 8430, Type MPD, mounted in suitable enclosure.

D. Motor Connections:

- 1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Heater Contactors:

- 1. Contactors for resistance heat shall be by same manufacturer as starters unless furnished with heaters. Contactors shall be of the magnetic type and mounted in NEMA Type 1 general purpose enclosure. Contactors shall carry a UL listing and shall be rated for 100,000 cycles.

F. Disconnect Switches:

- 1. Fusible Switches: Fused, each phase; heavy duty; horsepower rated; non-teasible, quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "open" position; arc quenchers; capacity and characteristics as indicated.
- 2. Non-fusible Switches: For equipment less than 1 horsepower, switches shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment 1 horsepower and larger, switches shall be the same as fusible type.

2.04 CAPACITORS:

A. Features:

- 1. Individual unit cells, all welded steel housing, each capacitor internally fused, non-flammable synthetic liquid impregnant, craft tissue insulation, and aluminum foil electrodes.
- 2. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger that have an uncorrected power factor of less than 85 percent at rated load.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

- B. Deliver starters and wiring devices which have not been factory-installed on equipment unit to electrical installer for installation.
- C. Install starters and wiring devices at locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions. Locate for proper operation access, including visibility, and for safety. Do not cover equipment data or informational tags when device is to be mounted on equipment.
- D. Install control connections for motors to comply with NEC and applicable provisions of Electrical. Install equipment grounding except where non-grounded isolation of motor is indicated.
- E. Connect protective relays to line side lugs of the motor starter and wire control contacts into motor starter circuit.
- F. Label starters with engraved plastic nameplate describing the equipment served, e.g., "A.C. Unit No. 1". Nameplates shall be U.V. stabilized for use indoor / outdoor. Attach nameplates with clear silicone sealant.

END OF SECTION



## SECTION 23 0075 - PLUMBING IDENTIFICATION

### PART 1 GENERAL

#### 1.01. SUMMARY

- A. This Section includes the following mechanical identification applications:
  - 1. Equipment identification.
  - 2. Pipe identification.
  - 3. Valve tags.
  - 4. Valve schedule.

#### 1.02. SUBMITTALS

- A. Product Data: For each type of product proposed.
- B. Product Schedule: Provide schedule indicating each type of identification material to be used for equipment, piping, and ductwork. Indicate colors to be used.
- C. Valve Schedule: Submit a valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Provide three (3) copies. Mark valves which are intended for emergency shut-off, normally open, normally closed, and similar special uses by special flag in the margin of the schedule. Include the following for each valve:
  - 1. Valve identification number.
  - 2. System.
  - 3. Purpose.
  - 4. Location.
  - 5. Type.
  - 6. Size.
  - 7. Manufacturer.

#### 1.03. QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems", for letter size, length of color field, for colors not included in the schedule herein, and for viewing angles of identification devices for piping.

#### 1.04. COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 PRODUCTS

#### 2.01. EQUIPMENT IDENTIFICATION

- A. Engraved Plastic Laminate Identification Signs
  - 1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where using adhesive mounting.
  - 2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.
  - 3. Fasteners: Self tapping stainless steel screws except use contact-type, permanent adhesive where screws cannot or should not penetrate the substrate. Where sign cannot be attached directly to device or equipment, attach with brass chain.
  - 4. Letter sizes: Minimum 1/4 inch for names of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionally larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

#### 2.02. PIPE IDENTIFICATION

- A. All above grade piping shall be identified with pipe markers with colors as indicated. Identification shall have proper legend and meet OSHA specifications. Comply with ASME A13.1, unless otherwise noted.
- B. For piping where diameter including insulation is less than 8", pipe markers shall be plastic, pre-tensioned, semi-rigid type that encircles entire pipe without the use

of adhesives. Tape and sticker types are unacceptable.

- C. For piping where diameter including insulation is 8” or greater, pipe markers shall be plastic, full-band, semi-rigid type strapped to pipe using manufacturer’s standard stainless steel bands.
- D. Underground line markers: Manufacturer’s standard permanent, bright colored, continuous printed, plastic tape intended for direct burial service, not less than 6” wide and 4 mils thick. Provide tape with printing which most accurately indicates the type of buried pipe.
- E. Manufacturer: Pipe markers as manufactured by Seton, Brady, Brimar, or EMED are acceptable.

F. Identification Schedule:

	<u>Piping System</u>	<u>Legend</u>	<u>Band/Text Color</u>
1.	<u>Plumbing Piping System</u>		
	Cold Water	Cold Water	Green/White
	Hot Water	Hot Water	Green/White
	Hot Water Return	Hot Water Return	Green/White
2.	<u>Gas Piping System</u>		
	Low Pressure Natural Gas	Low Pressure Gas	Yellow/Black
	High Pressure Natural Gas	High Pressure Gas	Yellow/Black
	Gas Vent	Gas Vent	Yellow/Black
3.	<u>Sanitary Sewer System</u>		
	Sanitary Waste	Sanitary Sewer	Green/White
	Sanitary Vent	Sanitary Vent	Green/White
	Acid Waste	Acid Waste	Orange/Black
4.	<u>Storm Drain System</u>		
	Storm Drain	Storm Drain	Green/White
5.	<u>Miscellaneous Piping Systems</u>		
	Compressed Air	Air (PSI)	Blue/White
	Vacuum - Process	Vacuum	White/Black
	LP Gas	Propane Gas	Yellow/Black
	Fuel Oil Supply	Fuel Oil Supply	Yellow/Black
	Fuel Oil Return	Fuel Oil Return	Yellow/Black
	De-Ionized Water	De-Ionized Water	Green/White
	Distilled Water	Distilled Water	Green/White
	Oxygen	Oxygen	Green/White
	Lawn Sprinkler	Non-Potable Water	Green/White
6.	<u>Medical Gas Piping System</u>		
	Oxygen	Oxygen	Green/White
	Nitrous Oxide	Nitrous Oxide	Blue/White
	Nitrogen	Nitrogen	Blue/White
	Medical Air	Medical Air	Yellow/Black
	Medical Vacuum	Medical Vacuum	White/Black
	Helium	Helium	Brown/White
	Carbon Dioxide	Carbon Dioxide	Grey/White

7.	<u>Waste Anesthetic Gas Disposal</u>		
	Waste Gas	Evac	Purple/White
	Non Medical Air	Non Med Air	Yellow & White Diagonal Stripe/Black
	Non Medical Vac	Non Med Vac	White & Black Diagonal Stripe/Black Boxed
	Laboratory Air	Lab Air	Yellow & White Checker Board/Black
	Laboratory Vac	Lab Vac	White & Black Checker Board/Black Boxed

- G. Arrows and lettering shall be black. Arrows shall point in the direction of flow. Locate downstream of pipe legend.
- H. Arrows shall be of same color as bands and shall point in direction of flow. Locate downstream of pipe legend.
- I. Valve Identification: Provide brass tags for all valves and steam traps with legend describing function of each valve and trap. Tag shall also indicate normally open or normally closed, where position is noted on the drawings.
- J. Valve Tags: Brass tags shall be a minimum of 2" diameter or 3-1/2" oval, to accommodate 1" high numbers. Tag shall be equipped with a 3/16" X 6" long brass chain.

2.03. STENCILS: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4" for ducts; and minimum letter height of 3/4" for equipment and access door signs. Use alkyd paint. Use stencils only as directed herein.

### PART 3 EXECUTION

#### 3.01. EQUIPMENT IDENTIFICATION

- A. Provide permanent, factory, operational data, nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Where manufacturer's nameplate is not stamped or engraved, provide additional heavy gauge, aluminum or brass, stamped or engraved nameplate. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.
- B. In addition to factory nameplate, provide an engraved plastic laminate (stenciled) identification sign for each major item of mechanical equipment and each operational device. Provide identification signs for the following general categories of equipment.
  - 1. Main control and operating valves, including safety devices and hazardous

- units such as gas outlets.
  - 2. Compressors, pumps, and similar motor-driven units.
  - 3. Tanks and pressure vessels.
  - 4. Strainers, filters, humidifiers, water treatment systems, and similar equipment.
  - 5. Control panels.
  - 6. Fuel burning units, such as boilers, furnaces, and heaters.
- C. Provide engraved sign at each access door, indicating equipment or device to be accessed.
- D. Coordinate names, abbreviations, and other designations used in equipment identification with corresponding designations shown, specified, scheduled, or as designated by the Owner's representative. Provide numbers, lettering, and wording as indicated or as directed by the Owner's representative. Owner shall set priority for lettering and graphics. Where multiple systems of the same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, AHU-1H, Standpipe G14).
- E. Provide Ceiling Grid Labels for Equipment:
- 1. Letter Color: Black
  - 2. Background Color: White
  - 3. Minimum Label Size: Length may vary for required label content, but dimensions shall not be less than 2-1/2 by 3/4 inch.
  - 4. Minimum Letter Size: 1/2 inch.
  - 5. Self adhesive, compatible with label and with substrate.
  - 6. Locate on ceiling grid or access door nearest access side of equipment.

### 3.02. PIPE IDENTIFICATION

- A. Provide 1" thick molded fiberglass insulation with jacket under each plastic pipe marker to be installed on uninsulated pipes where fluid temperatures will be 125°F or greater. Insulation shall extend 4" beyond edges of marker.
- B. Valve tags and steam traps shall be numbered as indicated on the valve listing provided to the Owner.

- C. As a minimum, identification shall be applied to piping at the following locations:
1. Adjacent to each valve.
  2. At each branch and riser take-off.
  3. At each pipe passage through wall, floor, and ceiling construction.
  4. At each pipe passage to underground.
  5. At not more than forty feet spacing on straight pipe runs.
- D. Place identification so it can be easily read. Arrows shall be applied to indicate direction of flow.
- E. Underground Piping: During back-filling of each exterior underground piping system, install plastic line marker, located directly over buried line no deeper than 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install a single line marker.

END OF SECTION 23 0075

## SECTION 22 0086

### PIPING INSULATION

#### PART 1 - GENERAL

##### 1.01. SUMMARY

- A. Perform all Work required to provide and install piping insulation, jackets, and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Insulation of Underground Piping is specified elsewhere and not work of this Section.

##### 1.02. REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - 2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.
  - 3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.
  - 4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.
  - 5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
  - 6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - 7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - 9. ASTM C547 - Mineral Fiber Pipe Insulation.
  - 10. ASTM C552 - Cellular Glass Thermal Insulation.
  - 11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C450 - Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
15. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.
16. ASTM C921 - Jackets for Thermal Insulation.
17. ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
18. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
19. ASTM D1667 - Flexible Cellular Materials – Poly (Vinyl Chloride) Foam (Closed-Cell).
20. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
21. ASTM C795 - Insulation For Use Over Austenitic Steel.
22. ASTM E84 - Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Water Vapor Transmission of Materials.
24. NFPA 255 - Surface Burning Characteristics of Building Materials.
25. UL 723 - Surface Burning Characteristics of Building Materials.
26. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

### 1.03. DEFINITIONS

- A. Concealed: Areas that cannot be seen by the building occupants.
- B. Interior Exposed: Areas that are exposed to view by the building occupants, including underneath countertops, inside cabinets and closets, and all equipment rooms.
- C. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.
- D. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.
- E. Unconditioned Space: Interior space that is not temperature-controlled by cooling and/or heating system. Includes attics, chases, unconditioned living spaces and non-conditioned equipment rooms.

### 1.04. QUALITY ASSURANCE



- A. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.
- B. All insulation, jacket, adhesives, mastics, sealers, and accessories utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.
  - 1. Certificates to this effect shall be submitted along with submittal data.
  - 2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- C. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years experience specializing in the trade.
- D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.
- E. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unwisely, inadequate, damaged or water-soaked Work will not be acceptable.
- F. Stainless Steel: Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36. These requirements are for prevention of external stress Corrosion Cracking (ESCC) for austenitic stainless steel.

#### 1.05. SUBMITTALS

- A. Prepare a schedule of piping insulation showing systems insulated. For each system, show insulation type, thickness, temperature rating, and special conditions where applicable.
- B. Submit product data for each piping system. Product data shall include but not be limited to the following:
  - 1. Manufacturer's name
  - 2. Insulation material and thickness
  - 3. Jacket
  - 4. Adhesives
  - 5. Fastening methods
  - 6. Fitting materials
  - 7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings

8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)
  9. Other appropriate data
- C. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.
- D. Operation and Maintenance Data: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

#### 1.06. DELIVERY, STORAGE and HANDLING

- A. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.
- B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.
- C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

### PART 2 - PRODUCTS

#### 2.01. GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

#### 2.02. MANUFACTURERS

- A. Insulation:
  1. Owens-Corning
  2. Certainteed Corporation
  3. Johns Manville Corporation
  4. Knauf Corporation
  5. Armstrong/Armacell (Armaflex)
  6. RBX Industries/Rubatex
  7. FOAMGLAS (Cellular Glass) by Pittsburgh Corning
- B. Jackets:
  1. Childers Products Company

2. PABCO
  3. RPR Products, Inc.
  4. John Mansfield Speedline
  5. Foamglas
- C. Coatings, Sealants, and Adhesives:
1. Foster
  2. Childers

### 2.03. INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Piping Insulation Type P1: Glass-Fiber, Preformed Pipe Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A with factory applied ASJ-SSL vapor barrier jacket with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Provide one of the following:
  1. Owens Corning; Evolution Fiberglas Pipe Insulation.
  2. Johns Manville; Micro-Lok Pipe Insulation.
  3. Knauf; Earthwool 1000 degree Pipe Insulation.
- F. Piping Insulation Type P2: Flexible Elastomeric Pipe Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Provide one of the following:
  1. Armacell LLC; AP Armaflex
  2. Aeroflex USA Inc; Aerocel
  3. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- G. Piping Insulation Type P3: Handicap Lavatory and Sink Piping Insulation Kit:

1. Handicap lavatory and sink drain piping, P-trap, cold and hot water assemblies and valves shall be insulated with fully molded insulation kit specifically designed for handicap lavatories and sinks. ADA conforming.
  2. Material shall be 3/16" thick molded closed cell vinyl with nylon fasteners, white finish and be self-extinguishing per ASTM D635, with K value of 1.17 BTU/in./hr./sq. ft./deg. F.
- H. Piping Insulation Type P4: Preformed Cellular Glass: Comply with ASTM C 585, ASTM C 450. Provide one of the following:
1. Pittsburgh Corning; Foamglas

#### 2.04. FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe. Provide one of the following:
1. Foster Brand, Specialty Construction Brands, Inc; Mast-A-Fab.
  2. Vimasco Corporation; Elastafab 894.

#### 2.05. FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Piping Jacket Type J1: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 40 mil thickness, roll stock ready for shop or field cutting and forming. Provide factory-fabricated fitting covers to match jacket. Provide one of the following
1. Johns Manville; Zeston.
  2. Proto Corporation; LoSmoke
- C. Piping Jacket Type J2: Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14. Provide factory-fabricated fitting covers or field fabricate covers only if factory-fabricated fitting covers are not available. Provide one of the following:
1. Provide Childers Brand Metal Jacketing Systems.
  2. Provide shop fabricated smooth aluminum jacket 0.016".

#### 2.06. TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.

#### 2.07. INSULATION INSERTS

- A. Provide insert between support shield and piping on piping 1 1/2" diameter or larger. Inserts shall be factory fabricated of heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:
1. 1 1/2" to 2 1/2" pipe size 10" long
  2. 3" to 6" pipe size 12" long
  3. 8" to 10" pipe size 16" long
  4. 12" and over 22" long

#### 2.08. PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12-inch centers.
- D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- E. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- F. Adhesives: Compatible with insulation.
- G. Banding:
1. Aluminum bands, 3/4" x 0.02 inches

2. Stainless Steel, 304, 3/4" by 0.02 inches

## PART 3 - EXECUTION

### 3.01. PREPARATION

- A. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application. Insulating piping where condensate is occurring is unacceptable. Wet insulation is unacceptable and shall be removed and replaced before acceptance by the Owner.
- B. Coordinate insulation installation with trade installing heat trace. Comply with requirements for heat tracing that apply to insulation.
- C. Verify that piping has been tested for leakage before applying insulation.

### 3.02. GENERAL INSTALLATION REQUIREMENTS

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards, and shall conform to codes and ordinances of authorities having jurisdiction.
- B. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.
- C. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.
- D. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.
- E. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.
- F. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- G. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- H. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- I. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Keep insulation materials dry during application and finishing.

- L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- M. Install insulation with least number of joints practical.
- N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- P. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches similar to butt joints.
- T. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

### 3.03. PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.



- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Section 15050 for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 15050."

#### 3.04. GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket where concealed unions, check valve or piping specialties are insulated. Provide descriptive label at device under the insulation. For example at each union stencil with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.05. INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.06. INSTALLATION OF GLASS-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below-ambient surfaces, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.07. FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.08. FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum jackets.

### 3.09. PIPING SYSTEMS INSULATION SCHEDULE

PIPING SYSTEMS INSULATION SCHEDULE										
SERVICE	INSULATION TYPE	LOCATION	JACKET TYPE	PIPE SIZE	INSULATION THICKNESS BY PIPE SIZE					
COLD PIPING										
DOMESTIC COLD WATER	P1	INTERIOR CONCEALED	--	0.75" AND SMALLER	0.5"					
				1.0" THROUGH 2.0"	1.0"					
				2.5" AND LARGER	1.5"					
			EXTERIOR	J2	0.75" AND SMALLER	1.0"				
					1.0" THROUGH 2.0"	1.5"				
							2.5" AND LARGER	2.0"		
							EQUIPMENT ROOMS	J1	0.75" AND SMALLER	0.5"
							BELOW 7.0" ABOVE FLOOR		1.0" THROUGH 2.0"	1.0"
							2.5" AND LARGER	1.5"		
							COOLING COIL CONDENSATE	P2	INTERIOR CONCEALED	--
BRANCH LINES				4.0" AND LARGER	0.75"					
COOLING COIL CONDENSATE		INTERIOR EXPOSED	J1	3.0" AND SMALLER	0.5"					
SEWER/STORM DRAIN LINES		UNCONDITIONED	--	3.0" AND SMALLER	0.5"					
CARRYING COOLING COIL CONDENSATE		SPACE		4.0" AND LARGER	0.75"					
		EXTERIOR	J2	3.0" AND SMALLER	0.5"					
				STORM WATER HORIZONTAL PIPING		4.0" AND LARGER	0.75"			
FROM DRAIN TO RISER										
		EQUIPMENT ROOMS	J1	3.0" AND SMALLER	0.5"					

		BELOW 7.0" ABOVE FLOOR		4.0" AND LARGER	0.75"
HOT PIPING					
DOMESTIC HOT WATER	P1	INTERIOR CONCEALED	--	0.75" AND SMALLER	0.5"
				1.0" THROUGH 2.0"	1.0"
				2.5" AND LARGER	1.5"
		INTERIOR EXPOSED		0.75" AND SMALLER	0.5"
				1.0" THROUGH 2.0"	1.0"
				2.5" AND LARGER	1.5"
		UNCONDITIONE D	--	0.75" AND SMALLER	0.5"
		SPACE		1.0" THROUGH 2.0"	1.0"
				2.5" AND LARGER	1.5"
		EXTERIOR		0.75" AND SMALLER	1.0"
				1.0" THROUGH 2.0"	1.5"
				2.5" AND LARGER	2.0"
		EQUIPMENT ROOMS	J1	0.75" AND SMALLER	0.5"
		BELOW 7.0" ABOVE FLOOR		1.0" THROUGH 2.0"	1.0"
				2.5" AND LARGER	1.5"
DOMESTIC HOT WATER AND DRAIN AT HANDICAP LAVATORIES	P3				

END OF SECTION 22 0086

## SECTION 22 0090

### SUPPORTS, HANGERS AND ANCHORS

#### PART 1 GENERAL

##### 1.01. WORK INCLUDED

- A. Inserts, Anchors, and Upper Attachments
- B. Pipe Hangers, Rods, Supports, and Accessories
- C. Fabricated Steel Support

##### 1.02. QUALITY ASSURANCE

- A. Design of pipe supporting elements shall be in accordance with ANSI B31.1
- B. Fabrication and installation of pipe hangers and supports shall be in accordance with the following Manufacturers Standardization Society (MSS) Standards:
  - 1. SP-58 Pipe Hangers and Supports: Materials, Design and Manufacture.
  - 2. SP-69 Pipe Hangers and Supports: Selection and Application.
  - 3. SP-89 Pipe Hangers and Supports: Fabrication and Installation Practices.
- C. Steel angles, channels and plate shall be in accordance with ASTM A36, red primed or hot dipped galvanized for interior applications and hot galvanized for exterior applications.
- D. Bolts, including nuts and washers, used for fabricating steel members shall be in accordance with ASTM A325 and shall be stainless steel or plated for corrosion protection. Plain steel components are unacceptable.
- E. Welding of steel members shall be in accordance with AWS D1.1.
- F. Steel supports for ducts, pipe anchors, pipe guides, and piping supported from below shall be fabricated in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for buildings. If required, the Contractor shall include the cost of the services of a structural engineer to design or review the system.

##### 1.03. APPLICABLE PUBLICATIONS

- A. Applicable sections of the publications listed below form a part of this Section. The publications are referenced by the basic designation only.
  - 1. American Institute of Steel Construction (AISC)
  - 2. American National Standards Institute (ANSI)

3. American Society for Testing and Materials (ASTM)
4. American Welding Society (AWS)
5. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)
6. National Fire Protection Agency (NFPA)
7. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)

1.04. SUBMITTALS

- A. Submit schedule indicating type of hanger to be used by system and pipe size. Include rod size for each hanger size.
- B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.
- C. Provide shop drawings for fabricated steel supports.

PART 2 PRODUCTS

2.01. ACCEPTABLE MANUFACTURERS

- A. Inserts, Anchors, and Upper Attachments:
  1. Anvil International, Inc.
  2. Carpenter Paterson, Inc.
  3. Cooper B-Line, Inc.
  4. Elcen Metal Products
  5. Hilti
  6. Unistrut
  7. ITW Red Head
- B. Pipe Hangers, Rods, Supports and Accessories:
  1. Anvil International, Inc.
  2. Carpenter Paterson, Inc.
  3. Cooper B-Line, Inc.
  4. Elcen Metal Products
  5. Hilti



6. Unistrut

- C. Fabricated Steel Support: As indicated on Drawings.

2.02. DESIGN REQUIREMENTS

- A. Supports capable of supporting the pipe for all service and testing conditions. Provide 4-to-1 safety factor.
- B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.
- C. Design supports and hangers to allow for proper pitch of pipes.
- D. For chemical and waste piping, design, materials of construction, and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.3.
  2. MSS SP-58 and MSS SP-69.
  3. Except where modified by this Specification.
- E. For steam and hot and cold water piping, design, materials of construction and installation pipe hangers, supports, guides, restraints and anchors:
1. ASME B31.1
  2. MSS SP-58 and MSS SP-69.
- F. Check all physical clearances between piping, support system, and structure. Provide for vertical adjustment after erection.
- G. Support vertical pipe runs in pipe chases at base of riser. Support pipes for lateral movement with clamps or brackets.
- H. Place hangers on outside of pipe insulation. Use a pipe covering protection saddle for insulated pipe at support point.
- I. Fabricated Steel Supports: As detailed on the drawings.

2.03. INSERTS AND ANCHORS

- A. Inserts: MSS Type 18; malleable iron body and nut, galvanized finish, opening in top of insert for reinforcing rod, lateral adjustable.
- B. Anchors: Steel shell and expander plug, snap off end fastener

2.04. HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. Select size of hangers and supports to exactly fit pipe size for bare piping, and around piping insulation with saddle or shield for insulated piping.

- B. For suspension of non-insulated or insulated stationary pipe lines: Adjustable steel clevises, MSS Type I.
- C. For suspension of non-insulated stationary pipe lines: Adjustable band hangers, MSS Type 7 or 9; or split pipe rings, MSS Type II.
- D. For support of piping where horizontal movement due to expansion and contraction may occur, and where a low coefficient of friction is desired: Pipe slides and slide plates, MSS Type 35, including guided plate mounted on a concrete pedestal or structural steel support.
- E. For support from floor stanchion, using floor flange to secure stanchion to floor: Adjustable pipe stanchion saddles, MSS Type 37 or 38, including steel pipe base support and cast-iron floor flange.
- F. For suspension of pipe from two (2) rods where longitudinal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.
- G. For suspension of pipe from a single rod where horizontal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.
- H. For support of pipe from a single rod where vertical adjustment is not necessary: Pipe roll stands, MSS Type 45.
- I. For support of pipe where small horizontal movement due to expansion and contraction may occur, but vertical adjustment is not necessary: Pipe rolls and plates, MSS Type 45.
- J. For support of pipe lines where vertical and lateral adjustment during installation may be required in addition to provision for expansion and contraction: Adjustment pipe rolls stands, MSS Type 46.

#### 2.05. VERTICAL PIPING CLAMPS

- A. Select size of vertical piping clamps to exactly fit size of bare pipe.
- B. For support and steadying of pipe risers: Two-bolt riser clamps, MSS Type 8 or 42.

#### 2.06. HANGER ROD ATTACHMENTS

- A. Select size of hanger rod attachments to suit hanger rods.
- B. For adjustment up to six (6) inches for heavy loads: Steel turnbuckles, MSS Type 13.
- C. For use on high temperature piping installations: Steel clevises, MSS Type 14.
- D. For use with split pipe rings, MSS Type II: Swivel turnbuckles, MSS Type 15.
- E. For attaching hanger rod to various types of building attachments: Malleable iron sockets, MSS Type 16 or 17.
- F. Rods:
  - 1. Size 3/8" and up: All thread steel rod electro galvanized. Sizing for pipe or equipment support as follows:

Copper Tube, Plastic	Steel, Cast Iron		
Pipe Size (Copper, Plastic)	Pipe Size (Steel, Cast Iron)	Rod Size	Max. Equip. Load
1/4" to 2"	1/4" to 2"	3/8"	730 lbs.
2-1/2" to 4"	2-1/2" to 3"	1/2"	1,350 lbs.
6"	4"	5/8"	2,160 lbs.
8" to 12"	6"	3/4"	3,230 lbs.
14"	8" to 12"	7/8"	4,480 lbs.
16"	14" to 16"	1"	5,900 lbs.
18" to 20"	18" to 20"	1-1/4"	9,500 lbs.
22" to 42"	22" to 42"	1-1/2"	13,800 lbs.

2. Rods may be reduced one size for double rod hangers with 3/8" minimum diameter, or when other paragraphs require a minimum of 2 hangers per section, provided the minimum diameter of 3/8" is maintained.

G. For upper attachment for suspending pipe hangers from concrete: Concrete inserts MSS Type 18.

H. For attachment to top flange of structural shape: Top beam C-clamps, MSS Type 19.

I. For attachment to bottom flange of structural shape: Side beam or channel clamps, MSS Type 20 or 27.

J. For attachment to center of bottom flange of beams: Center beam clamps, MSS Type 21.

K. For attachment to bottom of beams where heavy loads are encountered and hanger rod sizes are large: Welded attachments, MSS Type 22.

L. For attachment to structural shapes: C-clamps, MSS Type 23.

M. For attachment to top of beams when hanger rod is required tangent to edge of flange: Top I-beams clamps, MSS Type 25.

N. For attachment to bottom of steel I-beams for heavy loads: Steel I-beam/WF-beam clamps with eye nut, MSS Type 28 or 29.

O. Steel brackets, for indicated loading:

1. Light duty, 750 pounds, MSS Type 31.
2. Medium duty, 1,500 pounds, MSS Type 32.
3. Heavy duty, 3,000 pounds, MSS Type 33.

P. For use on sides of steel beams: Side beam brackets, MSS Type 34.

## 2.07. SPRING HANGERS AND SUPPORTS

A. Select spring hangers and supports to suit pipe size and loading.

B. For control of piping movement: Restraint control devices, MSS Type 47.

- C. For light loads where vertical movement does not exceed 1-1/4 inch: Springs cushion hangers, MSS Type 48.
- D. For equipping Type 41 roll hanger with springs: Spring cushion roll hangers, MSS Type 49.
- E. For retardation of sway or thermal expansion in piping systems: Spring way braces, MSS Type 50.
- F. For absorbing expansion and contraction of piping system from hanger: Variable spring hangers, MSS Type 51; preset to indicated load and limit variability factor to 25%.
- G. For absorbing expansion and contraction of piping system from base support: Variable spring base supports, MSS Type 52; preset to indicated load and limit variability factor to 25%; include flange.
- H. For absorbing expansion and contraction of piping system from trapeze support: Variable spring trapeze hangers, MSS Type 53; preset to indicated load and limit variability factor to 25%.
- I. Constant supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.
  - 1. Horizontal Type: MSS Type 54.
  - 2. Vertical Type: MSS Type 55.
  - 3. Trapeze Type: MSS Type 56.

#### 2.08. SUPPLEMENTARY SUPPORTS

- A. Where support spacing is more frequent than distance between structural members, provide steel angles, channels or beams sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer pipe support loads to structural members.
- B. Where deflection of center of trapeze support exceeds 1/240 of distance between hanger rods, provide additional hanger rods.
- C. Where multiple risers are supported within shafts, provide steel angles, channels or beams, sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer loads to the concrete floor slab. Anchor supplemental supports to the slab, and provide resilient element where required by other Sections of this Division.

#### 2.09. ACCESSORIES

- A. Protective Shields, MSS Type 40: Carbon steel, galvanized minimum of 12" length sized for required insulation.
- B. Protective Saddles, MSS Type 39: Carbon steel plate, minimum of 12" length, sized for required insulation.
- C. Steel Turnbuckle, MSS Type 13: Forged steel, galvanized finish with locknuts. Rated at a minimum of 730 lbs. at 3/8" size.
- D. Steel Clevis, MSS Type 1: Forged steel, galvanized finish with steel pin and cotter pin. Rated for a minimum of 730 lbs. at 3/8" size.
- E. Weldless Eye Nut, MSS Type 17: Forges steel, galvanized finish. Rated for a minimum of 730 lbs. at 3/8" size.

2.10. PIPE INSULATION HANGER SHIELDS

- A. Where hangers are placed outside the jackets of pipe insulation, provide shields equal to "Thermal Hanger Shields" as manufactured by Pipe Shields, Inc. or equivalent by Elcen Metal Products Company.
- B. Shields shall consist of a 360-degree insert of high-density, 100 psi, waterproof calcium silicate, encased in a 360-degree galvanized sheet steel shield. Insert shall be same thickness as adjoining pipe insulation, and shall extend 1 inch beyond sheet metal shield in each direction on cold lines. Shield lengths and minimum sheet metal gauges shall be as directed below:

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2" to 1-1/2"	4"	26
2" to 6"	6"	20
8" to 10"	9"	16
12" to 18"	12"	16
20" & Larger	18"	16

- C. Shields shall be Model CS-CW, except for pipe roller applications: then provide Model CSX-CW.
- D. At the Contractor's option, shop-fabricated galvanized metal shields may be provided based on approved shop drawings. Length and gauge of sheet metal shall be as specified above.
- E. For all insulated piping 4" and larger, provide insulation insert at a minimum of 12" long. Insert shall extend a minimum of one inch beyond shield. Insulation inserts shall be minimum 12" long section of foam glass insulation.

2.11. METAL FRAMING: Provide products compliant with NEMA ML-1.

2.12. STEEL PLATES, SHAPES AND BARS: Provide products compliant with ANSI/ASTM A-36.

2.13. PIPE GUIDES: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base, with a two-section guiding spider bolted tight to pipe or as shown on Drawings. Size guides and spiders to clear pipe, cylinder and insulation, if any. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 EXECUTION

3.01. GENERAL REQUIREMENTS

- A. Where applicable, install in accordance with the manufacturer's written installation instructions.
- B. Where supports are in contact with copper pipe, provide copper plated support.
- C. Where supports are in contact with glass, aluminum or brass pipe, provide plastic coating on supports.
- D. Interior hangers, supports, including attachments, that are plain steel shall be primed and painted.
- E. Hangers and supports, including attachments, exposed to weather or located in utility tunnels or

accessible utility trenches or subject to spillage shall be hot dip galvanized after fabrication.

- F. Fabricated steel supports exposed to weather or located in utility tunnels and accessible utility trenches or subject to spillage shall be primed and painted. Cut, welded, drilled or otherwise damaged surfaces of coating shall be repaired.

### 3.02. PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including but not limited to proper placement of inserts, anchors and other building structural attachments.

### 3.03. INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure in compliance with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together in trapeze-type hangers where possible. Install supports with maximum spacing as specified in this Section. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for small diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Support fire protection water piping independently of other piping
- D. The location of hangers and supports shall be coordinated with the structural work to ensure that the structural members will support the intended load.
- E. Provide hex head nut on rod at top and bottom of clevis hanger yoke, and at each rod connection to intermediate and upper attachment. Rod nuts shall be securely locked in place.
- F. Hanger rods shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing.
- G. Hangers shall be fabricated to permit adequate adjustment after erection while still supporting the load. Turnbuckles shall be provided where required for vertical adjustment of the piping.
- H. Supports for vertical piping shall be located at each floor or at intervals of not more than 15 feet and at intervals of not more than 8 feet from end of risers. Where supports are provided on intermediate floors spaced 15 feet or less between floors, no additional supports are required other than those specified for end of risers.
- I. A hanger or support shall be provided adjacent to each piece of equipment to ensure that none of the pipe weight is supported from the equipment.
- J. Provide protective shields on all piping required to be insulated.
- K. Provide protective saddles sized to match insulation thickness on all hot piping required to be insulated. Fill void between saddle and pipe with insulation as specified.
- L. Provide turnbuckles on all hangers that require leveling or aligning.
- M. Provide steel clevis where detailed and/or required.

N. Provide weldless eye nuts on hanger terminations where disassembly or swing may be required. Use in combination with steel clevis.

O. Supports

1. Provide additional supports at:
  - a. Changes in direction.
  - b. Branch piping and runouts over 5 feet.
  - c. Concentrated loads due to valves, strainers and similar items.
  - d. At valves 4 inches and larger in horizontal piping.
  - e. Support piping on each side of valve.
  - f. Brace hubless piping to prevent horizontal and vertical movement.
  - g. Where number of grooved couplings exceeds 3 between supports or provide continuous steel between supports.
2. Sanitary waste and vent, roof drains per UPC Section 316: Vertical supports are not required within 2.5 feet of wall penetrations for pipes 8 inches in diameter and smaller, and not more than 3 feet for 10 inches and larger.
3. Other piping support spacing shall be as scheduled on Drawing or as required by referenced standard.

3.04. HANGER SPACING

A. The maximum spacing between pipe supports for straight runs shall be in accordance with the following chart. If any deviation from the table exists within the manufacturer's written installation instruction, whichever spacing reflecting the smaller centerline to centerline dimension shall be used.

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING TABLE

1. Steel Pipe (Schedule 40 & 80):
  - Up to 1" ..... 7 ft. on center
  - 1-1/4" and greater ..... 10 ft. on center
2. Copper Pipe (Types L, K and M):
  - Up to 1" size: ..... 5 ft. on center
  - 1-1/4" to 2-1/2" ..... 7 ft. on center
  - 3" and larger..... 10 ft. on center
3. Ductile Iron and Cast Iron: Two hangers per section length.
4. Polyvinyl Chloride (PVC):
  - Up to 1-1/2" ..... 3 ft. on center
  - 2" to 4" ..... 4 ft. on center
  - 5" to 8" ..... 5 ft. on center
  - 10" and larger..... 6 ft. on center
5. Sprinkler and Standpipe: Pipe hangers to be as per NFPA-13 and NFPA-14 standards.

- B. Hanger centerline spacing shall be reduced by 50% in areas of concentrated valves and/or fittings, also no more than a maximum distance of 12 inches from valves, fittings and/or couplings, or 24 inches from a change in direction.

### 3.05. ATTACHMENT TO STRUCTURE

- A. For plain steel devices, prime and paint.
- B. Adjust attachment location for proper alignment and no more than 4 degrees offset from a perpendicular alignment.
- C. If proper alignment cannot be achieved from the existing building structure, provide a trapeze type support sized to handle the design load with a minimum safety factor of 5.

### 3.06. INSERTS

- A. Contractor shall have inserts at site and dimensional location drawings ready at the beginning of the involved concrete work.
- B. Install inserts by securing to concrete forms and inserting reinforcing rod through the opening provided in the insert in accordance with shop drawings.
- C. Provide necessary supervision while concrete is being poured to correct any misalignment caused by the concrete.

### 3.07. INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B-31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bards to piping and to structure. Comply with ANSI B-31, with AWS standards, and with the Details shown on the drawings.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required, accommodating both expansion and contraction of piping.
- E. Size anchor shell length to assure a minimum of 1" solid concrete remaining from shell and to concrete face.

### 3.08. INSTALLATION OF TRAPEZES OR PIPE RACKS

- A. Light/Medium Duty: Assemble from standard manufactured metal framing systems, in accordance with manufacturer's recommendations.
- B. Heavy Duty: Fabricate from structural steel shapes selected for loads required. Weld steel in accordance with AWS standards.

### 3.09. AUXILIARY STEEL

- A. Furnish all miscellaneous structural members necessary to hang or support ductwork, piping, and mechanical equipment.
- B. Notify Engineer of any adjustment necessary in main structural system for proper support of



major equipment.

- C. Fabricated Steel Supports: Steel for supports shall be saw cut, with sharp edges ground smooth. After fabrication, remove all foreign material, including welding slag and spatter, and leave ready for painting.

END OF SECTION

## SECTION 22 01 10

### BASIC VALVES

#### PART 1 - GENERAL

1.01 Valves specified in this section are for general use. See specifications for specific systems and special valves.

#### 1.02 SUBMITTALS

- A. Product Data: Provide for each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories. Provide valve schedule with product data listing valves used for each service application.

#### 1.03 QUALITY ASSURANCE:

- A. Single Source Responsibility: Where possible valves shall be by the same manufacturer.
- B. MSS Standard Practices: Comply with the MSS standards for valves specified.
- C. ASME: Comply with ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
- D. NSF: Comply with NSF 61 for valve materials for potable water service.

#### 1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Preparation for Transport:
1. Ensure valves are dry and internally protected against rusting and galvanic corrosion.
  2. Protect valve ends against mechanical damage to threads, flange faces, and weld end preps.
  3. Set valves in best position for handling. Globe and gate valves shall be closed to prevent rattling; plug valves shall be open to minimize exposure of functional surfaces; butterfly valves shall be shipped closed or slightly open; and swing check valves shall be blocked in either closed or open position.
- B. Storage:
1. Do not remove valve end protectors unless necessary for inspection; reinstall for storage.
  2. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is

necessary, support valves off the ground or pavement and protect in watertight enclosures.

- C. Handling: Valves whose size requires handling by crane or lift shall be slung or rigged to avoid damage to exposed valve parts. Handwheels and stems, in particular, shall not be used as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering valves which may be incorporated in the work include the following. For majority of valves, Milwaukee has been used as basis of design. Equal valves of other manufacturers may be submitted without substitution requests.

1. APCO
2. Apollo
3. CPV
4. Crane
5. DeZurick
6. Grinnell
7. Hammond
8. Jamesbury
9. Jenkins
10. Keflex
11. Metraflex
12. Milwaukee
13. Mueller
14. Nibco
15. Nordstrom
16. Powell
17. Stockham
18. Walworth
19. Watts

### 2.02 VALVE FEATURES:

- A. Valve Design: Valves shall have rising stem, or rising outside screw and yoke stems; except, non-rising stem valves may be used where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: Not less than indicated and required to suit system pressures and temperatures.
- C. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- D. Operators: Provide the following special operator features:
  - 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
  - 2. Lever handle on quarter-turn valves 4 inch and smaller, except for plug valves. Provide one wrench for every 10 plug valves.
  - 3. Chain-wheel operators for valves 2-1/2 inch and larger installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
  - 4. Gear drive operators on quarter-turn valves 6 inches and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Provide bypass and drain connections required by manufacturer and as indicated on the drawings.
- G. End Connections: As specified in the individual valve specifications.
  - 1. Threads: Comply with ANSI B1.20.1.
  - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
- H. Valves for Domestic Hot Water and Cold Water.
  - 1. Gate Valves:
    - a. 2 inch and Smaller: Class 125, body and bonnet of ASTM B62 cast bronze, threaded ends, solid disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires. Milwaukee #105.
    - b. 2-1/2 Inch and Larger: Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and packing gland assembly. Milwaukee #F-2885A.
  - 2. Ball Valves:
    - a. Valves 2 Inches and Smaller: Threaded ends, rated for 400 psi WOG pressure; 3 piece construction, bronze body conforming to ASTM B 62, full port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide insulator type handle for chilled water and condensate drain. Milwaukee BA-300.
  - 3. Plug Valves:

- a. 2 Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends. Lunkenheimer 454.
  - b. 2-1/2 Inch and Larger: 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends. Nordstrom 143.
4. Globe Valves:
- a. 2 Inch and Smaller: Class 125, body and screwed bonnet of ASTM B 62 cast bronze, threaded ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires. Milwaukee #502T.
  - b. 2-1/2 Inch and Larger: Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze mounted, flanged ends, and packing gland assembly. Milwaukee F2981A.
5. Butterfly Valves: 2-1/2 Inch and Larger: 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with nickel-plated ductile iron disc (except valves installed in condenser water piping which shall have aluminum bronze disc), stainless steel stem, and EPDM O-ring stem seals. Valves shall have gear operator with extended wheel handle and position indicator. Valves shall be lug type, drilled and tapped. Valves shall be suitable for dead end service, Class I, tight shut off. Milwaukee CL 223E.
6. Check Valves:
- a. Swing Check Valves:
    - 1. 2 Inch and Smaller: Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded ends. Valve shall be capable of being reground while the valve remains in the line. Class 150 valves meeting the above specifications may be used where pressure requires or Class 125 are not available. Milwaukee #509.
    - 2. 2-1/2 Inch and Larger: Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line. Milwaukee #F2974A.
  - b. Spring Loaded (Non-Slam Check Valves for Pumps: Valves shall be iron body, globe typed silent check valves, bronze mounted, stainless steel spring with flanged (125-pounds drilling) end connections for installation between ASA 150 lbs. flat face steel slip on weld flanges. Valves shall be comparable to Mueller #105-AP, APCO Series 600, CPV Globe Type Silent Check Valve, Kelflex K-Check Silent Check Valve, or Metraflex Globe Style Silent Check Valve.

## PART 3 – EXECUTION

### 3.01 EXAMINATION:

- A. Examine piping systems for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior, threads, and flanges for cleanliness, and signs of damage or corrosion. Remove all shipping materials.
- C. Actuate valve through an open-close cycle to determine if operation is proper.
- D. Examine the piping for cleanliness and alignment.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gaskets are of proper size, that material composition is suitable for service, and are free from defect.
- F. Do not attempt to repair a defective valve. Replace all defective valves with new valves.

### 3.02 VALVE SELECTION:

- A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:
  - 1. Copper Tube Size 2 Inch and Smaller: Threaded ends.
  - 2. Steel Pipe Sizes 2 Inch and Smaller: Threaded ends.
  - 3. Steel Pipe Sizes 2-1/2 Inch and Larger: Flanged.
- B. Ball valves may be used in lieu of gate valves for piping 2" and smaller except in steam and condensate return systems. Use gate valves for piping 2-1/2" and larger in size.

### 3.03 VALVE INSTALLATIONS:

- A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.
- B. Valves shall be located in an accessible position or made accessible through access panel.
- C. Where several valves are related as to function, they shall be grouped in a battery.
- D. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- E. Install a valved bypass around each pressure reducing valve using a globe valve for throttling.
- F. Installation of check valves:
  - 1. Swing Check Valves: Install in horizontal position with hinge pin level.
  - 2. Wafer Check Valves: Install between two flanges in horizontal or vertical position.
  - 3. Lift Check Valves: Install in piping with stem upright and plumb.
- G. No valve shall be installed with stem below horizontal position without prior approval.

- H. Provide special handles or operators as required or as indicated on the drawings.
- I. Valves specified under specific systems shall take precedence over those as specified herein.
- J. Valves in copper pipe shall have threaded ends (except where size dictates flanged ends), use copper to MPT adapters as required.
- K. Provide non-slam type check valves at pumps.

3.04 FIELD QUALITY CONTROL:

- A. Testing: After piping systems have been tested and put into service but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

3.05 ADJUSTING AND CLEANING:

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

3.06 VALVE BOXES

- A. Valves located below slabs or grade shall be housed in cast iron boxes and covers. Covers shall be properly identified as to service controlled by the valves.
- B. Furnish Owner with proper key or valve operator extension.

END OF SECTION

## SECTION 22 0120

### PIPING SPECIALTIES

#### PART 1 - GENERAL

- 1.01 Specific requirements for specialties indicated on drawings or in other sections of these specifications shall take precedence over items as specified in this section.
- 1.02 Submit brochures and other supportive product data for all items.
- 1.03 Ranges for thermometer, gages, or similar instruments shall be selected so that normal operation will be near center of scale. Range shall not be longer than required. Use compound gage where vacuum may be encountered.
- 1.04 Combination instruments for thermometers and gages will not be acceptable.

#### PART 2 - PRODUCTS

##### 2.01 THERMOMETERS:

- A. Thermometers shall be equal to Trerice Series BX9, 9-inch, adjustable type. Stem length shall be a minimum of 3/4 of the pipe diameter, plus well extension length. Use 12-inch stem length in tanks.
- B. Provide brass wells and stems.

##### 2.02 THERMOMETER WELLS:

- A. Provide wells with extension neck for insulated piping.
- B. Wells shall be Trerice Series 138 type.
- C. Test wells to be Trerice Series 169 type with cap and chain.

##### 2.03 GAGES:

- A. Gages shall be equal to Trerice Series 800, 3-1/2-inch size.
- B. Provide snubber and cock for each gage.
- C. Provide coil syphon and cock for each steam gage.
- D. Gauges shall be liquid filled.

##### 2.04 TEST PLUGS:

- A. Test plugs shall be equal to Peterson Engineering Company #110, 1/4" size, with brass body, dust cap and "Nordel" valve core material.



## 2.05 STRAINER:

### A. "Y" Type (Haywood, Muessco, or Sarco):

1. 1/2" through 2": Haywood Model 80, bronze, 300 lb. WP, 500 lb. WOG or Haywood Model 80 iron body, 250 lb. WP, 900 lb. WOG. Provide Monel or stainless steel screen, blow-off outlet, screwed ends.
2. 2-1/2" through 12": Haywood Model 80 iron body, 125 lb. SWP, 175 lb. WOG, brass screen, blow-off outlet, flanged ends.

### B. Screens - Steam:

1. Monel or stainless steel.
2. Perforations - .057 diameter, 144 per sq. in.

### C. Screens - Water:

1. Brass.
2. Perforations: Up to 2" - 1/10" diameter, 49 per sq. in.; 2-1/2" to 4" - 1/8" diameter, 32 per sq. in.; 5" up - 1/4" diameter, 8 per sq. in.

## 2.06 FLEXIBLE CONNECTORS:

- A. Pumps and Chillers: Bellows Type 3, equal to Keflex #151-TR-1250, with 150 lb. flanges and tie rods. 150 psig maximum working pressure. 304 stainless steel. Bellows welded to flanges. Tie rods with chatter proof spacers. Unit rated at 800°F.
- B. Coils, Valves, And Miscellaneous Equipment: Stainless steel braided hose type.

## 2.07 ELECTRICAL HEAT TAPE:

- A. Heat tape shall be equal to Emerson Chromalox.
- B. Electrical heat tape shall be installed where indicated on the drawings to prevent pipe freezing.
- C. Heat tape shall be approved for use in hazardous areas as indicated and U.L. listed.

## 2.08 CALIBRATED BALANCE VALVE:

- A. For valves 2" and smaller:
  1. Bronze body.
  2. Ball or globe type.
  3. 250 psig at 250° F rating.

4. Threaded ends.
  5. Calibrated orifice or venturi.
  6. Meter connections with integral seals.
  7. Memory stop.
- B. For valves 2-1/2" and larger:
1. Iron or steel body.
  2. Ball or globe type.
  3. 125 psig at 250° F rating.
  4. Flanged connection.
  5. Calibrated orifice or venturi.
  6. Meter connections with integral seals.
  7. Memory stop.
- C. Acceptable manufacturers:
1. Flow Design
  2. Bell and Gossett
  3. Taco
  4. Armstrong
  5. Nibco

### PART 3 - EXECUTION

#### 3.01 GAGES, THERMOMETERS, AND TEST PLUGS:

- A. Provide thermometers in inlet and outlet piping of chillers, boilers, water heaters, air handling unit coils, and elsewhere as indicated on the drawings.
- B. Provide gages on inlet and outlet piping of all pumps, except domestic hot water circulators, steam gages on boiler headers, and elsewhere as indicated on the drawings.
- C. Arrange thermometers and gages so they might be read standing in a normal position on the floor.
- D. Provide test plugs on inlet and outlet piping of all heat exchanger equipment not equipped with thermometers. This includes all heating and cooling coils in air handling units, fan coil units, and

other terminal devices with coils.

- E. Locate gages, thermometers, and test plugs as close as possible to equipment being monitored.

### 3.02 FLEXIBLE PIPE CONNECTORS:

- A. Install flexible pipe connectors where indicated on the drawings.
- B. Install connectors as close as possible to equipment inlets and outlets.
- C. Support pipe work independently of flexible connectors. Brace and anchor piping as required to prevent movement of piping ends of flexible connectors and align all equipment, pipe work, and flanges so that no flexible connectors shall be misaligned and/or stressed beyond the manufacturer's recommended maximum limits.

### 3.03 HEAT TAPE:

- A. Install the heat tape below the pipe insulation in a uniform distribution to obtain the watts/linear foot as indicated.
- B. Wiring installation shall be done in accordance with the NEC and the manufacturer's requirements.
- C. Power for heat tape shall come from an emergency circuit. If no emergency circuit is available, the power shall come from a dedicated circuit, marked heat tape in the panel.
- D. Unless indicated otherwise on the plans, install heat tape with a minimum capacity of 5 watts/foot.
- E. Heat tape shall be thermostatically controlled and shall be preset to energize before freezing. An indicator light shall energize when the heat tape is "on."

END OF SECTION

## SECTION 22140

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.01 SCOPE

- A. This section contains specifications for pipe and pipe fittings.

##### 1.02 REFERENCE STANDARDS

- A. ANSI A21.4
- B. ANSI A21.11
- C. ANSI A21.51
- D. ANSI B16.3 Malleable Iron Threaded Fittings
- E. ANSI B16.4 Cast Iron Threaded Fittings
- F. ANSI B16.5 Pipe Flanges and Flanged Fittings
- G. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- H. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings–DWV
- I. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- J. ASTM A105 Forgings, Carbon Steel, for Piping Components
- K. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- L. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- M. ASTM A536 Ductile Iron Castings
- N. ASTM B32 Solder Metal
- O. ASTM B88 Seamless Copper Water Tube
- P. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- Q. ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- R. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- S. ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- T. ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
- U. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

- V. ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
- W. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- X. ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings
- Y. ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- Z. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- AA. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- BB. ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials
- CC. ASTM D4101 Propylene Plastic Injection and Extrusion Materials
- DD. ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80
- EE. ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40
- FF. ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80
- GG. ASTM F493 Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings
- HH. ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- II. ASTM F1476 Performance of Gasketed Mechanical Couplings for Use in Piping Applications
- JJ. ASTM 2389 Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
- KK. AWS A5.8 Brazing Filler Metal
- LL. AWWA C104 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
- MM. AWWA C105 Polyethylene Encasement for Ductile Iron Piping for Water
- NN. AWWA C110 Ductile Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
- OO. AWWA C111 Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
- PP. AWWA C151 Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids
- QQ. AWWA C153 Ductile Iron Compact Fittings, 3 In. Through 48 In., for Water and Other

Liquids

- RR. AWWA C600 Installation of Ductile Iron Water Mains and Their Appurtenances
- SS. AWWA C606 Grooved and Shouldered Joints
- TT. AWWA C651 Disinfecting Water Mains
- UU. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

1.03 SUBMITTALS

- A. Provide schedule indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.
- B. Provide statement from manufacturer that pipe furnished meets the ASTM or specification contained in this section.
- C. Grooved joint couplings and fittings shall be shown on product submittals, and shall be specifically identified with the applicable style or series designation.

1.04 QUALITY ASSURANCE

- A. Pipe materials shall bear label, stamp, or other markings of specific testing agency.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- C. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.
- D. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.06 SYSTEM CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM or AWWA specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- D. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.
- E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

## PART 2 - PRODUCTS

### 2.01 DOMESTIC WATER

#### A. ABOVE GROUND:

- 1. Type L copper water tube, H (drawn) temper, ASTM B88;
  - a. Solder joint; wrought copper ASME B16.22 pressure fittings; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
  - b. Press-connect; ASME B16.51 cast copper alloy, wrought copper, and wrought copper alloy press-connect pressure fittings, EPDM O-rings.
- 2. (Water Service Entrance) Ductile iron pipe, thickness Class 53, AWWA C151/C115; with standard thickness cement mortar lining, AWWA C104; ductile iron mechanical grooved cement mortar lined fittings and couplings on cut grooved pipe, Class 350 12" and below, Class 250 above 12", AWWA C606; ductile iron or gray iron flanged cement mortar lined fittings, Class 250, AWWA C110; rubber gasket joints with non-toxic gasket lubricant, AWWA C111.

#### B. BELOW GROUND 2-1/2" AND SMALLER: Type K copper water tube, O (annealed) temper, ASTM B88; with cast copper pressure fittings, ASME B16.18; wrought copper pressure fittings, ASME B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; or cast copper flared pressure fittings, ASME B16.26.

#### C. BELOW GROUND 3" AND LARGER:

- 1. Ductile iron pipe, mechanical or push on joint, thickness Class 52, AWWA C151; with standard thickness cement mortar lining, AWWA C104; ductile iron or gray iron mechanical joint cement mortar lined fittings, Class 250, AWWA C110; ductile iron mechanical joint compact fittings, Class 350, AWWA C153; rubber gasket joints with non-toxic gasket lubricant, AWWA C111. Provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.
- 2. PVC pressure pipe, DR 18, Class 150, AWWA C900 and C905; with integral

bell and elastomeric gaskets, ASTM D3139. Fittings and fitting polyethylene encasement to be same as noted above for ductile iron.

- D. THRUST RESTRAINTS FOR UNDERGROUND PIPING: Asphaltic or epoxy coated ductile iron follower gland mechanical joint restraint with gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference, low alloy steel T-bolts and UL listing or Factory Mutual approval. For PVC pipe joint bells, use epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it is applied on.

## 2.02 RO / DI WATER

### A. ABOVE GROUND:

- 1. Polypropylene pipe, fittings and valves shall be manufactured from PP-R or PP—RCT compounds that meet or exceed the requirements of ASTM F2389. Polypropylene fittings and valves may be of the socket, butt, or electrofusion variety and shall comply with the requirements of ASTM F2389.

## 2.03 DIELECTRIC UNIONS AND FLANGES

- A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.
- B. Victaulic Series 47, dielectric waterway fittings to 8", threaded or grooved ends, electroplated steel or ductile iron casing, with inert thermosplastic lining having a pressure rating to 300 psig at 230 degrees F.

## 2.04 UNIONS AND FLANGES

- A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be Teflon type. Treated paper gaskets are not acceptable.
- B. 2" AND SMALLER STEEL:
  - 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
  - 2. 2" AND SMALLER COPPER: ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
- C. 2-1/2" AND LARGER STEEL: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full-face gaskets. Use ANSI B16.1 flat face flanges with full face Teflon gaskets for mating with other flat face flanges on equipment. Gaskets shall be



teflon type.

- D. 2-1/2" AND LARGER COPPER: ANSI B15.24 Class 150 cast bronze flanges with full face teflon gaskets.
- E. Fittings used on galvanized steel pipe to be ductile iron A536, with galvanized finish, ASTM A153. Fittings used on ductile iron pipe to be cement mortar lined ductile iron with coal tar coating, ASTM A536; conforming to requirements of AWWA C110/C153 and AWWA C606. Fittings used on copper tube to be copper tube dimensioned wrought copper ANSI B16.22 or cast bronze ASNI B16.18. Fittings used on stainless steel shall be ASTM A403 or factory fabricated ASTM A312.
- F. Gaskets to be EPDM, ASTM D1330. Gaskets for hot water systems and dry pipe systems to be flush seal design. Heat treated carbon track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633, or stainless steel ASTM F593.
- G. Gaskets used on potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service.
- H. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used. Victaulic Style 741 (steel pipe), 341 (AWWA ductile iron pipe) or 641 (copper tubing).

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

#### 3.02 INSTALLATION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping. All piping shall be concealed in areas with ceilings.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

1. For water systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the Engineer). Where expansion loops are required, use Victaulic Style 77 couplings on the loops.
- G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

### 3.03 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.
- B. Grooved joints for copper tubing shall be made at copper tube dimensions. (Flaring of tube ends to accommodate alternate sized couplings is not permitted).
- C. Join copper tube and press connect fittings with tools recommended by fitting manufacturer.

### 3.04 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### 3.05 MECHANICAL JOINT PIPE CONNECTIONS

- A. Comply with AWWA C600/C605 installation requirements. Clean pipe end and socket. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

### 3.06 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

### 3.07 DOMESTIC WATER

- A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- B. Install exterior water piping below predicted frost level in accordance with State Plumbing Code, but in no case less than 3' bury depth to top of pipe. Maintain minimum of 8' horizontal distance between 2-1/2" and larger water piping and sanitary sewer piping. Maintain minimum of 30" horizontal and 12" vertical distance, water on top, between 2" and smaller water piping and sanitary sewer piping. Where water piping crosses a sanitary sewer, provide minimum 18" vertical clearance and waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10' from sewer in both directions.
- C. Provide thrust restraints for 3" and larger exterior water piping joints, hydrants, caps, plugs, fittings and bends of 22-1/2 degrees or more. Field apply continuous anti-corrosion coating to rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover. Cover with 8 mil sheet or tube polyethylene material sleeve.
- D. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.
- E. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with a solution of water and chlorine containing at least 50 parts per million of chlorine and allow to stand for 24 hours. Alternately a solution containing at least 200 parts per million of chlorine may be used and allowed to stand for 3 hours. Flush system with potable water until chlorine concentration is no higher than source water level.
- F. Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall be representative of the system size and configuration and are subject to approval by Engineer. Test shall show the absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along with test results.

### 3.08 DIELECTRIC UNIONS AND FLANGES

- A. Install dielectric unions, waterway fittings, or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

### 3.09 UNIONS AND FLANGES

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.
- B. Union and flanges for disconnect and servicing area not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points).

3.10 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test must be witnessed by the Owner's representative. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Below Ground Domestic Water	Water	N/A	200 psig 2 Hour
Above Ground Domestic Water	Water	N/A	100 psig 8 Hour
Above Ground Non-Potable Water	Water	N/A	100 psig 8 Hour
Below Ground Non-Potable Water	Water	N/A	100 psig 8 Hour

END OF SECTION

SECTION 22150

SANITARY WASTE AND VENT

PART 1 - GENERAL

1.01 SCOPE

- A. This section contains specifications for sanitary waste and vent plumbing pipe and pipe fittings.

1.02 REFERENCE STANDARDS

ANSI A21.4

ANSI A21.11

ANSI A21.51

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanges and Flanged Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A234 Pipe Fittings-Wrought Carbon Steel & Alloy Steel for Moderate & Elevated Temperatures

ASTM A861 High Silicon Iron Pipe and Fittings

ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B32 Solder Metal

ASTM B88 Seamless Copper Water Tube

ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM B306 Copper Drainage Tube (DWV)

ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials

ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

ASTM F2618 Standard Specification for Chlorinated Poly Vinyl Chloride (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.

AWS A5.8 Brazing Filler Metal

## PART 2 - PRODUCTS

### 2.01 SANITARY WASTE AND VENT

#### A. INTERIOR ABOVE GROUND:

1. Hubless cast iron soil pipe and fittings, ASTM A888; ASTM A74. Provide heavy duty, shielded stainless steel bands and tightening devices with ASTM Standard C564 rubber sleeve, ANACO/HUSKY SD 4000 / IDEAL TRIDON Heavy Duty.
2. Solid Wall SCH 40 PVC pipe and fittings.
3. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
4. Science lab acid waste and vent piping system shall be equal to Orion Blueline. All piping from lab fixtures to acid neutralization tank, including p-traps,

cleanouts, and fittings shall be acid resistant.

B. INTERIOR BELOW GROUND:

1. Solid Wall SCH 40 PVC or Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.
2. Use PVC for areas with acidic soil, eg Fayetteville

C. EXTERIOR BELOW GROUND 15" AND SMALLER:

1. Solid Wall SCH 40 PVC or Cast iron soil pipe and fittings, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.

2.02 SUBMITTALS

- A. Provide schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.
- B. Provide statement from manufacturer that pipe furnished meets the ASTM specification contained in this section.

2.03 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specific testing agencies.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

2.04 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

2.05 SYSTEM CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be

acceptable in ventilation plenum spaces, including plenum ceilings.

- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.
- F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

### 3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

### 3.03 INSTALLATION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make



connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

#### 3.04 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

#### 3.05 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

#### 3.06 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturer's recommended torque.

#### 3.07 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

#### 3.08 SANITARY WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot for 2" and smaller piping and 1/8" per foot for piping 3" and larger.
- B. Install exterior piping below predicted frost level and not less than 3 feet bury depth to top of pipe wherever possible.
- C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

#### 3.09 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at

fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test must be witnessed by the local authority having jurisdiction. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Sanitary Waste & Vent	Water	N/A	10' Water 2 Hour

END OF SECTION

## SECTION 220155

### STORM DRAIN PIPING

#### PART 1 - GENERAL

##### 1.01 SCOPE

- A. This section contains specifications for storm drain piping.

##### 1.02 REFERENCE STANDARDS

ANSI A21.4

ANSI A21.11

ANSI A21.51

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanges and Flanged Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

STM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A861 High Silicon Iron Pipe and Fittings

ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B32 Solder Metal

ASTM B88 Seamless Copper Water Tube

ASTM B306 Copper Drainage Tube (DWV)

ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

ASTM C443 Joints for Circular Concrete Pipe Sewer and Culvert Pipe Using Rubber Gaskets

ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

ASTM D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe

ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings

ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

ASTM D4101 Propylene Plastic Injection and Extrusion Materials

ASTM F405 Corrugated Polyethylene (PE) Tubing and Fittings

ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40

ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80

ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

### 1.03 SUBMITTALS

- A. Provide schedule indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.
- B. Statement from manufacturer that pipe furnished meets the ASTM or AWWA specification contained in this section.

#### 1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specific testing agency.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

#### 1.06 SYSTEM CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM or AWWA specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- D. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.
- E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

### PART 2 - PRODUCTS

#### 2.01 STORM AND CLEARWATER WASTE

- A. Interior Above Ground:
  - 1. Hubless cast iron soil pipe and fittings, ASTM A888; ASTM A74. Provide heavy duty, shielded stainless steel bands and tightening devices with ASTM Standard C564 rubber sleeve, ANACO/HUSKY SD 4000 / IDEAL TRIDON Heavy Duty.
  - 2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813;

copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) the diameter of the main.

3. Copper drainage tube (DWV), ASTM B306; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) the diameter of the main.

B. Interior Below Ground 15" and Smaller:

1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.
2. PVC plastic pipe, Schedule 40, class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

C. Exterior Below Ground 15" and Smaller:

1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene compression rubber gaskets, ASTM C564.
2. PVC plastic pipe, Schedule 40, class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
3. Type PSM PVC sewer pipe and fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM D2564; or integral bell and flexible elastomeric seal, ASTM D3212.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

### 3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

### 3.03 INSTALLATION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult

drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

#### 3.04 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

#### 3.05 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

#### 3.06 SOLVENT WELDED PIPE JOINTS

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply

primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the Architect/Engineer.

- C. Solvent cement and primer shall be compliant with California South Coast Air Quality Management District (SCAQMD) Rule 1168 and Ozone Transport Commission (OTC) regulations for Volatile Organic Compound emissions levels.

### 3.07 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

### 3.08 PUSH ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

### 3.09 STORM AND CLEARWATER WASTE

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8" per foot where possible and in no case less than 1/16" per foot for piping 3" and larger.
- B. Install exterior piping below predicted frost level and not less than 3 feet bury depth to top of pipe wherever possible.

### 3.10 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the



high point in the system.

- D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test must be witnessed by the local authority having jurisdiction. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Clear Water Waste & Vent	Water	N/A	10' Water 2 Hour
Storm & Clear Water Waste	Water	N/A	10' Water 2 Hour

END OF SECTION

## SECTION 220155

### STORM DRAIN PIPING

#### PART 1 - GENERAL

##### 1.01 SCOPE

- A. This section contains specifications for storm drain piping.

##### 1.02 REFERENCE STANDARDS

ANSI A21.4

ANSI A21.11

ANSI A21.51

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanges and Flanged Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

STM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A861 High Silicon Iron Pipe and Fittings

ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

ASTM B32 Solder Metal

ASTM B88 Seamless Copper Water Tube

ASTM B306 Copper Drainage Tube (DWV)

ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

ASTM C443 Joints for Circular Concrete Pipe Sewer and Culvert Pipe Using Rubber Gaskets

ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

ASTM D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe

ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings

ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

ASTM D4101 Propylene Plastic Injection and Extrusion Materials

ASTM F405 Corrugated Polyethylene (PE) Tubing and Fittings

ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40

ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80

ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

### 1.03 SUBMITTALS

- A. Provide schedule indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.
- B. Statement from manufacturer that pipe furnished meets the ASTM or AWWA specification contained in this section.

#### 1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specific testing agency.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

#### 1.06 SYSTEM CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM or AWWA specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- D. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.
- E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

### PART 2 - PRODUCTS

#### 2.01 STORM AND CLEARWATER WASTE

- A. Interior Above Ground:
  - 1. Hubless cast iron soil pipe and fittings, ASTM A888; ASTM A74. Provide heavy duty, shielded stainless steel bands and tightening devices with ASTM Standard C564 rubber sleeve, ANACO/HUSKY SD 4000 / IDEAL TRIDON Heavy Duty.
  - 2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813;

copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) the diameter of the main.

3. Copper drainage tube (DWV), ASTM B306; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) the diameter of the main.

B. Interior Below Ground 15" and Smaller:

1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564.
2. PVC plastic pipe, Schedule 40, class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

C. Exterior Below Ground 15" and Smaller:

1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene compression rubber gaskets, ASTM C564.
2. PVC plastic pipe, Schedule 40, class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
3. Type PSM PVC sewer pipe and fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM D2564; or integral bell and flexible elastomeric seal, ASTM D3212.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

### 3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

### 3.03 INSTALLATION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult

drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

#### 3.04 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

#### 3.05 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

#### 3.06 SOLVENT WELDED PIPE JOINTS

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply

primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the Architect/Engineer.

- C. Solvent cement and primer shall be compliant with California South Coast Air Quality Management District (SCAQMD) Rule 1168 and Ozone Transport Commission (OTC) regulations for Volatile Organic Compound emissions levels.

### 3.07 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

### 3.08 PUSH ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

### 3.09 STORM AND CLEARWATER WASTE

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8" per foot where possible and in no case less than 1/16" per foot for piping 3" and larger.
- B. Install exterior piping below predicted frost level and not less than 3 feet bury depth to top of pipe wherever possible.

### 3.10 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the

high point in the system.

- D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test must be witnessed by the local authority having jurisdiction. All pressure tests are to be documented.

System	Test Medium	Initial Test Pressure Duration	Final Test Pressure Duration
Clear Water Waste & Vent	Water	N/A	10' Water 2 Hour
Storm & Clear Water Waste	Water	N/A	10' Water 2 Hour

END OF SECTION



## SECTION 220160 - NATURAL GAS SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section covers the complete natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

#### 1.2 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
- D. 2018 Edition of the International Fuel Gas Code.
- E. Latest Edition of NFPA 54, National Fuel Gas Code.

#### 1.3 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

#### 1.4 SUBMITTALS

- A. Product Data:
- B. Provide code and standards compliance verification, manufacturer's product data and ratings on pipe materials, pipe fittings, regulators, valves and accessories.

#### 1.5 DELIVERY, STORAGE and HANDLING

- A. Accept valves on Site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.
- B. Provide temporary protective coating on cast iron and steel valves.

- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.

## 1.6 EXTRA MATERIALS

- A. Provide one (1) plug valve wrench for every ten (10) plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench incorporating a setscrew.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Natural gas pressures shall not exceed five (5) pounds per square inch gauge on Owner's side of the meter.
- C. Pipe joint compound shall be lead-free, non-toxic, non-hardening, insoluble in the presence of natural gas and compliant with ANSI/NSF 61 and Federal Specification TT-S-1732. Temperature service range of -15 degrees F to +400 degrees F, manufactured by Hercules "MegaLoc" or approved equal by Rectorseal, La-Co or Oatey.

### 2.2 PIPING

- A. Buried Piping Outside of Building:
  - 1. Polyethylene, SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.
  - 2. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.
  - 3. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.
- B. Above Ground Piping Outside of Building (Including roof):
  - 1. Piping 2 inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

2. Piping 2½ inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.
3. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

### 2.3 UNDERGROUND WARNING TAPE

- A. Minimum 3 inch wide polyethylene detectable type marking tape. The tape shall be resistant to alkalis, acids and other destructive agents found in soil and impregnated with metal so that it can be readily recognized after burial by standard locating equipment.
- B. Lamination bond of one (1) layer of Minimum 0.35 mils thick aluminum foil between two (2) layers of minimum 4.3 mils thick inert plastic film.
- C. Minimum tensile strength: 63 LBS per 3 IN width.
- D. Minimum elongation: 500 percent.
- E. Provide continuous yellow with black letter printed message repeated every 16 to 36 inches warning of pipe buried below (e.g.: "CAUTION GAS LINE BURIED BELOW").
- F. Manufactured by Reef Industries "Terra Tape" or approved equal.

### 2.4 VALVES

- A. All valves shall be designed, manufactured and approved for natural gas service.
- B. Line Shut-off Valves sizes 2 inches and smaller shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, wrench operation, rated for 200 WOG service pressure and -20 to 200 degrees F., manufactured by Resun Model R-1430, Nordstrom Model 142, or approved equal.
- C. Line Shut-off Valves sizes 2½ inches and larger shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with flanged ends, wrench operation, rated for 200 WOG service pressure and -20 to 200 degrees F., manufactured by Resun Model R-143, Nordstrom Model 143, or approved equal.
- D. Appliance/Equipment Shut-off Valves at local connections sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F., manufactured by Nibco Model T585-70-UL, Model T580-70-UL, Milwaukee Model BB2-100, or approved equal.

- E. Manual Emergency Shut-off Valves sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F., manufactured by Nibco Model T585-70-UL, Model T580-70-UL, Milwaukee Model BB2-100, or approved equal.
- F. Automatic Emergency Shut-off Valves shall be U.L. Listed F.M. Approved for natural gas service, 2-way electrically tripped solenoid type; fail safe closed; manual reset; Type 1 solenoid enclosure; NBR seals and disc; stainless steel core tube and springs; copper coil; manufactured by ASCO Red Hat Series 8044, or approved equal.

## 2.5 PRESSURE REGULATORS

- A. All pressure regulators shall be designed, manufactured and approved for natural gas service.
- B. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Commercial grade diaphragm type with internal relief valve, vent valve, cast iron body, Buna-N diaphragm. Manufactured by Rockwell or Fisher.
- C. Install pressure gauge adjacent to and downstream of each line pressure regulator.

## 2.6 UNIONS

- A. Unions in 2 inches and smaller in ferrous lines shall be right and left hand nipple/coupling assembly, or ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends, 2-1/2 inches and larger shall be ground flange unions. Companion flanges on lines at various items of equipment, machines and pieces of apparatus may serve as unions to permit disconnection of piping.
- B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type.
- C. Above grade flexible stainless steel appliance/equipment connectors shall conform with AGA under the ANSI Z21.69 Standard. Hose shall be braided stainless steel with a polyolefin heat-shrink tubing with high flame-retardant qualities. Hose shall be equipped with malleable iron unions and spring loaded brass quick-link couplings. An easily accessible manual shut-off valve shall be installed ahead of all hose connections. Specify T&S Brass "Safe-T-Link" or approved equal.

## 2.7 FLANGES

- A. All 150 lb. and 300 lb. ANSI flanges shall be domestically manufactured, weld neck forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi. Flat-faced flanges shall be required to match flanges on check valves, strainers, and other valves and devices. Only one manufacturer of weld flanges will be approved.
- B. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. Gaskets shall be cut from 1/16 inch thick, non metallic, non asbestos gasket material suitable for operating temperatures from -150 degrees F to +75 degrees F, Klingersil C-4400, Manville Style 60 service sheet packing, or equal.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Ream pipe ends and remove cutting burrs. Bevel plain end ferrous pipe.
- B. Remove cutting oil, scale and dirt, on inside and outside of piping, before assembly.

### 3.2 EQUIPMENT CONNECTIONS

- A. Provide specified connections, shutoff valves, regulators and unions at each and every appliance and piece of equipment requiring natural gas.
- B. Provide and install union type connections at all equipment to permit removal of service piping.
- C. Gas service connections shall have a diameter at least one pipe size larger than that of the inlet connection to the equipment as provided by the manufacturer and be of adequate size to provide the total input demand of the connected equipment.
- D. Provide listed and labeled appliance connectors complying with ANSI Z21.69 and listed for use with food service equipment having casters, or that is otherwise subject to movement for cleaning, and other large movable equipment. Connectors shall have listed and labeled quick-disconnect devices and shall have retaining cables attached to structures and equipment. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.
- E. Rigid metallic pipe and fittings shall be used at service connections to all stationary equipment.

### 3.3 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Provide support for and connections to natural gas service meter in accordance with requirements of the utility company, when so indicated on the Drawings.
- D. All installation shall be in accordance with manufacturer's published recommendations.
- E. Distribution piping shall be as short and as direct as practicable between the point of delivery and the outlets.
- F. Do not install underground piping when bedding is wet or frozen.
- G. Bury all underground piping at least 3 feet below finished grade. Provide a continuous detectable warning tape on tamped backfill, 12 inches above all buried non-metallic gas lines.
- H. Do not install gas piping in the same trench with other utilities. The minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Do not install gas pipe through catch basins, vaults, manholes or similar underground structures.
- I. Install and support all polyethylene piping in accordance with manufacturer's recommendations. All heat fusion welds shall be performed by welders qualified to the manufacturer's procedures.
- J. Polyethylene piping shall not be installed above ground.
- K. Provide connection between buried plastic gas piping and metallic riser in accordance with the gas code.
- L. All above ground gas piping shall be electrically continuous and bonded to electrical system ground conductor in accordance with NFPA 70.
- M. Provide and install union type fittings at proper points to permit dismantling or removal of pipe. No unions will be required in welded lines except at equipment connections. Where union type fittings are necessary for piping dismantling purposes, right and left nipples and couplings shall be used. Flanges, ground-joint unions or approved flexible appliance connectors may be used at exposed fixture, appliance or equipment connections.
- N. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- O. Valves, regulators, flanges, union type fittings and similar appurtenances shall be accessible for operation and servicing and shall not be located above ceilings, within chases, walls/partitions, spaces utilized as return air plenums or non-accessible locations.
- P. Route piping in orderly manner and maintain gradient. Install piping to conserve building space. Group piping whenever practical at common elevations.
- Q. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- R. Make service connections at the top of the main, whenever the depth of the main is sufficient to allow top connections. When service connections cannot be made at the top of the main, they shall be made on the side of the main no lower than the horizontal midpoint of the gas main.
- S. Close nipples, bushing and cross type fittings shall not be installed in any gas piping system.
- T. Slope piping and arrange to drain at low points. Install drip/sediment traps at points where condensate and debris may collect. Locate drip/sediment traps where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing. Construct drip/sediment traps using tee fitting with capped nipple connected to bottom outlet. Use minimum-length nipple of 3 pipe diameters, but not less than 4 inches long, and same size as connected pipe. Cap shall be screwed pattern, black, standard weight, malleable iron. Install with adequate space for removal of cap.
- U. Install valves for shut off and to isolate equipment, parts of systems, or vertical risers. All valves shall be located such that servicing and operation is possible. All flanged valves shown in horizontal lines with the valve stem shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance.
- V. Install line shut-off valve at each branch connection to riser.
- W. Provide adequate clearance for access to and operation of all valves.
- X. Install valves with stems upright or horizontal, not inverted unless required otherwise by the valve manufacturer.
- Y. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminated with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least seven feet above grade or pedestrian traffic and a minimum three (3) feet above or twenty-five (25) feet horizontally from all air intakes or building openings.
- Z. Above ground horizontal natural gas and encasement piping shall be supported at intervals of no greater than 6 foot for 1/2 inch piping, 8 foot for 3/4 inch and 1 inch piping and 10 foot for 1-1/4 inches and larger piping. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.
- AA. Extension bars shall not be used for supporting gas or encasement piping. Gas or encasement piping shall not be used to support any other piping or component.
- BB. Provide piping and valve identification in accordance with Project Specification Section 20 05 53.

### 3.4 INSTALLATION OF WELDED PIPING

- A. Welding of pipe in normally occupied buildings is prohibited. Off-Site welding is acceptable. Should welding be required in a normally occupied building for connecting to an existing welded system, obtain written approval from the Owner and comply with Owner's fire and life safety requirements.
- B. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI the latest editions of Standard B32.1 for all systems from the Code for Pressure Piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
- C. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37-½ inch degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
- D. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- E. Contractor shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welded during welding operation.
- F. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- G. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
- H. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.

### 3.5 TESTING

- A. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required herein.
- B. All necessary apparatus for conducting tests shall be furnished by the Contractor and comply with the requirements of NFPA 54.
- C. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed herein. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.
- D. Systems on which the normal operating pressure is less than 0.5 pounds per square inch gauge (psig), the test pressure shall be 5.0 psig and the time interval shall be 30 minutes.



- E. Systems on which the normal operating pressure is between 0.5 psig and 5.0 psig, the test pressure shall be 1.5 times the normal operating pressure or 5.0 psig, whichever is greater, and the time interval shall be 30 minutes.
- F. Systems on which the normal operating pressure is 5.0 psig or greater, the test pressure shall be 1.5 times the normal operating pressure, and the time interval shall be one (1) hour.
- G. After testing is complete, the entire gas system shall be purged with dry nitrogen to eliminate all air, debris and moisture from the piping before natural gas is introduced into the system.
- H. After successful results of pressure test and purging have been completed, a leakage test shall be performed in accordance with NFPA 54 Appendix D.
- I. Connect, inspect and purge gas utilization equipment, lab hook-ups and outlets, and place into operation only after successful results of pressure test, leakage test and purging have been completed and accepted.
- J. Testing operations shall be repeated until gas-piping systems are absolutely tight at the pneumatic test pressures indicated above.
- K. Pressure test gas piping sleeve system with clean, dry compressed air at 15 psig by temporarily sealing all openings between gas carrier pipe and sleeve and vent openings. Sleeve systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of four hours.

END OF SECTION

## 220548: VIBRATION ISOLATION AND SEISMIC RESTRAINT FOR PLUMBING COMPONENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

The work under this section is subject to the requirements of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements.

Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them. In the event that this section conflicts with the requirements of other Sections, the more stringent criteria shall apply.

#### 1.2 DESCRIPTION

This section includes requirements for vibration isolation and seismic restraint of nonstructural components in Risk Category I, II, III, & IV structures, including, but not limited to:

Plumbing Components: Gas piping; water piping; waste or vent piping; water heaters, etc.

Work in this section includes the restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

#### 1.3 DEFINITIONS

Active Equipment: Equipment with dynamic moving or rotating parts or parts that are energized.

Attachments / Anchorage: Means by which nonstructural components or supports for nonstructural components are secured or connected to the seismic-force resisting system of the structure. Such attachments may include anchor bolts, welded connections, mechanical fasteners or other approved attachment devices. Friction attachments do not constitute positive attachments.

Bracing: Struts, braces, cables, anchors or other structural elements providing restraint for nonstructural components to prevent excessive movement.

Certificate of Compliance: A certificate, supplied by the component manufacturer, stating that materials and products meet specified standards and project specific requirements.

Component Importance Factor ( $I_p$ ): Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5 in accordance with ASCE 7, Section 13.1.3.

Consequential Damage: Failure of an essential component caused by the failure of a separate essential or non-essential component due to the functional and physical interrelationship of the components, their supports, and their effect on each other.

Designated Seismic System: Those nonstructural components that require design in accordance with Chapter 13 of ASCE 7, for which the Component Importance Factor ( $I_p$ ) is 1.5 in accordance with Section 13.1.3 of ASCE 7.

Special Seismic Certification: A certificate of compliance, supplied by the manufacturer of Active Designated Seismic Systems, which certifies that the equipment will remain operable during the design seismic event. Components with hazardous contents shall be certified as maintaining containment following the design seismic event.

Structure: The load-bearing building elements designed by the Structural Engineer of Record. Non-load bearing partition walls, unreinforced slabs or other building elements that do not provide direct load transfer to the load-bearing building elements shall not be defined as part of the Structure and cannot be used for attachment of seismic restraints.

Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, snubbers, curbs, rails, hangers, saddles or struts, and associated fasteners that transmit loads between non-structural components and their attachments to the structure.

#### 1.4 REGULATORY REQUIREMENTS

Comply with the 2015 International Building Code (IBC) and applicable local adopted amendments, and the 2010 Edition on ASCE 7 (ASCE 7-10).

#### 1.5 DESIGN PERFORMANCE CRITERIA

Provide seismic restraint of components to withstand seismic forces and displacements without displacing or overturning. Design of seismic restraint shall be performed in accordance with the 2015 International Building Code and ASCE 7-10, as follows.

1. Seismic forces shall be determined in accordance with Chapter 13 of ASCE 7-10. The seismic design parameters shall be as noted in the project Structural drawing. The assigned Component Importance Factors ( $I_p$ ) for each component, shall be as noted on the project drawings and/or specifications.
2. For components installed on the exterior of the building, wind forces shall be determined in accordance with Chapter 29 of ASCE 7-10, except that the uplift forces per Equation 29.5-3 shall be considered regardless of the building height. Reference the Structural drawings for wind design criteria.
3. In addition to seismic and wind loads, consideration shall be given to other loads, including but not limited to dead, live, snow, etc., as applicable. All restraint design shall be based on the "worst case" combination of the applicable loads as prescribed by the referenced code and standards.
4. Consideration shall also be given to thermal stresses and expansion. Where thermal expansion applies, seismic restraint design shall be in accordance with the requirements of ASME B31.1 in addition to ASCE 7.

#### 1.6 SUBMITTALS

Submit under the provisions of Division 1. Submittals shall include Product Data, Shop Drawings and the required Certificates of Compliance as described below.

Shop drawings shall be prepared and sealed by a professional engineer licensed in the state of the project, with a minimum of 5 years of experience in the design of vibration isolation and seismic restraint.

Vibration Isolation: submit the following, at a minimum, as applicable.

1. Detailed schedules of equipment requiring isolation, including clearly identified equipment identification or tag and equipment weight, and corresponding isolator type, manufacturer and model number.
2. Detailed drawings showing equipment, isolator bases and isolator spacing.
3. Descriptive data or cut sheets for each type of isolation mounting, including:
  - a. Dimensional data
  - b. Materials and finish
  - c. Rated loads
  - d. Rated deflection
  - e. Isolator free and operating heights
  - f. Detailed installations instructions

Seismic Restraint: submit the following, at a minimum, as applicable.

4. Catalog cut or data sheets on specific restraints detailing compliance with the project drawings and specifications.
5. Detailed schedules of components, showing seismic restraints by referencing numbered descriptive drawings.
6. Description, layout and location of items to be restrained with anchorage or brace points noted and dimensioned.
7. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, fasteners, bolts, welds etc. clearly identified and specified.
8. Numerical value of design seismic restraint loads, or controlling loads if different than load combinations with seismic, with all supporting calculations.
9. Detailed installation instructions for seismic restraints.
10. Acceptable attachment methods of seismic restraints to structural members.
11. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
12. Details for housekeeping pads for base-mounted equipment, including reinforcing and doweling requirements to the building structure.
13. Documentation verifying seismic prequalification for anchors in concrete per ACI 318 Appendix D.
14. Additional information as required to substantiate adequate design and installation of seismic restraints.

15. Manufacturer's Seismic Certificate of Compliance: Each manufacturer of a Designated Seismic System (with a Component Importance Factor,  $I_p = 1.5$ ) shall submit a *Certificate of Compliance* for review and acceptance by the design professional in responsible charge and the authority having jurisdiction, prior to installation.

## PART 2 - PRODUCTS

### 2.1 GENERAL

All materials and devices shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

Refer to the "Selection Guide" table in Section 4 to correlate the specification references listed below with the appropriate components.

### 2.2 MANUFACTURERS

Isolators and seismic restraints shall be from the following manufacturers, or approved equals. Unless otherwise noted, the isolators and seismic restraint systems listed in the following sections are as manufactured by Gripple and California Dynamics.

1. Gripple
2. California Dynamics
3. The VMC Group
4. Mason Industries
5. Kinetics Noise Control
6. Cooper B-Line
7. CADDY
8. Hilti
9. Twin City Hose
10. Imperial Metals

### 2.3 EQUIPMENT BASES

Specification B-1 (Integral Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-2 (Wide Flange Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-3 (Concrete Inertia Base): Rectangular steel concrete pouring forms for floating concrete frames. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 12" centers running both ways in a layer 1 1/2" above the bottom. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Base shall be type CW as manufactured by California Dynamics Corporation or approved equal

Specification B-4 (Non-Isolated Curbs): Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchored to concrete deck, or bolted or welded directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Curb shall use minimum 18 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of calculated seismic forces and /or wind loading per local building code. Design must be certified by registered professional engineer.

Specification B-5 (Isolated Curbs): Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. The upper curb shall be supported by Spec SV-1 isolators welded or bolted to concrete deck to the structure to withstand seismic loading. An EPDM nylon reinforced air tight weatherproof seal shall consolidate the upper and lower curbs. The lower curb shall be weatherproof and provide a base that the roofing system may be flashed to. Weatherproof access panel shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Isolation curb shall be designed to withstand the greater of calculated seismic forces and / or wind loading per local building code. Design must be certified by registered professional engineer.

Specification B-6 (Non-Isolated Rails): Non isolated seismically rated rooftop rail system that provides equipment support in one roof flashed assembly with all features as described for Non-Isolated Curbs.

Specification B-7 (Isolated Rails): Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment. Structural steel rails shall be type, WW as manufactured by California Dynamics Corporation or approved equal.

## 2.4 VIBRATION ISOLATION

Specification V-1 (Pad Type Elastomer Isolator): A pad type mounting consisting of two layers of ribbed elastomeric pads with a 1" sandwich pad in between. Where the equipment foot is less than 80 percent of the surface of the pad a load distribution plate must be added to the top of the pad. Pads shall be VT as manufactured by California Dynamics Corporation or approved equal.

Specification V-2 (Neoprene Mounting): Elastomeric mounts single or double-deflection type, oil-resistant rubber or Neoprene isolator element with factory-drilled, bonded in place top plate for bolting to equipment and factory drilled base plate for bolting to structure. Color-coded or otherwise identify to indicate capacity range. Mount shall be type RM/RMD as manufactured by California Dynamics Corporation or approved equal.

Specification V-3 (Spring Isolator, Free Standing): Spring isolators shall be free standing and laterally stable without any housing and complete with a Neoprene acoustical pad between the base plate and the spring support. All mountings shall have load transfer bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mountings shall be type SSL/K, as manufactured by California Dynamics Corporation or approved equal.

Specification V-4 (Elastomer Hanger Isolator): Hanger shall consist of a rigid steel frame and up to ½" deflection of a molded Neoprene element projecting thru the steel box so that no metal-to-metal contact occurs. Hanger shall be type RH/RHD as manufactured by California Dynamics Corporation or approved equal.

Specification V-5 (Spring Hanger Isolator): Hanger shall consist of a rigid steel frame containing a steel spring with a Neoprene sleeve to prevent steel to steel contact. Hanger shall be type CH as manufactured by California Dynamics Corporation or approved equal

Specification V-6 (Combination Spring/Elastomer Hanger Isolator): Hangers shall consist of rigid steel frames containing double deflection Neoprene element at the top and a steel spring and a Neoprene sleeve on bottom to position spring and prevent steel to steel contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side. Hangers shall be type HH30 as manufactured by California Dynamics Corporation or approved equal.

## 2.5 VIBRATION ISOLATION WITH SEISMIC RESTRAINT

Specification SV-1 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A steel housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. The housing shall be Zinc plated. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be CQA as manufactured by California Dynamics Corporation or approved equal. This product is an OSHPD/ DSA approved product. Product tested for IBS.

Specification SV-2 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A welded housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. A clearance of 1/4" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be DLK as manufactured by California Dynamics Corporation or approved equal.

Specification SV-3 (Neoprene Mounting with Seismic Snubber) JQTQN Restrained Neoprene isolators shall be free standing, with a rated static deflection of .5". A steel housing with cushioned lateral and vertical limit stops to restrict extension due to wind loads, or when weight is removed. The housing shall be hot-dipped galvanized or zinc plated. Hot-Dipped zinc coating shall be not less than 2 ounces per square foot complying with ASTM A123. A clearance of 1/4 "maximum shall be maintained around restraining bolts and between the housing and the Neoprene so as not to interfere with the isolator action. Limit stops shall be out of contact during normal operation. Isolator/Restraint shall be JQTQN as manufactured by California Dynamics Corporation.

## 2.6 SEISMIC RESTRAINTS

Specification S-1 (Seismic Snubbers): All directional seismic restraints shall consist of interlocking steel members. Neoprene shall have a minimum thickness of 1/4". Incorporate a minimum air gap of 1/8", and a maximum air gap of 1/4" in the design, before contact is made between the rigid and resilient surfaces. Provide removable end plate to allow inspection of internal clearances. Restraints shall be type RL-A/ RL-C as manufactured by California Dynamics Corporation.

Specification S-2 (Seismic Cable Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable Restraints shall be listed with any one of following evaluation agencies with certified break strength and shall be color-coded or include a tag for easy field verification.

1. IAPMO-UES
2. ICC-ES
3. OSHPD
4. Underwriters Laboratories (UL)



Secure cable to structure and braced component through bracket or stake eye specifically designed to meet or exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per ASTM A1023 or EN-12385 or other approved equivalent. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Gripple Inc. GS series.

Specification S-3 (Rigid Brace Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of steel angles or channels. Rigid braces and connecting elements shall be sized for the applied seismic loads. Connecting elements shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment. Restraint shall be CADDY Strut Seismic Hinge.

## 2.7 FLEXIBLE PIPE CONNECTIONS

Specification F-1 (Water Service Flexible Connection):

1. For flanged connections – A double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77” compression, 1.18” lateral and 1.18” extension. Connectors shall provide a minimum 35 degree angular movement up to 6”, minimum 30 degree up to 12” and minimum 20 degree up to 24”. Spring loaded control units shall be furnished to limit movement to within allowables. Flex connector shall be Twin City Hose Type MS2.
2. For threaded type – A double spherical rubber hose connector, minimum 8” long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8” compression, 7/8” lateral, 1/4” extension and 20 degree angular through 1-1/4”, 13 degree through 2”, and 9 degree through 3”. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to 1/4”. Flex connector shall be Twin City Hose Type MSFU.

Specification F-2 (Steam and Condensate Service):

3. For flanged connection – A metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Flex connector shall be Twin City Hose Type TCHS-FLG.
4. For threaded connections – A metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Flex connector shall be Twin City Hose Type TCHS-MMT.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

All areas that will receive components requiring vibration isolation and seismic restraint shall be thoroughly examined for deficiencies that will affect the installation or performance of the installed devices. Such deficiencies shall be corrected prior to the installation.

### 3.2 INSTALLATION, GENERAL

Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

All installation shall be in accordance with the requirements set forth in the project drawings and specifications, as well as the manufacturer's published instructions and all approved submittal data.

Do not anchor components to gypsum wallboard, plaster or other wall or ceiling finish that has not been engineered to resist imposed loads.

### 3.3 SEISMIC RELATIVE DISPLACEMENTS

Provide joints with sufficient flexibility capable of accommodating seismic relative displacements as follows.

1. Vertical ductwork, piping, etc. that pass between floors of the building,
2. Components that pass through a building seismic or expansion joint,
3. Rigidly supported components that connect to other components.

### 3.4 POST-INSTALLED ANCHORS:

Install all anchors in accordance with the manufacturer's written instructions for seismic applications.

Post-installed anchors in concrete shall be seismically prequalified for use in cracked concrete based on seismic testing in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for adhesive anchors.

### 3.5 HOUSEKEEPING PADS

Housekeeping pads shall be designed by the seismic restraint vendor with adequate reinforcing and doweling to the building structure, so as to withstand calculated seismic or wind forces. Frictional resistance due to the effects of gravity shall be neglected.

The size & thickness of the housekeeping pad shall be determined to ensure adequate edge distances & embedment depths in order to obtain the desired equipment anchor capacities.

1. If cast-in-place anchors are used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

2. If post-installed anchors are used, the minimum edge distances, embedment depths and concrete/masonry member thicknesses specified by the anchor manufacturer shall be maintained.

### 3.6 PLUMBING COMPONENTS

Floor and base-mounted components, vibration isolated equipment and associated system vibration and seismic controls for connections.

1. Design equipment anchorage to resist seismic design force in any direction.
2. Design vibration and seismic controls for equipment to include base and isolator requirements.
3. Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.
4. Where equipment is mounted on vibration isolators, use isolators designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
5. Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
6. Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.
7. Housekeeping pads shall be coordinated with the seismic restraint vendor based on the equipment anchorage specified in the seismic design.

Suspended plumbing equipment

8. Design support and bracing to resist seismic design force in any direction.
9. Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.
10. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.

Wall-mounted plumbing equipment

11. Design attachments to resist seismic design force in any direction.
12. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

Piping

13. Provide supports, braces and anchors to resist gravity and seismic design forces.
14. Design piping and piping risers to accommodate interstory drift. Provide flexible connections wherever relative differential movements could damage pipe in an earthquake.
15. Brace every run (5' or more in length) with two transverse and one longitudinal bracing locations. For pipes and connections constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections) provide transverse bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center. For pipes and their connections constructed of nonductile materials (cast iron, no-hub pipe and plastic or non-UL listed grooved coupling pipe), provide transverse bracing at not more than 20 feet on center and longitudinal bracing at spacing not more than 40 feet on center.
16. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.
17. Where piping is explicitly exempt from seismic bracing requirements,
  - a. Install piping such that swinging of the pipes will not cause damaging impact with adjacent components. This will be considered satisfied if there is horizontal clear distance of at least  $\frac{2}{3}$  the hanger length between subject components.
  - b. Provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.

### 3.7 QUALITY CONTROL

Do not install vibration isolators or seismic restraints until submittals have been reviewed and approved by the registered design professional in responsible charge.

Verify that multiple systems installed in the same vicinity can be installed without conflict.

Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the registered design professional in responsible charge of the project that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

Coordinate with the Structural Engineer of Record for confirming that the structure is capable of supporting the loads imposed by nonstructural components.

No work shall be concealed by the Contractor prior to the required inspections being performed and all discrepancies resolved. The Contractor shall be responsible for all repairs required to uncover uninspected or unapproved work.

Where Special Inspections are required per Sections 1704 and 1705 of the 2015 International Building Code, the owner shall engage a qualified agency to perform the required inspections for components listed in the project-specific Statement of Special Inspections.

PART 4 - EQUIPMENT ISOLATION AND SEISMIC RESTRAINT SCHEDULE

PLUMBING EQUIPMENT

EQUIPMENT TAG	I <sub>p</sub> (Note 4)	ISOLATION SPEC.	ISOLATION DEFL.	SEISMIC REST. SPEC. (NOTE 1)
GAS PIPING	1.5	NONE	N/A	SPEC S-2
GAS WATER HEATERS	1.5	NONE	N/A	NOTE 2
STEAM WATER HEATERS	1.5	NONE	N/A	NOTE 2
ELECTRIC WATER HEATERS	1.0	NONE	N/A	NOTE 2
VACUUM PUMPS	1.0	N/A	N/A	NOTE 2
DOMESTIC WATER	1.0	NOTE 3	N/A	SPEC S-2
WASTE, VENT PIPING	1.0	NONE	N/A	SPEC S-2
STORM DRAIN PIPING	1.0	NONE	N/A	SPEC S-2
COMPRESSED AIR PIPING	1.5	NOTE 3	N/A	SPEC S-2
AIR COMPRESSORS	1.5	N/A	N/A	NOTE 2

NOTES

1. Seismic restraint to be provided only where required in the project drawings.
2. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic engineer. If required, Spec. S-1 snubbers or Spec. S-2 cable kits shall be provided.
3. Provide Type V-6 isolator for the first three hangers from all equipment specified with spring isolation.
4. All components in a Risk Category IV building are assigned a Component Importance Factor I<sub>p</sub> equal to 1.5.

END OF SECTION 220548

## INDEX OF SPECIFICATIONS

### DIVISION 23 MECHANICAL

<u>SECTION</u>	<u>SECTION TITLE</u>
230010	MECHANICAL GENERAL
230015	FIRESTOPPING AND SMOKE STOPPING
230030	ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT
230060	BASIC PIPING
230075	MECHANICAL IDENTIFICATION
230086	PIPING INSULATION
230090	SUPPORTS, HANGERS AND ANCHORS
230100	SEISMIC RESTRAINT
230110	BASIC VALVES FOR HVAC
230120	PIPING SPECIALTIES
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230990	TESTING, ADJUSTING AND BALANCING

## SECTION 23 00 10 - MECHANICAL GENERAL

### PART 1 - GENERAL

#### 1.01. CONTRACT DOCUMENTS

- A. Drawings are diagrammatic, due to scale, and indicate the general arrangements and geometric relationships of equipment, systems, and services. They are not intended to show or indicate every offset, sequence, device, option, fitting, valve, or accessory. Plan work around building details and other crafts. Do not scale drawings for exact sizes and locations.
- B. Contractor shall base all his measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Contractor shall verify all measurements at site and check correctness as related to the work.
- C. In case of interferences between trades, Engineer will decide which work is to take precedence regardless of work that might be installed.

#### 1.02. CODES, ORDINANCES, INSPECTIONS AND PERMITS

- A. Work is to be executed and inspected in accordance with local and State codes, laws, ordinances, rules and regulations applicable to particular class of work, including the State Mechanical Code, State Plumbing Code, State Gas Code, and State Fire Code. Associated fees shall be paid by the Contractor.
- B. Should any part of drawings or specifications be found to be in conflict with applicable codes or ordinances, notify the Engineer, in writing, within 72 hours prior to bid deadline for review and/or correction of bid documents. After project bidding is closed, any discovery of code violations shall be promptly reported to the Engineer. Any work performed in violation of applicable codes or ordinances shall be corrected without additional expense to the Owner or his representatives.
- C. Pressure and heating vessels, including hot water storage containers, shall be constructed in compliance with the rules and regulations of the Boiler Inspection Division of the State. All installations of such equipment shall be made by a firm licensed and approved by the Boiler Inspection Division of the State.
- D. Facilities shall be installed in compliance with the requirements of the current version of the Americans with Disabilities Act (ADA). Installation of mechanical and plumbing systems including fixtures and control mounting heights, clear knee space, and access clearances shall comply with ADA required dimensions, and as shown on details or schedules when shown.
- E. Contractor shall arrange with County, City or State, if City has no ordinances covering work, for complete inspection, paying all charges required. Give proper

authority requisite notice relating the work; afford Engineer and authorized inspectors adequate access to the Work for inspection; and be responsible for all violations of law. Upon completion of work, have work inspected, if required, obtaining certificates of inspection and approval from inspecting agency and deliver certificates to Engineer and Owner.

#### 1.03. REVIEW OF CONTRACT DOCUMENTS AND SITE

- A. With the submission of his bid, Contractor shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that the Contractor has included the cost of all required items in his proposal for a complete project.
- B. Contractor shall acknowledge that he has examined the Plans, Specifications, and Site, and that from his own investigation he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, water, electric power, roads and uncertainties of weather; the confirmation and condition of the ground; the characters, quality and quantity of subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the Work, especially the prohibited use of Owner's permanent equipment, ductwork, and controls; all federal, state, county, township and municipal laws, ordinances, and regulations particularly those relating to employment of labor, wage rates, and construction methods; and all other matters which can in any way affect the Work or the associated cost of the Work under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.
- C. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

#### 1.04. USE OF THE OWNER'S EXISTING AND NEW, PERMANENT HVAC SYSTEM DURING CONSTRUCTION

- A. Use of the Owner's existing and currently being installed, permanent HVAC system during Construction is prohibited. Provide temporary means for heating and cooling required by construction activities for curing or drying completed installations or for protecting installed construction from adverse effects of temperature and humidity. Provide temporary dehumidification systems when



required to reduce substrate moisture levels required to accommodate installation or application of finishes.

- B. Maintain a minimum ambient temperature of 50 DEG. F. in areas where construction is in progress, unless indicated otherwise in the specifications.
- C. Prevent dust, fumes, construction debris, and odors from entering existing and newly installed HVAC equipment, ductwork, and control system components. Prior to commencing work, isolate HVAC equipment. Where existing HVAC systems will be affected, isolate existing supply, return, and exhaust ducts by disconnecting ductwork at point where existing duct shall remain. Cover ends of existing ductwork securely with black plastic material.
- D. Newly installed ductwork shall be thoroughly cleaned before installation. Each section that is installed at the end of the day shall have open ends securely covered with black plastic material.
- E. Newly installed HVAC equipment shall be securely covered and protected with black plastic material or by other approved method. After installation of air moving equipment, duct connections shall be securely covered with black plastic material. Connections to duct systems shall not be made until final finishes have been installed, areas served are clean, and building is ready for HVAC equipment start-up and use.
- F. Securely cover control system components to prevent damage from construction debris, dust, and dirt. Control systems shall not be energized for testing and adjusting until HVAC system start-up.
- G. HVAC Equipment, Ductwork, and Control Components contaminated by construction debris, dirt, and construction dust shall not be acceptable and shall be replaced at no additional cost to the Owner. HVAC Equipment, Ductwork, and Control components shall be kept clean throughout construction. Cleaning after an HVAC system has been contaminated shall not be an acceptable alternate to replacement.

#### 1.05. SHOP DRAWINGS AND SUBMITTALS

- A. Submit manufacturer's catalog sheets and/or shop drawings covering all phases of work included in this Contract.
- B. Arrange submittals in sets and bind in PDF format. Loose sheets are not acceptable. Indicate for each item the location, system, or position where it is to be used, arrange by equipment type and tab sections.
  - 1. Individual submittal packages may be made for plumbing, HVAC, fire protection, test and balance, and controls. The Contractor may submit up to 5 different packages, but where practical provide all submittals in a single PDF.

2. Items which are required to be resubmitted shall come in a single PDF. Approved equipment is not required to be resubmitted.
  3. The Contractor is responsible for verification that all items are submitted.
- C. Submittals shall bear written certification to the effect that the Contractor has examined them and found them to include all items required to be submitted and to be in accordance with specifications.
- D. Submittals are required even though equipment being furnished is exactly as specified.
- E. Submittals shall include all data required in individual sections of these specifications.
- F. Contractor is responsible for making all submittals required by the specifications for approval. If equipment is delivered or installed without an approved submittal, Contractor may be required to remove and replace equipment with specified and approved equipment, as directed by the Engineer, without additional cost to the project.
- G. Exceptions for Submittals
1. Exceptions to the Specifications or Drawings shall be clearly defined in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an “or equal” or “exception” to the Specifications shall be at the sole discretion of the Engineer.
  2. By noting the term “compliance”, it shall be understood that the Contractor is in full compliance with the item specified and will provide exactly the same with no deviations.
  3. By noting the term “deviation”, it shall be understood that the Contractor prefers to provide a different component in lieu of the one specified and in so doing, takes full responsibility for making the equipment work as specified and will provide any and all ancillary components to make the equipment work at no extra cost to the Owner.
  4. By noting the term “alternate”, it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner and in so doing, takes full responsibility for making the equipment work as specified and will provide necessary ancillary components to make the equipment work at no extra cost to the Owner. The alternate method shall be fully described with schematic diagrams and one-line diagrams as applicable.

## 1.06. SUBSTITUTION OF MATERIALS

- A. Final decision as to whether or not a specific piece of equipment meets specifications shall rest with Engineer.
- B. Substitution requests will not be accepted prior to bid.
- C. Equipment and material manufacturers are referenced in the Plans and Specifications to establish the basis of design and required standards.
- D. With each Substitution Request, submit technical data that will fully establish the equality of the proposed substitute product with that listed. Submit completed Substitution Request Form.
- E. Substitution Process
  - 1. The naming of a manufacturer's product with the words "basis of design" or the naming of a single manufacturer's product on a drawing equipment schedule, on other drawings, or in the specifications, establishes that specific product as the basis for design. In the absence of any other named acceptable manufacturer's product, provide the "basis of design" product. No substitutions will be accepted.
  - 2. Where other manufacturer's names are listed on the drawings or in the specifications as acceptable in addition to the "basis of design" product, product acceptability for these manufacturers shall be verified via submittal review after the project has bid. No other substitutions will be accepted.
  - 3. Where the words "include but shall not be limited to" or "or equal" are used in addition to a manufacturer's name or a list of manufacturer's names, product acceptability for these manufacturers shall be verified via submittal review after the project has bid.
  - 4. It is the responsibility of the Contractor to provide all of the data necessary to establish acceptability of the product.
  - 5. The submittal for the substitution will be reviewed for conformance with the specifications and equality to the specified products. Full submittals will be required of all equipment. Substitution submittals will be reviewed and shall be rejected if the proposed equipment is found to be different than indicated on the Substitution Request Form, or is found deficient compared to scheduled performance/or specifications.
- F. Any proposed substitutions of equipment shall be accompanied by product submittal and shop drawings showing revised equipment layouts, piping diagrams, ductwork drawings and/or wiring diagrams. Where substituted equipment furnished requires use of larger, more, or differently arranged

connections, such connections shall be installed to the complete satisfaction of Engineer without additional cost to Owner.

- G. The Contractor is responsible for full coordination of all changes required by substituted equipment, including dimensional clearance.
- H. The Contractor is responsible for all additional costs of equipment installation, coordination and engineering which results from his substitution. This includes all aspects of the work including architectural, structural, civil, electrical, and mechanical. This also includes costs for the redesign time of Architects and Engineers.
- I. Costs associated with dimensional, performance, or other deviations from the “basis of design” equipment, including engineering costs to evaluate such deviations, shall be paid by the Contractor. If a product other than the “basis of design” product is submitted and subsequently rejected during the submittal process, Contractor shall provide the “basis of design” product.
- J. Should a substitution be accepted and subsequently proven unsatisfactory for the service intended within the warranty period, the Contractor shall provide the basis of design, or make corrections as directed by Engineer.

#### 1.07. GUARANTY-WARRANTY

- A. Guarantee shall include capacity and integrated performance of component parts of various systems in strict accord with the intent and purpose of these specifications. Conduct such tests as herein specified or as may be required by the Engineer to demonstrate capacity and performance ability of various systems to maintain specified conditions.
- B. Compile and assemble the warranties specified in the mechanical division, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment; date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- D. All materials and equipment shall carry a full year's warranty from time Owner accepts building or the date of substantial completion, whichever is earlier, regardless of start-up date of equipment, unless a longer warranty period is specified under other sections. Longer warranty periods for specific items shall be listed in other sections of these specifications.

## PART 2 MATERIAL

### 2.01. MATERIAL AND EQUIPMENT

- A. Equipment shall be new, undamaged, and of the same manufacturer except where indicated otherwise.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- D. Protect work and equipment at all times from damage, weather, and entrance of dirt and water. Close pipe and duct openings with caps or plugs during installation.

## 2.02. ELECTRICAL

- A. Contractor shall carefully coordinate voltage and amperage requirements of equipment to be provided. Coordinate with Electrical Contractor prior to equipment order. Any change to electrical systems required by Contractor's substitutions or uncoordinated equipment needs shall be made without cost to the project.
- B. Provide all electrical interlock, control, and other wiring, not covered specifically under the electrical drawings and specifications, for proper operation and control of all equipment specified under this Division of the specifications.
- C. Supervise and coordinate all electrical work in connection with mechanical systems.
- D. Furnish all motor controllers and contactors, not furnished as part of a motor control center, or by Electrical Division for proper operation of all motors. Submit motor data with submittals.

## 2.03. ROOF AND FLASHINGS

- A. A. Special care shall be taken on roofs to prevent damage. Promptly repair any damage at no additional expense to the Owner. Comply with bonding requirements of new and existing roofs.
- B. B. Flashings are not covered by this section. Refer to Architectural Division.

## 2.04. ACCESS PANELS

- A. Provide access panels in all floors, walls, and plaster and non-lay-in type ceilings as required or as indicated to service devices in piping requiring access, controls, devices in ductwork requiring access, and other system components requiring access for service or regular maintenance. Closely coordinate requirements for

access doors before bidding.

- B. Access doors shall be "Milcor" type appropriate for the construction involved.
- C. Size and type shall be as required for proper service and/or as may be directed by the Engineer. Minimum size to be 24" x 24".

#### 2.05. ASBESTOS AND OTHER HAZARDOUS OR TOXIC MATERIALS

- A. No Asbestos containing materials shall be used on this project.
- B. Contractor is responsible for his own means and methods of safety where Hazardous or Toxic materials are use for the installation of his work. All work shall comply with state and federal regulations.
- C. Contractor shall protect the Owner's facility and employees from conditions generated by his work.
- D. In the event that a potentially hazardous material is discovered during the course of the work, Contractor shall stop work immediately, and provide for the safety of his employees and other occupants. He shall make proper notifications as required by his contract and by law.

#### 2.06. CONCRETE

- A. Concrete materials and installations indicated on the drawings for curbs, pads, and supports for mechanical equipment shall be provided as part of the contract.
- B. Comply with other architectural and structural portions of the specifications for materials and methods.
- C. Concrete.
  - 1. Concrete shall be commercial grade containing Portland cement, aggregates, clean water, and mix ratios suitable for the loads, and site conditions.
  - 2. Concrete shall be 3,000 psi class indoors and 3,500 psi class outdoors unless noted otherwise.
  - 3. Comply with ACI standards for cold and hot weather applications.
- D. Installation
  - 1. Use rigid and smooth forms to prevent visible defects and deflections in the work. Use form compound to prevent concrete bonding to the forms.
  - 2. Provide chamfered corners on the tops of curbs.

3. Reinforce pads and curbs with steel reinforcing bars minimum size number 3, welded wire fabric, or as indicated on the drawings. Set the reinforcing depth within the concrete for optimum strength for the application.
4. Provide equipment pads of sizes indicated and at least large enough to extend past the mechanical equipment 6" on all sides. Minimum height 6" unless otherwise noted.
5. Pour pads integral with the floor slab, isolate from the floor slab, or dowel the pads, as indicated on the drawings.
6. Grout all voids with high strength grout mixture.
7. Installation of the pads shall be coordinated so that the concrete has set and the strength is suitable for installation of the equipment.
8. Set anchor bolts where indicated by either equipment manufacturer or Structural Engineer.
9. Brush-finish equipment pads.

#### 2.07. LOCAL SITE CONDITIONS

- A. Before bidding, make complete investigation at site in order to be informed as to location of utilities and as to conditions under which work is to be performed. Utility locations shown were obtained from surveys and/or local utility companies and are offered as a general guide only and are not to be assured accurate.
- B. Make determination of soil conditions before bidding. These specifications and accompanying drawings in no way imply condition of soil to be encountered.

#### 2.08. EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavation, trenching, and backfilling in connection with the mechanical system, to a point 5'-0" outside the building, is included as part of this Division, unless indicated otherwise.
- B. Excavation required shall be done as part of the contract price regardless of any implied conditions on the drawings or in these specifications.
- C. Excavation to have 12" minimum and 24" maximum clearance on all sides. Do not carry excavation below required level unless indicated otherwise on the drawings. Excess excavation below required level shall be backfilled at no expense to Owner with earth, sand, gravel, or concrete, as directed by Engineer and thoroughly compacted. Remove any unstable soil and replace with gravel, crushed stone, or clean sand and thoroughly compact. Engineer will determine the depth of removal of any unstable soil encountered. Grade ground adjacent to

excavation to prevent water from running into excavation. Remove accumulated water in the excavation.

- D. Banks of trenches shall be vertical or as shown on the drawings. Width of trench shall be 5" minimum, 8" maximum on each side of pipe bell. Excavate bell holes accurately to size by hand. In rock, excavations shall be carried 8" below bottom of pipe. Use loose earth or gravel for backfill and tamp thoroughly.
- E. Bracing, sheathing, and shoring shall be performed as necessary to complete and protect excavations indicated on the drawings, as required for safety, as directed by Engineer, and to conform to governing laws and state and federal regulations. Comply with OSHA Regulations.
- F. After piping installation, inspection, testing, and approval by governing agency; backfill trenches with clean, stable soil free from stones. Place backfill in 4" layers, tamped under and around pipe and conduit to height of at least 2' above pipe. Tamping shall be done in such manner as not to disturb underlying work. Remainder of trenches and excavations shall be backfilled with clean, stable earth, deposited in 8" layers and brought up to rough grade, with each layer compacted to density of surrounding soil. Remove sheathing and shoring as backfill is placed and fill space with dry sand. Compaction tests may be required by the Engineer, with the costs paid by the Contractor.
- G. Underground piping shall be marked with metallic marking tape inserted in the trench a minimum of 12" below grade and a minimum of 12" above mains.
- H. Replace existing appurtenances removed or damaged in connection with work, and restore to original conditions, unless directed otherwise.

#### 2.09. MECHANICAL INSTALLATIONS:

- A. Coordinate mechanical equipment and material installation with other building components and other trades. Investigate each space in the structure through which mechanical equipment furnished under these specifications must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. Verify all dimensions by field measurements. By ordering equipment, Contractor assumes responsibility for the installation and orientation of equipment in the available space.
- C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of mechanical materials and



equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

- F. Fit equipment, pipe, and duct into the available spaces in the building and introduce into the building, at a time, and in a manner, as not to damage the structure. Install ductwork and piping to provide the maximum possible clear height underneath.
- G. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.
- H. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- I. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
- J. Coordinate the installation of mechanical materials and equipment above ceilings with suspension systems, light fixtures, and other installations.
- K. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- L. Do not support material or equipment of other trades from piping or ductwork.
- M. Do not use equipment, piping, or ductwork as scaffolding, scaffolding support, or as other means to access the work. Damaged systems and components shall be repaired or replaced in accordance with the full satisfaction of the Owner and Engineer.
- N. Core drill piping penetrations of concrete walls, floors, and other concrete structures.
- O. Equipment locations shown on the drawings are approximate. Final locations shall be established and determined in the field to best utilize available space.
- P. Replace architectural features removed or damaged during the course of the work.
- Q. Maintain fire assembly ratings as dictated by authorities having jurisdiction. Seal around penetrations through UL rated assemblies, fire, and smoke walls.
- R. Fully seal around duct or pipe routed through exterior walls.

## 2.10. EQUIPMENT CONNECTIONS

- A. Each equipment item with drain connections shall be provided with a properly-sized drain run to the nearest floor drain or as directed.
- B. Rough-in and make final required connections to equipment, furnished under other Divisions of the Specifications or by the Owner.
  - 1. Provide necessary labor and materials for a complete installation. Trap and vent drainage connections as required.
  - 2. If equipment or fixtures furnished by others are not delivered prior to final acceptance, services shall be capped or plugged at walls or floor as directed, ready for future connection.
- C. No equipment or fixture shall be "roughed-in" until proper rough-in drawings are provided to the installer.
- D. Extend grease fittings to accessible locations.

#### 2.11. CUTTING AND PATCHING

- A. Provide cutting and patching required to perform the mechanical work, when alteration, repair, renovation, or addition, to existing construction is specified or required for new work.
- B. Cutting of structural members will not be permitted except through explicit instructions from the Engineer. Reinforcing will be required where members are cut.
- C. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching required to:
  - 1. Uncover Work to provide for installation of ill-timed Work.
  - 2. Remove and replace defective Work.
  - 3. Remove and replace Work not confirming to requirements of the Contract Documents.
  - 4. Remove samples of installed Work as specified for testing.
  - 5. Upon written instructions from Engineer, uncover and restore Work to

provide for Engineer observation of concealed Work.

## 2.12. GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.
- I. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5,000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.13. SEISMIC

- A. Mechanical systems shall be installed in conformance with the requirements of the state and federal codes and regulations for Seismic considerations, as specified and noted on the drawings.
- B. All seismic restraining and snubbing devices shall be manufactured specifically for this duty. Devices constructed by the Contractor will not be accepted.
- C. Contractor shall be responsible for the design and installation of the restraining and snubbing systems based on the criteria included on the drawings and in the specifications, and the actual equipment, and locations of installation.

## 2.14. START UP, TESTING, AND ADJUSTING

- A. Contractor shall include adequate time in construction schedule for HVAC system start-up; testing, adjusting, and balancing; and control system installation,

programming, testing, and commissioning.

- B. Each and every phase of the plumbing, air conditioning, heating and ventilating systems shall be operated separately, or in conjunction, one with the other, for a sufficient period of time to demonstrate to the entire satisfaction of the Engineer the ability of the systems to meet the capacity and the performance requirements while maintaining design conditions, in accordance with the intent of these specifications.
- C. Previous to any performance tests, the Contractor shall have set and adjusted valves, dampers, motors, controllers, thermostats, and other items as are necessary to properly balance phases of the mechanical systems and shall have the systems operating and maintaining design temperatures, humidity, and air circulation throughout all areas of the building.
- D. See other sections of these specifications for other possible records and tests to be made.
- E. During the first-year warranty, the Contractor may be required to make some or all of the readings above to assure system is functioning properly through the various seasons. Contractor shall make additional adjustments as required.

## 2.15. PAINTING

- A. Provide mechanical equipment with factory painted finish. Where factory finish is damaged during handling and installation, use touch-up paint of same type and color as original paint. Where extensive refinishing of factory applied finishes are required, equipment shall be repainted by the factory.
- B. All uninsulated, ferrous equipment, tanks, pipes, fittings, pipe hangers, supports, miscellaneous steel, and ironwork without factory finish shall be primed and painted. Do not paint galvanized hanger rods or galvanized duct straps.
  - 1. Where exposed to view, except in mechanical spaces, color shall be as selected by the Architect.
  - 2. Where located in mechanical spaces or in areas not exposed to view, color shall be as directed by Owner's representative to match Owner's existing color schedule. In the absence of an Owner's color schedule, color shall be black.
- C. All insulated mechanical equipment, tanks, and piping not provided with a factory finish shall be painted.
  - 1. Where exposed to view, except in mechanical spaces, color shall be as selected by the Architect.
  - 2. Where located in mechanical spaces or in areas not exposed to view, color shall be as directed by Owner's representative to match Owner's existing color schedule. In the absence of an Owner's color schedule, color shall

be black.

- D. For uninsulated material to be painted, prime with one coat of alkyd primer and paint with two coats of alkyd enamel gloss. Paint shall be suitable for the environmental and temperature conditions where material is installed.
  - E. Paint insulated material with two coats of alkyd enamel gloss. Paint shall be suitable for the environmental and temperature conditions where material is installed.
  - F. Prepare surfaces for painting in accordance with the paint manufacturer's requirements. Remove or protect portions of the work which are not to be painted.
  - G. Apply primer coat(s) of paint as recommended by the paint manufacturer.
  - H. Apply final coat(s) of paint as recommended by the paint manufacturer. Apply paint by brush or roller as dictated by the surface to be painted. Paint should have a smooth appearance without cloudiness, spotting, marks, runs, or other surface imperfections.
  - I. Clean-up the area of materials, waste, and rubbish. Clean splattered surfaces.
  - J. Protect the work from damage. Touch-up and restore defaced painted surfaces at the end of the project.
- 2.16. NOISE: Contractor shall isolate pipes, ductwork, equipment, and other items to insure no additional noise is generated or transmitted to the building when systems are in operation.
- 2.17. ERECTION OF METAL SUPPORTS AND ANCHORAGES
- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment. See Paragraph 3.11 for painting.
  - B. Field Welding: Comply with AWS D1.1.
- 2.18. OPERATION INSTRUCTIONS
- A. Contractor shall provide bound manuals containing complete repair parts' lists, and operating service and maintenance instructions for equipment provided. The manual shall include:
    - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
    - 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
    - 3. Maintenance procedures for routine preventative maintenance and

troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing and instructions and lubrication charts and schedules.
- B. Contractor shall carefully instruct the Owner's operations personnel during the adjustment and testing period of the equipment for such length of time as may be necessary to thoroughly familiarize them with the proper care, operation, and maintenance of the equipment.
- C. Contractor shall turn special tools, maintenance items, keys, other devices and materials required to operate or maintain the systems over to the Owner.

#### 2.19. CLEAN UP

- A. Do not allow waste material or rubbish to accumulate in or about jobsite. Clean work areas daily.
- B. At completion of work, remove rubbish, tools, scaffolding, and surplus materials from and about building, leaving work clean and ready for use without further cleaning required. Clean equipment, piping, valves, fixtures, and fittings of grease, metal cuttings, insulation cement, dust, dirt, paper labels, and other materials that are not part of the final finish.
- C. Any discoloration or other damage to parts of building, its finish or furnishings due to failure to properly clean or keep mechanical systems clean shall be repaired without cost to Owner.

#### 2.20. NAMEPLATE DATA:

- A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
- B. Locate nameplates in an accessible location. Where manufacturer's name plate is not stamped or engraved, provide additional heavy gauge aluminum or brass, stamped or engraved nameplate.
- C. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.

#### 2.21. RECORD DOCUMENTS

- A. At completion of this project, the Contractor shall provide Engineer with one set of "red lined" design drawings and specification showing all Work installed by him.
- B. These documents shall incorporate all changes made in the course of the project

so as to enable the Owner to properly maintain, operate, and repair both exposed and concealed work. The redlines shall indicate changes:

1. Made by Contractor.
  2. Addendum Items.
  3. Change Orders.
  4. Substitutions.
- C. Drawings and specifications shall be updated during the progress of the work and kept at the job site.
- D. Record Prints: Maintain one set of blue-line or black-line prints of the Contract Drawings, Submittals, and Shop Drawings.
1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
- 2.22. FINAL PROJECT OBSERVATION: The final project observation shall not be made until the following items have been assembled and approved as indicated in other sections of the specifications.
- A. Certificate of acceptance from local inspecting authorities.
  - B. Letter of compliance from the Controls Systems Provider indicating that the system is complete, fully operational, and installed as specified by manufacturer's certified or licensed individuals.
  - C. Test and Balance report.
  - D. Owner's Operations and Maintenance manual.
  - E. Copies of bonds, insurance certificates, waivers, affidavits, warranties and guarantees, and other documents required in the specifications signed and ready for appropriate action.
  - F. Written notification from the Contractor that the work is complete and ready for final observation and the above documents are completed and available

G. Other documentation which may be required by the Engineer.

## 2.23. PROJECT CLOSEOUT

A. The final mechanical systems closeout shall not be completed until the Contractor has completed his work and submitted the documents required by Division 1 portions of the specifications. In addition the following work items and specific mechanical documents described in other portions of this specification section shall also be submitted and approved:

1. Record drawings.
2. Record specifications.
3. Guarantee and Warranties.
4. Operating and Maintenance Manuals (O&M). O&M Manuals shall also be provided to the Owner in duplicate. Manuals shall contain approved shop drawings, operations and maintenance instructions, parts manuals for HVAC equipment, an accurate set of design plans showing all construction revisions to the design set, and a copy of the test and balance report.
5. Final clean up.
6. Final Test and Balance Reports with startup logs.
7. Pipe and Equipment Identification.
8. Pipe test certifications.
9. Water treatment analysis and application.
10. Bonds, Insurance Certificates, Waivers, Affidavits, and other documents required in the specifications signed and ready for appropriate action.
11. Other items which may be required by the Engineer.

B. Confirm in writing that specified training specified has been completed with the Owner.

C. Confirm in writing that specified demonstrations have been completed with the Owner.

D. Confirm that test and balance is complete.

END OF SECTION



## SECTION 23 0015 - FIRESTOPPING AND SMOKE STOPPING

### PART 1 - GENERAL

#### 1.01. SUMMARY

- A. Section includes:
  - 1. Through-penetration firestopping in fire rated construction.
- B. Scope:
  - 1. The scope of the work shall include the mechanical systems, HVAC piping and ductwork, plumbing piping, fire protection piping, and other systems installed by the contractor.

#### 1.02. 1.02 REFERENCES

- A. Underwriters Laboratories
  - 1. U.L. Fire Resistant Directory
    - a. Through-penetration firestop devices (XHCR)
    - b. Fire resistance ratings (BXUV)
    - c. Through-penetration firestop systems (XHEZ)
    - d. Fill, void, or cavity material (XHHW)
- B. American Society for Testing and Materials Standards:
  - 1. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

#### 1.03. 1.03 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.
- B. Barriers: Time rated fire walls, time rated ceiling/floor assemblies, and structural floors.
- C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
- E. System: Specific products and applications, classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.
- F. Sleeve: Metal fabrication or pipe section extending through thickness off barrier and used to permanently guard penetration. Sleeves are described as part of

penetrating system in other sections and may or may not be required.

#### 1.04. SYSTEM DESCRIPTION

##### A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

#### 1.05. SUBMITTALS

A. Submit in accordance with general conditions unless otherwise indicated.

B. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication
2. Manufacturer's installation instructions.

C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL System number, or UL classified devices.
2. Manufacturer or manufacturers' representative shall provide qualified engineering judgements and drawings relating to non-standard applications as needed.

D. Quality control submittals:

1. Statement of qualifications.

E. Applicators' qualifications statement:

1. List past projects indicating required experience.

#### 1.06. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing the work of this section with

minimum three years documented experience and approved by manufacturer.

#### 1.07. REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

#### 1.08. ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for 3 days after installation of materials.
- C. Provide ventilation in areas to receive solvent cured materials.
- D. Furnish forced air ventilation during installation if required by manufacturer.
- E. Keep flammable materials away from sparks or flame.
- F. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
- G. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

#### 1.09. SEQUENCING

- A. Sequence work to permit firestopping materials to be installed after adjacent and surrounding work is complete.

#### 1.10. QUALITY ASSURANCE

- A. Installer's qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:
  - 1. Acceptable to or licensed by manufacturer, State or local authority where applicable.
  - 2. At least 2 years experience with systems.
  - 3. Successfully completed at least 5 comparable scale projects using this system.
- B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.
- C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

### 1.11. DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
  - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
  - 2. Coordinate delivery with scheduled installation date, allow minimum storage at site.
- B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instruction.

### 1.12. PROJECT CONDITIONS

- A. Existing conditions:
  - 1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
  - 2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

### 1.13. GUARANTEE

- A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

## PART 2 PRODUCTS

### 2.01. THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

- A. Systems or devices listed in the U.L. Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.
  - 1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.
  - 2. Acceptable manufacturers and products: Those listed in the U.L. Fire Resistance directory for the U.L. System involved and as further defined in Part 3.06 of this section.

3. All firestopping products must be from a single manufacturer. All trades shall use products from the same manufacturer.
4. Products shall be 3M firestopping products and systems or equal.

#### 2.02. SMOKE-STOPPING AT SMOKE PARTITIONS

- A. Through-Penetration Smoke-Stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.
- B. Construction-Gap Smoke-Stopping: Any system complying with the requirements for construction-gap firestopping in fire-rated construction, as specified in this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

#### 2.03. MATERIALS

- A. Firestopping Material: Single or multiple component silicone elastomeric rubber type foam compound mixed with incombustible non-asbestos ceramic fibers.
- B. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

#### 2.04. 2.04 ACCESSORIE

- A. Fill, void or cavity materials: As classified under category XHHW in the U.L. Fire Resistance Directory.
- B. Forming materials: As classified under Category XHKU in the U.L. Fire Resistance Directory.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
  2. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02. SURFACE PREPARATION

- A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion,

or the required fire resistance.

### 3.03. INSTALLATION

- A. Apply primer and materials in accordance with manufacturer's instructions.
- B. Install penetration seal materials in accordance with printed instruction of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction.
- C. Seal holes or voids made by penetrations to ensure an effective smoke barrier.
- D. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.
- E. Apply firestopping material in sufficient thickness to achieve rating and to a uniform density and texture.
- F. Protect materials from damage on surfaces subject to traffic.
- G. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
- H. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges - installed in accordance with fire damper manufacturer's recommendations.
- I. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable tray, bus duct or other items, close unused portions of opening with firestopping material tested for the application. See U.L. Fire Resistance Directory.
- J. Install smoke stopping as specified for firestopping.
- K. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical 12 inch wide fiber dams for full thickness and height of air cavity at maximum 15 foot intervals.
- L. Dam material to remain.

### 3.04. FIELD QUALITY CONTROL

- A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

3.05. ADJUSTING AND CLEANING

- A. Clean adjacent surfaces of firestopping materials.
- B. Clean up spills of liquid components.
- C. Neatly cut and trim materials as required.
- D. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.06. PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.07. SYSTEMS AND APPLICATION

- A. The installation shall be as required by manufacturer for type of construction, Type of U.L. systems, type of penetration, and type of fire stopping system.

END OF SECTION

## SECTION 23 00 30 - ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

### PART 1 - GENERAL

#### 1.01 SUMMARY:

- A. This section specifies the basic requirements for electrical components which are to be provided for operation of mechanical equipment. These components include, but are not limited to, motors, starters, and disconnect switches when indicated, furnished as an integral part of packaged mechanical equipment, or furnished separately for mechanical equipment.
- B. Furnish all motor controllers and contactors, not furnished as part of a motor control center, for proper operation of all motors.
- C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specification sections and scheduled on the drawings.

#### 1.02 REFERENCES:

- A. NEMA Standards MG 1: Motors and Generators.
- B. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment.
- D. NEMA Standard KS 1: Enclosed Switches.
- E. National Electric Code (NFPA 70).

#### 1.03 SUBMITTALS:

- A. Separate submittal is not required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

#### 1.04 QUALITY ASSURANCE:

- A. Electrical components and materials shall be UL labeled.
- B. The electrical work shall comply with the National Electric Code.

### PART 2 - PRODUCTS



2.01 MANUFACTURERS:

- A. Equipment shall be by same manufacturer, except those items furnished by an equipment manufacturer as an integral part of his equipment. Where possible the equipment shall be by the same manufacturer specified in Division 16.

2.02 MOTORS: The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

- A. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
- B. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
- C. 2-speed motors shall have 2 separate windings on poly-phase motors.
- D. Temperature Rating: Rated for 40 degrees C. environment with maximum 90 degree C rise for continuous duty at full load (Class B insulation).
- E. Starting Capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly spaced starts per hour for manually controlled motors.
- F. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
- G. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
  - 1. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
  - 2. Bearings:
    - a. Ball or roller bearings with inner and outer shaft seals.
    - b. Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
    - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
    - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.

3. Enclosure Type:
  - a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
  - b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
  - c. Weather protected Type I for outdoor use, Type II where not housed.
4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: "Quiet".
6. Efficiency:
  - a. Motor shall comply with the efficiency requirements of the Energy Independence and Security Act of 2007.
  - b. Motors smaller than 1 HP shall have minimum full load efficiencies levels per NEMA Standards.
  - c. Motors 1 HP and larger shall be premium efficiency.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

## 2.03 STARTERS, ELECTRICAL DEVICES, AND WIRING:

- A. Motor Starter Characteristics:
  1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R or NEMA 12 with conduit hubs installed by contractor, or units in hazardous locations which shall have NEC proper class and division.
  2. Type and size of starter shall conform to adopted standards and recommended practices of the National Electric Code and Underwriters' Laboratories.
- B. Manual Switches: Manual switches shall have:
  1. Pilot lights and extra positions for multi-speed motors.

2. Overload protection: Melting alloy type thermal overload relays.
3. Manual starters / switches are to be used on fractional horsepower motors only.

C. Magnetic Starters:

1. Momentary contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, witches and similar devices as required for coordination with control requirements of controls sections.
4. Built-in 120 volt control circuit transformer, with 2 primary and one secondary fuse, where service exceeds 240 volts. Fuses sized to carry holding coil circuit and other connected devices.
5. Externally operated manual reset.
6. Under-voltage release or protection (3-wire control).
7. Branch circuit protection shall meet type 2 coordination protection.
8. A hand-off-auto selector switch shall be provided in addition to start-stop buttons for all devices being controlled automatically.
9. Phase loss relay.
  - a. Provide protective relays with DPDT 600V rated contacts, locking potentiometer undervoltage adjustment, and LED indicating light at each starter for motors greater than 5 HP. Equal to Square D Class 8430, Type MPD, mounted in suitable enclosure.

D. Motor Connections:

1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Heater Contactors:

1. Contactors for resistance heat shall be by same manufacturer as starters unless furnished with heaters. Contactors shall be of the magnetic type and mounted in NEMA Type 1 general purpose enclosure. Contactors shall carry a UL listing and shall be rated for 100,000 cycles.

F. Disconnect Switches:

1. Fusible Switches: Fused, each phase; heavy duty; horsepower rated; non-teasible, quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "open" position; arc quenchers; capacity and characteristics as indicated.
2. Non-fusible Switches: For equipment less than 1 horsepower, switches shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment 1 horsepower and larger, switches shall be the same as fusible type.

2.04 CAPACITORS:

A. Features:

1. Individual unit cells, all welded steel housing, each capacitor internally fused, non-flammable synthetic liquid impregnant, craft tissue insulation, and aluminum foil electrodes.
2. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger that have an uncorrected power factor of less than 85 percent at rated load.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Deliver starters and wiring devices which have not been factory-installed on equipment unit to electrical installer for installation.
- C. Install starters and wiring devices at locations indicated, securely supported and anchored, and in accordance with manufacturer's installation instructions. Locate for proper operation access, including visibility, and for safety. Do not cover equipment data or informational tags when device is to be mounted on equipment.

- D. Install control connections for motors to comply with NEC and applicable provisions of Electrical. Install equipment grounding except where non-grounded isolation of motor is indicated.
- E. Connect protective relays to line side lugs of the motor starter and wire control contacts into motor starter circuit.
- F. Label starters with engraved plastic nameplate describing the equipment served, e.g., "A.C. Unit No. 1". Nameplates shall be U.V. stabilized for use indoor / outdoor. Attach nameplates with clear silicone sealant.

END OF SECTION

## SECTION 23 0060

### BASIC PIPING

#### PART 1 - GENERAL

##### 1.01. THERMAL EXPANSION:

- A. Swing joints, turns, expansion loops, and long offsets shall be provided where necessary to allow for expansion and contraction. Pipe, fittings, or equipment damaged during the warranty period due to thermal expansion shall be replaced at no additional cost to the Owner.

##### 1.02. NOISE CONTROL:

- A. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise.

##### 1.03. CROSS CONNECTIONS:

- A. No piping shall be installed that will provide a cross-connection between potable water system and a polluted supply.

##### 1.04. SUBMITTALS

- A. Product Data: Submit catalog cut sheets and specifications for each type of pipe, tube, and fitting. Submit pipe schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

##### 1.05. DELIVERY, STORAGE, AND HANDLING

- A. Except for hub and spigot, clay, and similar piping, provide factory applied end caps on all pipe and tubing to prevent damage, and dirt and moisture entry. Maintain end caps through shipping, storage, and handling.
- B. Where possible, store pipe, tube, flanges, and fittings inside and protected from the weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

##### 1.06. QUALITY ASSURANCE

- A. Qualify and certify welding and brazing procedures, equipment, and operators in accordance with ASME codes and standards for shop and job site work.
- B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

- C. Welding procedures and testing shall comply with ANSI Standard B31.1.
- D. Soldering and brazing procedures and testing shall comply with ANSI Standard B31.9. Comply with ANSI Standard B31.5 for refrigerant piping.

## PART 2 - PRODUCTS

### 2.01. MATERIALS:

- A. Refer to specific piping specification sections for materials to be used on the various piping systems.
- B. Materials shall be manufactured by firms whose products of types and sizes required for this project have been in satisfactory use in similar service for 5 years.
- C. All materials shall be new and undamaged.
- D. For corrosive environments all bare copper piping shall be provided with special Heresite coating even if located within outdoor equipment.

### 2.02. CONDENSATE, CONDENSING FURNACE, EXHAUST, AND INTAKE PIPE: Sch 40 PVC

- A. Condensate exhaust pipe should be sloped back to furnace.

### 2.03. REFRIGERANT PIPE, INCLUDING LIQUID AND HOT GAS LINES: hard drawn copper, Type "L" (degreased).

- A. Soft copper will be permitted when sleeving below grade or installing in wall to eliminate fittings. Soft copper may also be installed on units less than 1 1/2 tons.
- B. Do not run refrigerant lines thru return air plenum unless approved by engineer.
- C. Do not run refrigerant piping underground.

### 2.04. JOINING MATERIALS:

- A. Refer to specific piping specification sections for special joining materials not list below.
- B. Pipe Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8 inch maximum thickness, unless other thickness or specific material is indicated.
  - 2. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

3. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32.
1. Alloy Sn95 or Alloy Sn94: approximately 95 percent tin and 5 percent silver, with 0.1 percent lead content.
  2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.1 percent maximum lead content.
  3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.1 percent maximum lead content.
  4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.1 percent maximum lead content.
  5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.2 percent maximum lead content.
- E. Brazing Filler Metals:
1. BcuP Series: Copper-phosphorus alloys.
  2. Bag1: Silver Alloy.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements: Manufacturer's standard solvent cements for the following:
1. ABS Piping: ASTM D 2235.
  2. CPVC Piping: ASTM F 493.
  3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  4. PVC to ABS Piping Transition: ASTM D 3138.
- H. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- I. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.



J. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel Paint.

K. Dielectric Fittings

1. 1. Provide dielectric connection at all connections between pipe materials of differing types whether indicated on plans or not.
2. 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. 3. Dielectric Unions: Factory fabricated, union assembly, for 250-psig minimum working pressure at 180 °F.
4. 4. Dielectric flanges: Factory fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
5. 5. Dielectric-Flange Insulation Kits: Field assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
6. 6. Dielectric couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends, and 300-psig minimum working pressure at 225°F,
7. 7. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; threaded ends, and 300-psig minimum working pressure at 225°F.

2.05. PIPE ESCUTCHEONS:

- A. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to

completely cover pipe penetration hole in floor, walls, or ceilings; and pipe sleeve extension, if any. Furnish solid pipe escutcheons with nickel or chrome finish for occupied areas. Prime paint finish for unoccupied areas. Split hinge type is not acceptable in occupied areas, except on existing piping.

- B. For waterproof floors and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons.

#### 2.06. PIPE SLEEVES:

- A. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3” diameter and smaller, 20 gauge; 4” to 6” diameter, 16 gauge; over 6” diameter, 14 gauge.
- B. Steel-Pipe: Fabricate from ASTM A 53, Grade A, Schedule 40 galvanized steel pipe.
- C. Iron-Pipe: Fabricate from cast-iron or ductile iron pipe; cast-iron sleeve to be same wall thickness as equivalent ductile iron pipe.

#### 2.07. SLEEVE SEALS:

- A. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing water tight seal and electrical insulation. Thunderline, “Link Seal” or equal.
- B. Fire Protection Mechanical Sleeve Seals: Three (3) hour rated modular mechanical type, consisting of interlocking fire resistant silicone rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing water tight seal and fire resistant seal. Thunderline, “Link Seal” or equal.
- C. Fire Protection Sealant
  1. Firestop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies and provide a fire rating equal to that of construction being penetrated.
  2. All firestop materials and methods shall conform to applicable governing codes having local jurisdiction, whether approved by submittal or not.
  3. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer’s engineering judgment derived from similar independently tested system designs will

be submitted to local authorities having jurisdiction for their review and approval prior to installation.

- D. Elastomeric Joint Sealant: Type S, Grade NS, Class 25, Use O, neutral-curing, silicone sealant unless otherwise indicated.
- E. Grout: Nonshrink, nonmetallic, hydraulic cement grout, ASTM C 1107, Grade B. Post hardening, volume adjusting, dry, nonstaining, noncorrosive, and nongaseous recommended for interior and exterior applications. 5000 psig, 28 day strength.

### PART 3 - EXECUTION

#### 3.01. GENERAL:

- A. Install piping as described below, unless indicated otherwise in the individual piping sections. See the individual piping sections for unique piping installation requirements.
- B. Exposed lines are to be run parallel with, or perpendicular to, building lines and wherever possible shall be grouped together for easy service and identification. Lines requiring a definite grade for drainage shall have precedence in routing over all other lines. Wherever possible, horizontal and vertical lines shall be held as close as possible to walls, ceilings, struts, and structural members to occupy minimum space consistent with the proper requirements for insulation, expansion, removal of pipe, and access to valves. Except in mechanical spaces, piping shall not be run exposed in finished area of buildings unless otherwise noted.
- C. General Locations and Arrangements: Drawings including plans, schematics, and diagrams indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, and below grade or floors, unless indicated otherwise.
- G. Install piping at indicated slopes and as prescribed by Code.
- H. Install components with pressure rating equal to or greater than system operating pressure.
- I. Install piping free of sags and bends.

- J. Install piping with sufficient space above removable ceiling panels to allow for panel removal.
- K. Install drains at low points in mains, risers, and branch lines consisting of a branch fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- L. Piping shall be worked into place without springing and/or forcing. Arrange piping so that it does not interfere with removal of other equipment or devices, nor to block access to doors, windows, manholes, or other access openings.
- M. All piping shall be installed so as to avoid liquid or air pockets throughout the work. Piping shall be erected and pitched to insure proper draining. Provide air vents and drain traps where indicated and as required.
- N. All exposed plumbing fixture supplies and stops shall be chrome-plated.
- O. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. If piping must be run through electrical spaces, comply with NFPA 70 for access clearance requirements for electrical equipment. Install drip pan under piping which must be run through electrical spaces. Pan drain shall be run at exterior or sanitary, as permitted by Code.
- P. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.
- Q. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

### 3.02. ASSEMBLY:

- A. All pipes shall be cut square and shall have burr and cutting slag removed by reaming or other cleaning methods.
- B. Remove scale, slag, dirt, and debris from both inside and outside of piping and fittings before assembly.
- C. Unions or flanges shall be used at all equipment connections to facilitate dismantling.
- D. All joints and changes of direction shall be made with standard fittings. Reducers shall be used at pipe size changes.
- E. Where required to prevent electrolysis and corrosion, dielectric fittings and couplings, or brass or bronze fittings or valves, shall be used between copper and steel piping. Provide insulating coupling on all underground metallic utility lines where they connect to building.

- F. Nipples shall be of same material and composition as pipe on which they are installed, and shall be extra heavy when unthreaded shoulder is less than 1-1/2". No running thread nipples will be permitted. Minimum exposed shoulder of any nipple shall not be less than 3/4".
- G. Joints between steel or copper pipe and cast iron shall be made with caulking ferrules.
- H. Cast iron soil pipe and fittings shall be assembled with approved molded push-on type gaskets. Approved no-hub pipe may be used where applicable.
- I. Galvanized steel pipe shall be assembled with galvanized screwed fittings.
- J. Black steel pipe shall be assembled with screwed or welded fittings.
- K. Copper pipe shall be assembled with wrought copper fittings. Use Alloy Sn95 (95/5) solder as a minimum. See specific piping sections for other requirements.
- L. For steel piping, use new forged tees for branch connections to main in new piping systems. Forged tees or forged weld-o-lets shall be used for branch connections to existing mains.
- M. Soldered Joints: Construct joints according to AWS's "Soldering Manual"; or CDA's "Copper Tube Handbook".
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook".
- O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Use appropriate tape or thread compound as required unless dry threading is specified.
- P. Welded Joints: Construct joints according to AWS D10.12 using qualified processes and welding operators.
- Q. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- R. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: ASTM D 2235 and ASTM D 2661.
3. CPVC Piping: ASTM D 2846 and ASTM F 493.
4. PVC Pressure Piping: ASTM D 2672.
5. PVC Nonpressure Piping: ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

### 3.03. FITTINGS AND ACCESSORIES:

- A. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
- B. Install unions adjacent to each valve at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
- C. Install flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
- D. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through walls, partitions, and ceilings where penetration is exposed to view; and on the exterior of the building.

### 3.04. SUPPORTS:

- A. Provide an adequate pipe suspension system in accordance with recognized engineering practices, using, where possible, standard, commercially accepted pipe hangers and accessories. No piping shall be supported by, or from, hangers supporting electrical conduit.

### 3.05. SLEEVES

- A. Install pipe sleeves of types indicated where piping passes through walls, floors, slabs, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as directed by the Structural Engineer.
- B. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than piping run. Where insulation includes vapor barrier jacket, provide sleeve with sufficient clearance for insulation.

- C. Install length of sleeve equal to the thickness of construction penetrated, and finished flush to surface; except extend floor sleeves 1 inch above level floor finish.
- D. Sleeves are not required for core-drilled holes.
- E. Permanent sleeves are not required for holes formed by removable plastic sleeves.
- F. Provide temporary support of sleeves during placement of concrete and other work around sleeves. Provide temporary closure to prevent concrete and other materials from entering sleeves.
- G. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings for pipe diameter including insulation (if any) of 6 inches and larger.
- H. Install iron-pipe sleeves at exterior penetrations, both above and below grade and for slab on grade penetrations.
- I. Install steel-pipe sleeves at interior partitions for pipe diameter including insulation (if any) of less than 6 inches.
- J. Seal voids between outside of sleeve and construction with nonshrink, nonmetallic grout.
- K. Sleeves Seals:
  - 1. Provide sleeve seals for core drilled holes and holes made using removable plastic sleeves.
  - 2. Provide mechanical sleeve seals for exterior wall, floor, and slab on grade applications. Install in accordance with manufacturer's recommendations for a water tight seal. Except for slab on grade and below grade wall penetrations, elastomeric joint sealants may be used in lieu of mechanical sleeve seals.
  - 3. Provide fire mechanical sleeves seals for penetrations of rated walls, slabs, floors, and ceilings. Fire protection sealants complying with all authorities having jurisdiction may be used in lieu of mechanical type seals.
  - 4. Sleeve seals are not required in non-rated interior partitions and ceilings.

### 3.06. CLEANING, FLUSHING, INSPECTION:

- A. Clean exterior surfaces of installed piping systems and prepare for application of coating and painting (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each length for completion, supports, and accessories.

3.07. TESTING:

- A. Test all piping systems as hereinafter specified and furnish to the Engineer copies of the test reports signed by the Contractor.
- B. Piping located underground shall be tested and inspected by the governing agency before backfilling.
- C. Equipment and personnel required for tests shall be furnished without additional cost. Testing equipment shall be as required for particular test, with all equipment and gauges accurate and in good working order.
- D. Equipment subject to damage at given test pressure shall be removed from line before pressure is applied. Use proper plugs or caps.
- E. Repair piping system sections which fail the required test, by disassembly and re-installation, using new materials. Do not use chemicals, stop-leak, mastics, or other temporary repair methods. Retest the system.
- F. Drain test water after testing and repair work has been completed.
- G. See specific piping system sections for test pressure, duration and medium.
- H. Comply with ANSI Standard B31.1.

END OF SECTION 23 0060



## SECTION 23 0060

### BASIC PIPING

#### PART 1 - GENERAL

##### 1.01. THERMAL EXPANSION:

- A. Swing joints, turns, expansion loops, and long offsets shall be provided where necessary to allow for expansion and contraction. Pipe, fittings, or equipment damaged during the warranty period due to thermal expansion shall be replaced at no additional cost to the Owner.

##### 1.02. NOISE CONTROL:

- A. Piping shall be free of any objectionable self-generated noise. Isolate piping from building where required to prevent transmission of noise.

##### 1.03. CROSS CONNECTIONS:

- A. No piping shall be installed that will provide a cross-connection between potable water system and a polluted supply.

##### 1.04. SUBMITTALS

- A. Product Data: Submit catalog cut sheets and specifications for each type of pipe, tube, and fitting. Submit pipe schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

##### 1.05. DELIVERY, STORAGE, AND HANDLING

- A. Except for hub and spigot, clay, and similar piping, provide factory applied end caps on all pipe and tubing to prevent damage, and dirt and moisture entry. Maintain end caps through shipping, storage, and handling.
- B. Where possible, store pipe, tube, flanges, and fittings inside and protected from the weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

##### 1.06. QUALITY ASSURANCE

- A. Qualify and certify welding and brazing procedures, equipment, and operators in accordance with ASME codes and standards for shop and job site work.
- B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

- C. Welding procedures and testing shall comply with ANSI Standard B31.1.
- D. Soldering and brazing procedures and testing shall comply with ANSI Standard B31.9. Comply with ANSI Standard B31.5 for refrigerant piping.

## PART 2 - PRODUCTS

### 2.01. MATERIALS:

- A. Refer to specific piping specification sections for materials to be used on the various piping systems.
- B. Materials shall be manufactured by firms whose products of types and sizes required for this project have been in satisfactory use in similar service for 5 years.
- C. All materials shall be new and undamaged.
- D. For corrosive environments all bare copper piping shall be provided with special Heresite coating even if located within outdoor equipment.

### 2.02. CONDENSATE, CONDENSING FURNACE, EXHAUST, AND INTAKE PIPE: Sch 40 PVC

- A. Condensate exhaust pipe should be sloped back to furnace.

### 2.03. REFRIGERANT PIPE, INCLUDING LIQUID AND HOT GAS LINES: hard drawn copper, Type "L" (degreased).

- A. Soft copper will be permitted when sleeving below grade or installing in wall to eliminate fittings. Soft copper may also be installed on units less than 1 1/2 tons.
- B. Do not run refrigerant lines thru return air plenum unless approved by engineer.
- C. Do not run refrigerant piping underground.

### 2.04. JOINING MATERIALS:

- A. Refer to specific piping specification sections for special joining materials not list below.
- B. Pipe Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8 inch maximum thickness, unless other thickness or specific material is indicated.
  - 2. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

3. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32.
1. Alloy Sn95 or Alloy Sn94: approximately 95 percent tin and 5 percent silver, with 0.1 percent lead content.
  2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.1 percent maximum lead content.
  3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.1 percent maximum lead content.
  4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.1 percent maximum lead content.
  5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.2 percent maximum lead content.
- E. Brazing Filler Metals:
1. BcuP Series: Copper-phosphorus alloys.
  2. Bag1: Silver Alloy.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements: Manufacturer's standard solvent cements for the following:
1. ABS Piping: ASTM D 2235.
  2. CPVC Piping: ASTM F 493.
  3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  4. PVC to ABS Piping Transition: ASTM D 3138.
- H. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- I. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

J. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel Paint.

K. Dielectric Fittings

1. 1. Provide dielectric connection at all connections between pipe materials of differing types whether indicated on plans or not.
2. 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. 3. Dielectric Unions: Factory fabricated, union assembly, for 250-psig minimum working pressure at 180 °F.
4. 4. Dielectric flanges: Factory fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
5. 5. Dielectric-Flange Insulation Kits: Field assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
6. 6. Dielectric couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends, and 300-psig minimum working pressure at 225°F,
7. 7. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; threaded ends, and 300-psig minimum working pressure at 225°F.

2.05. PIPE ESCUTCHEONS:

- A. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to

completely cover pipe penetration hole in floor, walls, or ceilings; and pipe sleeve extension, if any. Furnish solid pipe escutcheons with nickel or chrome finish for occupied areas. Prime paint finish for unoccupied areas. Split hinge type is not acceptable in occupied areas, except on existing piping.

- B. For waterproof floors and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons.

#### 2.06. PIPE SLEEVES:

- A. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" diameter and smaller, 20 gauge; 4" to 6" diameter, 16 gauge; over 6" diameter, 14 gauge.
- B. Steel-Pipe: Fabricate from ASTM A 53, Grade A, Schedule 40 galvanized steel pipe.
- C. Iron-Pipe: Fabricate from cast-iron or ductile iron pipe; cast-iron sleeve to be same wall thickness as equivalent ductile iron pipe.

#### 2.07. SLEEVE SEALS:

- A. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing water tight seal and electrical insulation. Thunderline, "Link Seal" or equal.
- B. Fire Protection Mechanical Sleeve Seals: Three (3) hour rated modular mechanical type, consisting of interlocking fire resistant silicone rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing water tight seal and fire resistant seal. Thunderline, "Link Seal" or equal.
- C. Fire Protection Sealant
  1. Firestop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies and provide a fire rating equal to that of construction being penetrated.
  2. All firestop materials and methods shall conform to applicable governing codes having local jurisdiction, whether approved by submittal or not.
  3. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar independently tested system designs will

be submitted to local authorities having jurisdiction for their review and approval prior to installation.

- D. Elastomeric Joint Sealant: Type S, Grade NS, Class 25, Use O, neutral-curing, silicone sealant unless otherwise indicated.
- E. Grout: Nonshrink, nonmetallic, hydraulic cement grout, ASTM C 1107, Grade B. Post hardening, volume adjusting, dry, nonstaining, noncorrosive, and nongaseous recommended for interior and exterior applications. 5000 psig, 28 day strength.

## PART 3 - EXECUTION

### 3.01. GENERAL:

- A. Install piping as described below, unless indicated otherwise in the individual piping sections. See the individual piping sections for unique piping installation requirements.
- B. Exposed lines are to be run parallel with, or perpendicular to, building lines and wherever possible shall be grouped together for easy service and identification. Lines requiring a definite grade for drainage shall have precedence in routing over all other lines. Wherever possible, horizontal and vertical lines shall be held as close as possible to walls, ceilings, struts, and structural members to occupy minimum space consistent with the proper requirements for insulation, expansion, removal of pipe, and access to valves. Except in mechanical spaces, piping shall not be run exposed in finished area of buildings unless otherwise noted.
- C. General Locations and Arrangements: Drawings including plans, schematics, and diagrams indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, and below grade or floors, unless indicated otherwise.
- G. Install piping at indicated slopes and as prescribed by Code.
- H. Install components with pressure rating equal to or greater than system operating pressure.
- I. Install piping free of sags and bends.

- J. Install piping with sufficient space above removable ceiling panels to allow for panel removal.
- K. Install drains at low points in mains, risers, and branch lines consisting of a branch fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- L. Piping shall be worked into place without springing and/or forcing. Arrange piping so that it does not interfere with removal of other equipment or devices, nor to block access to doors, windows, manholes, or other access openings.
- M. All piping shall be installed so as to avoid liquid or air pockets throughout the work. Piping shall be erected and pitched to insure proper draining. Provide air vents and drain traps where indicated and as required.
- N. All exposed plumbing fixture supplies and stops shall be chrome-plated.
- O. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. If piping must be run through electrical spaces, comply with NFPA 70 for access clearance requirements for electrical equipment. Install drip pan under piping which must be run through electrical spaces. Pan drain shall be run at exterior or sanitary, as permitted by Code.
- P. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.
- Q. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

### 3.02. ASSEMBLY:

- A. All pipes shall be cut square and shall have burr and cutting slag removed by reaming or other cleaning methods.
- B. Remove scale, slag, dirt, and debris from both inside and outside of piping and fittings before assembly.
- C. Unions or flanges shall be used at all equipment connections to facilitate dismantling.
- D. All joints and changes of direction shall be made with standard fittings. Reducers shall be used at pipe size changes.
- E. Where required to prevent electrolysis and corrosion, dielectric fittings and couplings, or brass or bronze fittings or valves, shall be used between copper and steel piping. Provide insulating coupling on all underground metallic utility lines where they connect to building.

- F. Nipples shall be of same material and composition as pipe on which they are installed, and shall be extra heavy when unthreaded shoulder is less than 1-1/2". No running thread nipples will be permitted. Minimum exposed shoulder of any nipple shall not be less than 3/4".
- G. Joints between steel or copper pipe and cast iron shall be made with caulking ferrules.
- H. Cast iron soil pipe and fittings shall be assembled with approved molded push-on type gaskets. Approved no-hub pipe may be used where applicable.
- I. Galvanized steel pipe shall be assembled with galvanized screwed fittings.
- J. Black steel pipe shall be assembled with screwed or welded fittings.
- K. Copper pipe shall be assembled with wrought copper fittings. Use Alloy Sn95 (95/5) solder as a minimum. See specific piping sections for other requirements.
- L. For steel piping, use new forged tees for branch connections to main in new piping systems. Forged tees or forged weld-o-lets shall be used for branch connections to existing mains.
- M. Soldered Joints: Construct joints according to AWS's "Soldering Manual"; or CDA's "Copper Tube Handbook".
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook".
- O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Use appropriate tape or thread compound as required unless dry threading is specified.
- P. Welded Joints: Construct joints according to AWS D10.12 using qualified processes and welding operators.
- Q. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- R. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe handling practice of cleaners, primers, and solvent cements.



2. ABS Piping: ASTM D 2235 and ASTM D 2661.
3. CPVC Piping: ASTM D 2846 and ASTM F 493.
4. PVC Pressure Piping: ASTM D 2672.
5. PVC Nonpressure Piping: ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

### 3.03. FITTINGS AND ACCESSORIES:

- A. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
- B. Install unions adjacent to each valve at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
- C. Install flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
- D. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through walls, partitions, and ceilings where penetration is exposed to view; and on the exterior of the building.

### 3.04. SUPPORTS:

- A. Provide an adequate pipe suspension system in accordance with recognized engineering practices, using, where possible, standard, commercially accepted pipe hangers and accessories. No piping shall be supported by, or from, hangers supporting electrical conduit.

### 3.05. SLEEVES

- A. Install pipe sleeves of types indicated where piping passes through walls, floors, slabs, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as directed by the Structural Engineer.
- B. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than piping run. Where insulation includes vapor barrier jacket, provide sleeve with sufficient clearance for insulation.

- C. Install length of sleeve equal to the thickness of construction penetrated, and finished flush to surface; except extend floor sleeves 1 inch above level floor finish.
- D. Sleeves are not required for core-drilled holes.
- E. Permanent sleeves are not required for holes formed by removable plastic sleeves.
- F. Provide temporary support of sleeves during placement of concrete and other work around sleeves. Provide temporary closure to prevent concrete and other materials from entering sleeves.
- G. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings for pipe diameter including insulation (if any) of 6 inches and larger.
- H. Install iron-pipe sleeves at exterior penetrations, both above and below grade and for slab on grade penetrations.
- I. Install steel-pipe sleeves at interior partitions for pipe diameter including insulation (if any) of less than 6 inches.
- J. Seal voids between outside of sleeve and construction with nonshrink, nonmetallic grout.
- K. Sleeves Seals:
  - 1. Provide sleeve seals for core drilled holes and holes made using removable plastic sleeves.
  - 2. Provide mechanical sleeve seals for exterior wall, floor, and slab on grade applications. Install in accordance with manufacturer's recommendations for a water tight seal. Except for slab on grade and below grade wall penetrations, elastomeric joint sealants may be used in lieu of mechanical sleeve seals.
  - 3. Provide fire mechanical sleeves seals for penetrations of rated walls, slabs, floors, and ceilings. Fire protection sealants complying with all authorities having jurisdiction may be used in lieu of mechanical type seals.
  - 4. Sleeve seals are not required in non-rated interior partitions and ceilings.

### 3.06. CLEANING, FLUSHING, INSPECTION:

- A. Clean exterior surfaces of installed piping systems and prepare for application of coating and painting (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each length for completion, supports, and accessories.

3.07. TESTING:

- A. Test all piping systems as hereinafter specified and furnish to the Engineer copies of the test reports signed by the Contractor.
- B. Piping located underground shall be tested and inspected by the governing agency before backfilling.
- C. Equipment and personnel required for tests shall be furnished without additional cost. Testing equipment shall be as required for particular test, with all equipment and gauges accurate and in good working order.
- D. Equipment subject to damage at given test pressure shall be removed from line before pressure is applied. Use proper plugs or caps.
- E. Repair piping system sections which fail the required test, by disassembly and re-installation, using new materials. Do not use chemicals, stop-leak, mastics, or other temporary repair methods. Retest the system.
- F. Drain test water after testing and repair work has been completed.
- G. See specific piping system sections for test pressure, duration and medium.
- H. Comply with ANSI Standard B31.1.

END OF SECTION 23 0060

## SECTION 230075

### MECHANICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following mechanical identification applications:
  - 1. Equipment identification.
  - 2. Pipe identification.
  - 3. Valve tags.
  - 4. Valve schedule.
  - 5. Duct identification.

##### 1.02 SUBMITTALS

- A. Product Data: For each type of product proposed.
- B. Product Schedule: Provide schedule indicating each type of identification material to be used for equipment, piping, and ductwork. Indicate colors to be used.
- C. Valve and Steam Trap Schedule: Submit a valve and steam trap schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Provide three (3) copies. Mark valves which are intended for emergency shut-off, normally open, normally closed, and similar special uses by special flag in the margin of the schedule. Include the following for each valve:
  - 1. Valve identification number.
  - 2. System.
  - 3. Purpose.
  - 4. Location.
  - 5. Type.
  - 6. Size.
  - 7. Manufacturer.

##### 1.03 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems", for letter size, length of color field, for colors not included in the schedule herein, and for viewing angles of identification devices for piping.

##### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting

of surfaces where devices are to be applied.

- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.01 EQUIPMENT IDENTIFICATION

- A. Engraved Plastic Laminate Identification Signs
  1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where using adhesive mounting.
  2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.
  3. Fasteners: Self tapping stainless steel screws except use contact-type, permanent adhesive where screws cannot or should not penetrate the substrate. Where sign cannot be attached directly to device or equipment, attach with brass chain.
  4. Letter sizes: Minimum 1/4 inch for names of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionally larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

### 2.02 PIPE IDENTIFICATION

- A. All above grade piping shall be identified with pipe markers with colors as indicated. Identification shall have proper legend and meet OSHA specifications. Comply with ASME A13.1, unless otherwise noted.
- B. For piping where diameter including insulation is less than 8", pipe markers shall be plastic, pre-tensioned, semi-rigid type that encircles entire pipe without the use of adhesives. Tape and sticker types are unacceptable.
- C. For piping where diameter including insulation is 8" or greater, pipe markers shall be plastic, full-band, semi-rigid type strapped to pipe using manufacturer's standard stainless steel bands.
- D. Underground line markers: Manufacturer's standard permanent, bright colored, continuous printed, plastic tape intended for direct burial service, not less than 6" wide and 4 mils thick. Provide tape with printing which most accurately indicates the type of buried pipe.
- E. Manufacturer: Pipe markers as manufactured by Seton, Brady, Brimar, or EMED are acceptable.
- F. Identification Schedule:

	<u>Piping System</u>	<u>Legend</u>	<u>Band/Text Color</u>
1.	<u>Chilled Water System</u>		
	Chilled Water Supply	Chilled Water Supply	Green/White
	Chilled Water Return	Chilled Water Return	Green/White
	Condensate Drain	Drain	Green/White
	System Make-up Water	Make-Up Water	Green/White
2.	<u>Hot Water System</u>		
	Hot Water Supply	Hot Water Supply	Green/White
	Hot Water Return	Hot Water Return	Green/White
	System Make-up Water	Make-Up Water	Green/White
3.	<u>Cooling Tower System</u>		
	Condenser Water Supply	Condenser Water Supply	Green/White
	Condenser Water Return	Condenser Water Return	Green/White
	Cooling Tower Feedwater	Make-Up Water	Green/White
	Cooling Tower Drain	Drain	Green/White
4.	<u>Steam Piping System</u>		
	Low Pressure Steam	Low Pressure Steam	Green/White
	High Pressure Steam	High Pressure Steam	Green/White
	Condensate Return	Condensate Return	Green /White
	Pumped Condensate	Cond. Pump Discharge	Green /White
5.	Arrows and lettering shall be black. Arrows shall point in the direction of flow. Locate downstream of pipe legend.		
6.	Arrows shall be of same color as bands and shall point in direction of flow. Locate downstream of pipe legend.		
7.	Valve Identification: Provide brass tags for all valves and steam traps with legend describing function of each valve and trap. Tag shall also indicate normally open or normally closed, where position is noted on the drawings.		
G.	Valve Tags: Brass tags shall be a minimum of 2" diameter or 3-1/2" oval, to accommodate 1" high numbers. Tag shall be equipped with a 3/16" X 6" long brass chain.		

## 2.03 DUCT IDENTIFICATION

### A. Engraved Plastic Laminate Identification Signs

1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, colored black background with white letters except as otherwise indicated.
2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.
3. Fasteners: Contact-type, permanent adhesive.
4. Letter sizes: Minimum 1/4 inch for names of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionally larger

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

- B. Stencils: As specified and indicated herein.

#### 2.04 STENCILS:

- A. Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4" for ducts; and minimum letter height of 3/4" for equipment and access door signs.
- B. Use alkyd paint.
- C. Use stencils only as directed herein.

### PART 3 - EXECUTION

#### 3.01 EQUIPMENT IDENTIFICATION

- A. Provide permanent, factory, operational data, nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Where manufacturer's nameplate is not stamped or engraved, provide additional heavy gauge, aluminum or brass, stamped or engraved nameplate. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.
- B. In addition to factory nameplate, provide an engraved plastic laminate (stenciled) identification sign for each major item of mechanical equipment and each operational device. Provide identification signs for the following general categories of equipment.
  1. Main control and operating valves, including safety devices and hazardous units such as gas outlets or steam relief valves.
  2. Chillers, cooling towers, condensing units, compressors, pumps, and similar motor-driven units.
  3. Heat exchangers, coils, and similar equipment.
  4. Fans and blowers.
  5. Packaged and central-station type air units.
  6. Tanks and pressure vessels.
  7. Strainers, filters, humidifiers, water treatment systems, and similar equipment.
  8. Control panels.
  9. Fuel burning units, such as boilers, furnaces, and heaters.
  10. Fire department hose valves and hose stations.
- C. Provide engraved sign at each access door, indicating equipment or device to be

accessed.

- D. Coordinate names, abbreviations, and other designations used in equipment identification with corresponding designations shown, specified, scheduled, or as designated by the Owner's representative. Provide numbers, lettering, and wording as indicated or as directed by the Owner's representative. Owner shall set priority for lettering and graphics. Where multiple systems of the same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, AHU-1H, Standpipe G14).

### 3.02 PIPE IDENTIFICATION

- A. Provide 1" thick molded fiberglass insulation with jacket under each plastic pipe marker to be installed on uninsulated pipes where fluid temperatures will be 125°F or greater. Insulation shall extend 4" beyond edges of marker.
- B. Valve tags and steam traps shall be numbered as indicated on the valve listing provided to the Owner.
- C. As a minimum, identification shall be applied to piping at the following locations:
  - 1. Adjacent to each valve.
  - 2. At each branch and riser take-off.
  - 3. At each pipe passage through wall, floor, and ceiling construction.
  - 4. At each pipe passage to underground.
  - 5. At not more than forty feet spacing on straight pipe runs.
- D. Place identification so it can be easily read. Arrows shall be applied to indicate direction of flow.
- E. Underground Piping: During back-filling of each exterior underground piping system, install plastic line marker, located directly over buried line no deeper than 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install a single line marker.

### 3.03 DUCTWORK IDENTIFICATION

- A. Identify ductwork with plastic identification signs. Letter color shall be white. Sign background color shall be according to the following color codes. Indicate direction flow and duct service (such as supply, return, and exhaust).
  - 1. Green: Supply air ductwork.
  - 2. Yellow: Return air ductwork.
  - 3. Blue: Exhaust, outside air, mixed air, and relief air.
- B. Apply ductwork identification at the following locations:
  - 1. Adjacent to each damper.



2. At each passage through walls, floors, or ceiling construction.
3. At no more than forty feet intervals.
4. At air handling units, fans, and air terminal boxes

END OF SECTION

## SECTION 23 0086

### PIPING INSULATION

#### PART 1 - GENERAL

##### 1.01. SUMMARY

- A. Perform all Work required to provide and install piping insulation, jackets, and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Insulation of Underground Piping is specified elsewhere and not work of this Section.

##### 1.02. REFERENCE STANDARDS

- C. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- D. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- E. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - 2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.
  - 3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.
  - 4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.
  - 5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
  - 6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - 7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - 9. ASTM C547 - Mineral Fiber Pipe Insulation.
  - 10. ASTM C552 - Cellular Glass Thermal Insulation.

11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C450 - Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
15. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.
16. ASTM C921 - Jackets for Thermal Insulation.
17. ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
18. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
19. ASTM D1667 - Flexible Cellular Materials – Poly (Vinyl Chloride) Foam (Closed-Cell).
20. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
21. ASTM C795 - Insulation For Use Over Austenitic Steel.
22. ASTM E84 - Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Water Vapor Transmission of Materials.
24. NFPA 255 - Surface Burning Characteristics of Building Materials.
25. UL 723 - Surface Burning Characteristics of Building Materials.
26. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

### 1.03. DEFINITIONS

- F. Concealed: Areas that cannot be seen by the building occupants.
- G. Interior Exposed: Areas that are exposed to view by the building occupants, including underneath countertops, inside cabinets and closets, and all equipment rooms.
- H. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.
- I. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.

- J. Unconditioned Space: Interior space that is not temperature-controlled by cooling and/or heating system. Includes attics, chases, unconditioned living spaces and non-conditioned equipment rooms.

#### 1.04. QUALITY ASSURANCE

- K. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.
- L. All insulation, jacket, adhesives, mastics, sealers, and accessories utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.
  - 1. Certificates to this effect shall be submitted along with submittal data.
  - 2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- M. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years experience specializing in the trade.
- N. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.
- O. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, damaged or water-soaked Work will not be acceptable.
- P. Stainless Steel: Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36. These requirements are for prevention of external stress Corrosion Cracking (ESCC) for austenitic stainless steel.

#### 1.05. SUBMITTALS

- Q. Prepare a schedule of piping insulation showing systems insulated. For each system, show insulation type, thickness, temperature rating, and special conditions where applicable.
- R. Submit product data for each piping system. Product data shall include but not be limited to the following:
  - 1. Manufacturer's name
  - 2. Insulation material and thickness

3. Jacket
  4. Adhesives
  5. Fastening methods
  6. Fitting materials
  7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
  8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)
  9. Other appropriate data
- S. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.
- T. Operation and Maintenance Data: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

#### 1.06. DELIVERY, STORAGE AND HANDLING

- U. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.
- V. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.
- W. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

### PART 2 - PRODUCTS

#### 2.01. GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

#### 2.02. MANUFACTURERS

- B. Insulation:
1. Owens-Corning
  2. Certaineed Corporation

3. Johns Manville Corporation
4. Knauf Corporation
5. Armstrong/Armacell (Armaflex)
6. RBX Industries/Rubatex
7. FOAMGLAS (Cellular Glass) by Pittsburgh Corning

C. Jackets:

1. Childers Products Company
2. PABCO
3. RPR Products, Inc.
4. John Mansfield Speedline
5. Foamglas

D. Coatings, Sealants, and Adhesives:

1. Foster
2. Childers

### 2.03. INSULATION MATERIALS

- E. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- F. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- G. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- H. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- I. Piping Insulation Type P1: Glass-Fiber, Preformed Pipe Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A with factory applied ASJ-SSL vapor barrier jacket with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Provide one of the following:
  1. Owens Corning; Evolution Fiberglas Pipe Insulation.

2. Johns Manville; Micro-Lok Pipe Insulation.
  3. Knauf; Earthwool 1000 degree Pipe Insulation.
- J. Piping Insulation Type P2: Flexible Elastomeric Pipe Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Provide one of the following:
1. Armacell LLC; AP Armaflex
  2. Aeroflex USA Inc; Aerocel
  3. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- K. Piping Insulation Type P3: Handicap Lavatory and Sink Piping Insulation Kit:
1. Handicap lavatory and sink drain piping, P-trap, cold and hot water assemblies and valves shall be insulated with fully molded insulation kit specifically designed for handicap lavatories and sinks. ADA conforming.
  2. Material shall be 3/16" thick molded closed cell vinyl with nylon fasteners, white finish and be self-extinguishing per ASTM D635, with K value of 1.17 BTU/in./hr./sq. ft./deg. F.
- L. Piping Insulation Type P4: Preformed Cellular Glass: Comply with ASTM C 585, ASTM C 450. Provide one of the following:
1. Pittsburgh Corning; Foamglas

#### 2.04. FIELD-APPLIED FABRIC-REINFORCING MESH

- M. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe. Provide one of the following:
1. Foster Brand, Specialty Construction Brands, Inc; Mast-A-Fab.
  2. Vimasco Corporation; Elastafab 894.

#### 2.05. FIELD-APPLIED JACKETS

- N. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- O. Piping Jacket Type J1: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 40 mil thickness, roll stock ready for shop or field cutting and forming. Provide factory-fabricated fitting covers to match jacket. Provide one of the following
1. Johns Manville; Zeston.

2. Proto Corporation; LoSmoke
- P. Piping Jacket Type J2: Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14. Provide factory-fabricated fitting covers or field fabricate covers only if factory-fabricated fitting covers are not available. Provide one of the following:
1. Provide Childers Brand Metal Jacketing Systems.
  2. Provide shop fabricated smooth aluminum jacket 0.016".

#### 2.06. TAPES

- Q. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- R. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.

#### 2.07. INSULATION INSERTS

- S. Provide insert between support shield and piping on piping 1 1/2" diameter or larger. Inserts shall be factory fabricated of heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:
1. 1 1/2" to 2 1/2" pipe size 10" long



2. 3" to 6" pipe size 12" long
3. 8" to 10" pipe size 16" long
4. 12" and over 22" long

## 2.08. PIPE INSULATION ACCESSORIES

- T. Vapor Retarder Lap Adhesive: Compatible with insulation.
- U. Covering Adhesive Mastic: Compatible with insulation.
- V. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12-inch centers.
- W. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- X. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- Y. Adhesives: Compatible with insulation.
- Z. Banding:
  1. Aluminum bands, 3/4" x 0.02 inches
  2. Stainless Steel, 304, 3/4" by 0.02 inches

## PART 3 - EXECUTION

### 3.01. PREPARATION

- A. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application. Insulating piping where condensate is occurring is unacceptable. Wet insulation is unacceptable and shall be removed and replaced before acceptance by the Owner.
- B. Coordinate insulation installation with trade installing heat trace. Comply with requirements for heat tracing that apply to insulation.
- C. Verify that piping has been tested for leakage before applying insulation.

### 3.02. GENERAL INSTALLATION REQUIREMENTS

- D. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards, and shall conform to codes and ordinances of authorities having jurisdiction.

- E. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.
- F. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.
- G. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.
- H. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.
- I. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- J. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- K. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- L. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- M. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- N. Keep insulation materials dry during application and finishing.
- O. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- P. Install insulation with least number of joints practical.
- Q. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- R. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- S. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- T. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- U. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- V. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches similar to butt joints.
- W. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.

5. Handholes.
6. Cleanouts.

### 3.03. PENETRATIONS

- X. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- Y. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- Z. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- AA. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- BB. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Section 15050 for firestopping and fire-resistive joint sealers.
- CC. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 15050."

### 3.04. GENERAL PIPE INSULATION INSTALLATION

DD. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

EE. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket where concealed unions, check valve or piping specialties are insulated. Provide descriptive label at device under the insulation. For example at each union stencil with the word "union." Match size and color of pipe labels.
- FF. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- GG. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.05. INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

HH. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

II. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

JJ. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

KK. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.06. INSTALLATION OF GLASS-FIBER PREFORMED PIPE INSULATION

LL. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below-ambient surfaces, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

MM. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

NN. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with bands.

OO. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.



### 3.07. FIELD-APPLIED JACKET INSTALLATION

- PP. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- QQ. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.08. FINISHES

- RR. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- SS. Do not field paint aluminum jackets.

### 3.09. PIPING SYSTEMS INSULATION SCHEDULE

PIPING SYSTEMS INSULATION SCHEDULE						
Service	Insulation Type	Location	Jacket Type	Pipe Size	Insulation Thickness by Pipe Size	
<b>COLD PIPING</b>						
Chilled Water	P1	Interior Concealed	--	3.0" and smaller	1.0"	
				4.0" and larger	1.5"	
Cooling Tower Condenser Water	P1	Interior Exposed	J1	3.0" and smaller	1.0"	
				Exposed	4.0" and larger	1.5"
		Unconditioned	Space	--	3.0" and smaller	1.0"
					4.0" and larger	1.5"
Unconditioned	Space	--	3.0" and smaller	1.5"		

		Space		4.0" and larger	2.0"
		Exterior	J2	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Equipment Rooms	J1	3.0" and smaller	1.5"
		below 7.0" above floor		4.0" and larger	2.0"
Make-Up Water				2.5" and larger	1.5"
		Interior	J1	0.5" and smaller	0.5"
		Exposed		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Unconditioned	--	0.5" and smaller	0.5"
		Space		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Unconditioned	--	0.5" and smaller	0.5"
		Space		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Exterior	J2	0.5" and smaller	1.0"
				1.0" through 2.0"	1.5"
				2.5" and larger	2.0"
		Equipment Rooms	J1	0.5" and smaller	0.5"

		below 7.0" above floor		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
Refrigerant Suction	P2	Interior Concealed	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Interior Exposed	J1	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Unconditioned	--	3.0" and smaller	0.75"
		Space		4.0" and larger	1.0"
		Exterior	J2	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Equipment Rooms	J1	3.0" and smaller	0.75"
		below 7.0" above floor		4.0" and larger	1.0"
Cooling Coil Condensate	P2	Interior Concealed	--	3.0" and smaller	0.5"
Branch Lines				4.0" and larger	0.75"
Cooling Coil Condensate		Interior Exposed	J1	3.0" and smaller	0.5"
Drain Main Lines				4.0" and larger	0.75"
Sewer/Storm Drain Lines		Unconditioned	--	3.0" and smaller	0.5"
Carrying Cooling Coil		Space		4.0" and larger	0.75"
Condensate					
		Exterior	J2	3.0" and smaller	0.5"

HOT PIPING					
Heating Water	P1	Interior Concealed	--	3.0" and smaller	1.0"
				4.0" and larger	1.5"
Make-up Water					
		Interior Exposed	J1	3.0" and smaller	
				4.0" and larger	
		Unconditioned	--	3.0" and smaller	1.5"
		Space		4.0" and larger	2.0"
		Exterior	J2	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Equipment Rooms	J1	3.0" and smaller	
		below 7.0" above floor		4.0" and larger	
Refrigerant Hot Gas	P2	Interior Concealed	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Interior Exposed		3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Unconditioned	--	3.0" and smaller	0.75"
		Space		4.0" and larger	1.0"
		Exterior	J2	3.0" and smaller	0.75"
				4.0" and larger	1.0"

		Equipment Rooms		3.0" and smaller	0.75"
		below 7.0" above floor		4.0" and larger	1.0"

END OF SECTION 23 0086

## SECTION 230075

### MECHANICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following mechanical identification applications:
  - 1. Equipment identification.
  - 2. Pipe identification.
  - 3. Valve tags.
  - 4. Valve schedule.
  - 5. Duct identification.

##### 1.02 SUBMITTALS

- A. Product Data: For each type of product proposed.
- B. Product Schedule: Provide schedule indicating each type of identification material to be used for equipment, piping, and ductwork. Indicate colors to be used.
- C. Valve and Steam Trap Schedule: Submit a valve and steam trap schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Provide three (3) copies. Mark valves which are intended for emergency shut-off, normally open, normally closed, and similar special uses by special flag in the margin of the schedule. Include the following for each valve:
  - 1. Valve identification number.
  - 2. System.
  - 3. Purpose.
  - 4. Location.
  - 5. Type.
  - 6. Size.
  - 7. Manufacturer.

##### 1.03 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems", for letter size, length of color field, for colors not included in the schedule herein, and for viewing angles of identification devices for piping.

##### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting

of surfaces where devices are to be applied.

- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.01 EQUIPMENT IDENTIFICATION

- A. Engraved Plastic Laminate Identification Signs
  1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where using adhesive mounting.
  2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.
  3. Fasteners: Self tapping stainless steel screws except use contact-type, permanent adhesive where screws cannot or should not penetrate the substrate. Where sign cannot be attached directly to device or equipment, attach with brass chain.
  4. Letter sizes: Minimum 1/4 inch for names of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionally larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

### 2.02 PIPE IDENTIFICATION

- A. All above grade piping shall be identified with pipe markers with colors as indicated. Identification shall have proper legend and meet OSHA specifications. Comply with ASME A13.1, unless otherwise noted.
- B. For piping where diameter including insulation is less than 8", pipe markers shall be plastic, pre-tensioned, semi-rigid type that encircles entire pipe without the use of adhesives. Tape and sticker types are unacceptable.
- C. For piping where diameter including insulation is 8" or greater, pipe markers shall be plastic, full-band, semi-rigid type strapped to pipe using manufacturer's standard stainless steel bands.
- D. Underground line markers: Manufacturer's standard permanent, bright colored, continuous printed, plastic tape intended for direct burial service, not less than 6" wide and 4 mils thick. Provide tape with printing which most accurately indicates the type of buried pipe.
- E. Manufacturer: Pipe markers as manufactured by Seton, Brady, Brimar, or EMED are acceptable.
- F. Identification Schedule:

	<u>Piping System</u>	<u>Legend</u>	<u>Band/Text Color</u>
1.	<u>Chilled Water System</u>		
	Chilled Water Supply	Chilled Water Supply	Green/White
	Chilled Water Return	Chilled Water Return	Green/White
	Condensate Drain	Drain	Green/White
	System Make-up Water	Make-Up Water	Green/White
2.	<u>Hot Water System</u>		
	Hot Water Supply	Hot Water Supply	Green/White
	Hot Water Return	Hot Water Return	Green/White
	System Make-up Water	Make-Up Water	Green/White
3.	<u>Cooling Tower System</u>		
	Condenser Water Supply	Condenser Water Supply	Green/White
	Condenser Water Return	Condenser Water Return	Green/White
	Cooling Tower Feedwater	Make-Up Water	Green/White
	Cooling Tower Drain	Drain	Green/White
4.	<u>Steam Piping System</u>		
	Low Pressure Steam	Low Pressure Steam	Green/White
	High Pressure Steam	High Pressure Steam	Green/White
	Condensate Return	Condensate Return	Green /White
	Pumped Condensate	Cond. Pump Discharge	Green /White
5.	Arrows and lettering shall be black. Arrows shall point in the direction of flow. Locate downstream of pipe legend.		
6.	Arrows shall be of same color as bands and shall point in direction of flow. Locate downstream of pipe legend.		
7.	Valve Identification: Provide brass tags for all valves and steam traps with legend describing function of each valve and trap. Tag shall also indicate normally open or normally closed, where position is noted on the drawings.		
G.	Valve Tags: Brass tags shall be a minimum of 2" diameter or 3-1/2" oval, to accommodate 1" high numbers. Tag shall be equipped with a 3/16" X 6" long brass chain.		

## 2.03 DUCT IDENTIFICATION

### A. Engraved Plastic Laminate Identification Signs

1. General: Provide engraving stock melamine plastic laminate in the sizes and thicknesses indicated, with engraver's standard letter style, colored black background with white letters except as otherwise indicated.
2. Thickness: 1/16" for units up to 20 inches square or 8" length; 1/8" for larger units.
3. Fasteners: Contact-type, permanent adhesive.
4. Letter sizes: Minimum 1/4 inch for names of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionally larger



lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of the principal lettering.

- B. Stencils: As specified and indicated herein.

#### 2.04 STENCILS:

- A. Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4" for ducts; and minimum letter height of 3/4" for equipment and access door signs.
- B. Use alkyd paint.
- C. Use stencils only as directed herein.

### PART 3 - EXECUTION

#### 3.01 EQUIPMENT IDENTIFICATION

- A. Provide permanent, factory, operational data, nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Where manufacturer's nameplate is not stamped or engraved, provide additional heavy gauge, aluminum or brass, stamped or engraved nameplate. Do not remove manufacturer's nameplates. When manufacturer's nameplates are to be covered by insulation or other material, provide a separate nameplate for mounting on the exterior of the covering.
- B. In addition to factory nameplate, provide an engraved plastic laminate (stenciled) identification sign for each major item of mechanical equipment and each operational device. Provide identification signs for the following general categories of equipment.
  1. Main control and operating valves, including safety devices and hazardous units such as gas outlets or steam relief valves.
  2. Chillers, cooling towers, condensing units, compressors, pumps, and similar motor-driven units.
  3. Heat exchangers, coils, and similar equipment.
  4. Fans and blowers.
  5. Packaged and central-station type air units.
  6. Tanks and pressure vessels.
  7. Strainers, filters, humidifiers, water treatment systems, and similar equipment.
  8. Control panels.
  9. Fuel burning units, such as boilers, furnaces, and heaters.
  10. Fire department hose valves and hose stations.
- C. Provide engraved sign at each access door, indicating equipment or device to be

accessed.

- D. Coordinate names, abbreviations, and other designations used in equipment identification with corresponding designations shown, specified, scheduled, or as designated by the Owner's representative. Provide numbers, lettering, and wording as indicated or as directed by the Owner's representative. Owner shall set priority for lettering and graphics. Where multiple systems of the same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, AHU-1H, Standpipe G14).

### 3.02 PIPE IDENTIFICATION

- A. Provide 1" thick molded fiberglass insulation with jacket under each plastic pipe marker to be installed on uninsulated pipes where fluid temperatures will be 125°F or greater. Insulation shall extend 4" beyond edges of marker.
- B. Valve tags and steam traps shall be numbered as indicated on the valve listing provided to the Owner.
- C. As a minimum, identification shall be applied to piping at the following locations:
  - 1. Adjacent to each valve.
  - 2. At each branch and riser take-off.
  - 3. At each pipe passage through wall, floor, and ceiling construction.
  - 4. At each pipe passage to underground.
  - 5. At not more than forty feet spacing on straight pipe runs.
- D. Place identification so it can be easily read. Arrows shall be applied to indicate direction of flow.
- E. Underground Piping: During back-filling of each exterior underground piping system, install plastic line marker, located directly over buried line no deeper than 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install a single line marker.

### 3.03 DUCTWORK IDENTIFICATION

- A. Identify ductwork with plastic identification signs. Letter color shall be white. Sign background color shall be according to the following color codes. Indicate direction flow and duct service (such as supply, return, and exhaust).
  - 1. Green: Supply air ductwork.
  - 2. Yellow: Return air ductwork.
  - 3. Blue: Exhaust, outside air, mixed air, and relief air.
- B. Apply ductwork identification at the following locations:
  - 1. Adjacent to each damper.

2. At each passage through walls, floors, or ceiling construction.
3. At no more than forty feet intervals.
4. At air handling units, fans, and air terminal boxes

END OF SECTION

## SECTION 23 0086

### PIPING INSULATION

#### PART 1 - GENERAL

##### 1.01. SUMMARY

- A. Perform all Work required to provide and install piping insulation, jackets, and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Insulation of Underground Piping is specified elsewhere and not work of this Section.

##### 1.02. REFERENCE STANDARDS

- C. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- D. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- E. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - 2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.
  - 3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.
  - 4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.
  - 5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
  - 6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - 7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
  - 9. ASTM C547 - Mineral Fiber Pipe Insulation.
  - 10. ASTM C552 - Cellular Glass Thermal Insulation.

11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C450 - Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
15. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.
16. ASTM C921 - Jackets for Thermal Insulation.
17. ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
18. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
19. ASTM D1667 - Flexible Cellular Materials – Poly (Vinyl Chloride) Foam (Closed-Cell).
20. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
21. ASTM C795 - Insulation For Use Over Austenitic Steel.
22. ASTM E84 - Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Water Vapor Transmission of Materials.
24. NFPA 255 - Surface Burning Characteristics of Building Materials.
25. UL 723 - Surface Burning Characteristics of Building Materials.
26. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

### 1.03. DEFINITIONS

- F. Concealed: Areas that cannot be seen by the building occupants.
- G. Interior Exposed: Areas that are exposed to view by the building occupants, including underneath countertops, inside cabinets and closets, and all equipment rooms.
- H. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.
- I. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.

- J. Unconditioned Space: Interior space that is not temperature-controlled by cooling and/or heating system. Includes attics, chases, unconditioned living spaces and non-conditioned equipment rooms.

#### 1.04. QUALITY ASSURANCE

- K. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.
- L. All insulation, jacket, adhesives, mastics, sealers, and accessories utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.
  - 1. Certificates to this effect shall be submitted along with submittal data.
  - 2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- M. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years experience specializing in the trade.
- N. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.
- O. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, damaged or water-soaked Work will not be acceptable.
- P. Stainless Steel: Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36. These requirements are for prevention of external stress Corrosion Cracking (ESCC) for austenitic stainless steel.

#### 1.05. SUBMITTALS

- Q. Prepare a schedule of piping insulation showing systems insulated. For each system, show insulation type, thickness, temperature rating, and special conditions where applicable.
- R. Submit product data for each piping system. Product data shall include but not be limited to the following:
  - 1. Manufacturer's name
  - 2. Insulation material and thickness

3. Jacket
  4. Adhesives
  5. Fastening methods
  6. Fitting materials
  7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
  8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)
  9. Other appropriate data
- S. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type.
- T. Operation and Maintenance Data: Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

#### 1.06. DELIVERY, STORAGE AND HANDLING

- U. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.
- V. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.
- W. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

### PART 2 - PRODUCTS

#### 2.01. GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

#### 2.02. MANUFACTURERS

- B. Insulation:
1. Owens-Corning
  2. Certaineed Corporation

3. Johns Manville Corporation
4. Knauf Corporation
5. Armstrong/Armacell (Armaflex)
6. RBX Industries/Rubatex
7. FOAMGLAS (Cellular Glass) by Pittsburgh Corning

C. Jackets:

1. Childers Products Company
2. PABCO
3. RPR Products, Inc.
4. John Mansfield Speedline
5. Foamglas

D. Coatings, Sealants, and Adhesives:

1. Foster
2. Childers

### 2.03. INSULATION MATERIALS

- E. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- F. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- G. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- H. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- I. Piping Insulation Type P1: Glass-Fiber, Preformed Pipe Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A with factory applied ASJ-SSL vapor barrier jacket with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Provide one of the following:
  1. Owens Corning; Evolution Fiberglas Pipe Insulation.



2. Johns Manville; Micro-Lok Pipe Insulation.
  3. Knauf; Earthwool 1000 degree Pipe Insulation.
- J. Piping Insulation Type P2: Flexible Elastomeric Pipe Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Provide one of the following:
1. Armacell LLC; AP Armaflex
  2. Aeroflex USA Inc; Aerocel
  3. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- K. Piping Insulation Type P3: Handicap Lavatory and Sink Piping Insulation Kit:
1. Handicap lavatory and sink drain piping, P-trap, cold and hot water assemblies and valves shall be insulated with fully molded insulation kit specifically designed for handicap lavatories and sinks. ADA conforming.
  2. Material shall be 3/16" thick molded closed cell vinyl with nylon fasteners, white finish and be self-extinguishing per ASTM D635, with K value of 1.17 BTU/in./hr./sq. ft./deg. F.
- L. Piping Insulation Type P4: Preformed Cellular Glass: Comply with ASTM C 585, ASTM C 450. Provide one of the following:
1. Pittsburgh Corning; Foamglas

#### 2.04. FIELD-APPLIED FABRIC-REINFORCING MESH

- M. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe. Provide one of the following:
1. Foster Brand, Specialty Construction Brands, Inc; Mast-A-Fab.
  2. Vimasco Corporation; Elastafab 894.

#### 2.05. FIELD-APPLIED JACKETS

- N. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- O. Piping Jacket Type J1: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 40 mil thickness, roll stock ready for shop or field cutting and forming. Provide factory-fabricated fitting covers to match jacket. Provide one of the following
1. Johns Manville; Zeston.

2. Proto Corporation; LoSmoke
- P. Piping Jacket Type J2: Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14. Provide factory-fabricated fitting covers or field fabricate covers only if factory-fabricated fitting covers are not available. Provide one of the following:
1. Provide Childers Brand Metal Jacketing Systems.
  2. Provide shop fabricated smooth aluminum jacket 0.016".

#### 2.06. TAPES

- Q. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- R. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.

#### 2.07. INSULATION INSERTS

- S. Provide insert between support shield and piping on piping 1 1/2" diameter or larger. Inserts shall be factory fabricated of heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:
1. 1 1/2" to 2 1/2" pipe size 10" long

2. 3" to 6" pipe size 12" long
3. 8" to 10" pipe size 16" long
4. 12" and over 22" long

## 2.08. PIPE INSULATION ACCESSORIES

- T. Vapor Retarder Lap Adhesive: Compatible with insulation.
- U. Covering Adhesive Mastic: Compatible with insulation.
- V. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12-inch centers.
- W. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- X. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- Y. Adhesives: Compatible with insulation.
- Z. Banding:
  1. Aluminum bands, 3/4" x 0.02 inches
  2. Stainless Steel, 304, 3/4" by 0.02 inches

## PART 3 - EXECUTION

### 3.01. PREPARATION

- A. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application. Insulating piping where condensate is occurring is unacceptable. Wet insulation is unacceptable and shall be removed and replaced before acceptance by the Owner.
- B. Coordinate insulation installation with trade installing heat trace. Comply with requirements for heat tracing that apply to insulation.
- C. Verify that piping has been tested for leakage before applying insulation.

### 3.02. GENERAL INSTALLATION REQUIREMENTS

- D. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards, and shall conform to codes and ordinances of authorities having jurisdiction.

- E. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.
- F. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.
- G. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.
- H. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.
- I. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- J. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- K. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- L. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- M. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- N. Keep insulation materials dry during application and finishing.
- O. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- P. Install insulation with least number of joints practical.
- Q. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- R. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- S. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- T. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- U. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- V. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere and seal patches similar to butt joints.
- W. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.

5. Handholes.
6. Cleanouts.

### 3.03. PENETRATIONS

- X. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- Y. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- Z. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- AA. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- BB. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Comply with requirements in Section 15050 for firestopping and fire-resistive joint sealers.
- CC. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 15050."

### 3.04. GENERAL PIPE INSULATION INSTALLATION

DD. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

EE. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket where concealed unions, check valve or piping specialties are insulated. Provide descriptive label at device under the insulation. For example at each union stencil with the word "union." Match size and color of pipe labels.
- FF. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- GG. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.



### 3.05. INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

HH. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

II. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

JJ. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

KK. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.06. INSTALLATION OF GLASS-FIBER PREFORMED PIPE INSULATION

LL. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below-ambient surfaces, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

MM. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

NN. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with bands.

OO. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.07. FIELD-APPLIED JACKET INSTALLATION

- PP. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- QQ. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.08. FINISHES

- RR. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- SS. Do not field paint aluminum jackets.

### 3.09. PIPING SYSTEMS INSULATION SCHEDULE

PIPING SYSTEMS INSULATION SCHEDULE							
Service	Insulation Type	Location	Jacket Type	Pipe Size	Insulation Thickness by Pipe Size		
<b>COLD PIPING</b>							
Chilled Water	P1	Interior Concealed	--	3.0" and smaller	1.0"		
				4.0" and larger	1.5"		
Cooling Tower Condenser Water	P1	Interior Exposed	J1	3.0" and smaller	1.0"		
				Exposed		4.0" and larger	1.5"
		Space	Unconditioned	--	3.0" and smaller	1.0"	
					4.0" and larger	1.5"	
				Unconditioned	--	3.0" and smaller	1.5"

		Space		4.0" and larger	2.0"
		Exterior	J2	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Equipment Rooms	J1	3.0" and smaller	1.5"
		below 7.0" above floor		4.0" and larger	2.0"
Make-Up Water				2.5" and larger	1.5"
		Interior	J1	0.5" and smaller	0.5"
		Exposed		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Unconditioned	--	0.5" and smaller	0.5"
		Space		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Unconditioned	--	0.5" and smaller	0.5"
		Space		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
		Exterior	J2	0.5" and smaller	1.0"
				1.0" through 2.0"	1.5"
				2.5" and larger	2.0"
		Equipment Rooms	J1	0.5" and smaller	0.5"

		below 7.0" above floor		1.0" through 2.0"	1.0"
				2.5" and larger	1.5"
Refrigerant Suction	P2	Interior Concealed	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Interior Exposed	J1	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Unconditioned	--	3.0" and smaller	0.75"
		Space		4.0" and larger	1.0"
		Exterior	J2	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Equipment Rooms	J1	3.0" and smaller	0.75"
		below 7.0" above floor		4.0" and larger	1.0"
Cooling Coil Condensate	P2	Interior Concealed	--	3.0" and smaller	0.5"
Branch Lines				4.0" and larger	0.75"
Cooling Coil Condensate		Interior Exposed	J1	3.0" and smaller	0.5"
Drain Main Lines				4.0" and larger	0.75"
Sewer/Storm Drain Lines		Unconditioned	--	3.0" and smaller	0.5"
Carrying Cooling Coil		Space		4.0" and larger	0.75"
Condensate					
		Exterior	J2	3.0" and smaller	0.5"

HOT PIPING					
Heating Water	P1	Interior Concealed	--	3.0" and smaller	1.0"
				4.0" and larger	1.5"
Make-up Water					
		Interior Exposed	J1	3.0" and smaller	
				4.0" and larger	
		Unconditioned	--	3.0" and smaller	1.5"
		Space		4.0" and larger	2.0"
		Exterior	J2	3.0" and smaller	1.5"
				4.0" and larger	2.0"
		Equipment Rooms	J1	3.0" and smaller	
		below 7.0" above floor		4.0" and larger	
Refrigerant Hot Gas	P2	Interior Concealed	--	3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Interior Exposed		3.0" and smaller	0.75"
				4.0" and larger	1.0"
		Unconditioned	--	3.0" and smaller	0.75"
		Space		4.0" and larger	1.0"
		Exterior	J2	3.0" and smaller	0.75"
				4.0" and larger	1.0"

		Equipment Rooms		3.0" and smaller	0.75"
		below 7.0" above floor		4.0" and larger	1.0"

END OF SECTION 23 0086

## SECTION 23 0090 - SUPPORTS, HANGERS AND ANCHORS

### PART 1 GENERAL

#### 1.01. WORK INCLUDED

- A. Inserts, Anchors, and Upper Attachments
- B. Pipe Hangers, Rods, Supports, and Accessories
- C. Fabricated Steel Support

#### 1.02. QUALITY ASSURANCE

- A. Design of pipe supporting elements shall be in accordance with ANSI B31.1
- B. Fabrication and installation of pipe hangers and supports shall be in accordance with the following Manufacturers Standardization Society (MSS) Standards:
  - 1. SP-58 Pipe Hangers and Supports: Materials, Design and Manufacture.
  - 2. SP-69 Pipe Hangers and Supports: Selection and Application.
  - 3. SP-89 Pipe Hangers and Supports: Fabrication and Installation Practices.
- C. Steel angles, channels and plate shall be in accordance with ASTM A36, red primed or hot dipped galvanized for interior applications and hot galvanized for exterior applications.
- D. Bolts, including nuts and washers, used for fabricating steel members shall be in accordance with ASTM A325 and shall be stainless steel or plated for corrosion protection. Plain steel components are unacceptable.
- E. Welding of steel members shall be in accordance with AWS D1.1.
- F. Steel supports for ducts, pipe anchors, pipe guides, and piping supported from below shall be fabricated in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for buildings. If required, the Contractor shall include the cost of the services of a structural engineer to design or review the system.

#### 1.03. APPLICABLE PUBLICATIONS

- A. Applicable sections of the publications listed below form a part of this Section. The publications are referenced by the basic designation only.
  - 1. American Institute of Steel Construction (AISC)
  - 2. American National Standards Institute (ANSI)
  - 3. American Society for Testing and Materials (ASTM)
  - 4. American Welding Society (AWS)
  - 5. The Manufacturer's Standardization Society of the Valve and Fittings Industry



(MSS)

6. National Fire Protection Agency (NFPA)

7. Sheet Metal and Air Conditioning Contractor's National Association, Inc.  
(SMACNA)

1.04. SUBMITTALS

- A. Submit schedule indicating type of hanger to be used by system and pipe size. Include rod size for each hanger size.
- B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.
- C. Provide shop drawings for fabricated steel supports.

PART 2 PRODUCTS

2.01. ACCEPTABLE MANUFACTURERS

- A. Inserts, Anchors, and Upper Attachments:
  - 1. Anvil International, Inc.
  - 2. Carpenter Paterson, Inc.
  - 3. Cooper B-Line, Inc.
  - 4. Elecen Metal Products
  - 5. Hilti
  - 6. Unistrut
  - 7. ITW Red Head
- B. Pipe Hangers, Rods, Supports and Accessories:
  - 1. Anvil International, Inc.
  - 2. Carpenter Paterson, Inc.
  - 3. Cooper B-Line, Inc.
  - 4. Elcen Metal Products
  - 5. Hilti
  - 6. Unistrut
- C. Fabricated Steel Support: As indicated on Drawings.

2.02. DESIGN REQUIREMENTS

- A. Supports capable of supporting the pipe for all service and testing conditions. Provide 4-to-1 safety factor.

- B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.
- C. Design supports and hangers to allow for proper pitch of pipes.
- D. For chemical and waste piping, design, materials of construction, and installation of pipe hangers, supports, guides, restraints, and anchors:
  1. ASME B31.3.
  2. MSS SP-58 and MSS SP-69.
  3. Except where modified by this Specification.
- E. For steam and hot and cold water piping, design, materials of construction and installation pipe hangers, supports, guides, restraints and anchors:
  1. ASME B31.1
  2. MSS SP-58 and MSS SP-69.
- F. Check all physical clearances between piping, support system, and structure. Provide for vertical adjustment after erection.
- G. Support vertical pipe runs in pipe chases at base of riser. Support pipes for lateral movement with clamps or brackets.
- H. Place hangers on outside of pipe insulation. Use a pipe covering protection saddle for insulated pipe at support point.
- I. Fabricated Steel Supports: As detailed on the drawings.

#### 2.03. INSERTS AND ANCHORS

- A. Inserts: MSS Type 18; malleable iron body and nut, galvanized finish, opening in top of insert for reinforcing rod, lateral adjustable.
- B. Anchors: Steel shell and expander plug, snap off end fastener

#### 2.04. HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. Select size of hangers and supports to exactly fit pipe size for bare piping, and around piping insulation with saddle or shield for insulated piping.
- B. For suspension of non-insulated or insulated stationary pipe lines: Adjustable steel clevises, MSS Type I.
- C. For suspension of non-insulated stationary pipe lines: Adjustable band hangers, MSS Type 7 or 9; or split pipe rings, MSS Type II.
- D. For support of piping where horizontal movement due to expansion and contraction may occur, and where a low coefficient of friction is desired: Pipe slides and slide plates, MSS Type 35, including guided plate mounted on a concrete pedestal or structural steel support.

- E. For support from floor stanchion, using floor flange to secure stanchion to floor: Adjustable pipe stanchion saddles, MSS Type 37 or 38, including steel pipe base support and cast-iron floor flange.
- F. For suspension of pipe from two (2) rods where longitudinal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.
- G. For suspension of pipe from a single rod where horizontal movement due to expansion and contraction may occur: Adjustable roller hangers, MSS Type 43.
- H. For support of pipe from a single rod where vertical adjustment is not necessary: Pipe roll stands, MSS Type 45.
- I. For support of pipe where small horizontal movement due to expansion and contraction may occur, but vertical adjustment is not necessary: Pipe rolls and plates, MSS Type 45.
- J. For support of pipe lines where vertical and lateral adjustment during installation may be required in addition to provision for expansion and contraction: Adjustment pipe rolls stands, MSS Type 46.

2.05. VERTICAL PIPING CLAMPS

- A. Select size of vertical piping clamps to exactly fit size of bare pipe.
- B. For support and steadying of pipe risers: Two-bolt riser clamps, MSS Type 8 or 42.

2.06. HANGER ROD ATTACHMENTS

- A. Select size of hanger rod attachments to suit hanger rods.
- B. For adjustment up to six (6) inches for heavy loads: Steel turnbuckles, MSS Type 13.
- C. For use on high temperature piping installations: Steel clevises, MSS Type 14.
- D. For use with split pipe rings, MSS Type II: Swivel turnbuckles, MSS Type 15.
- E. For attaching hanger rod to various types of building attachments: Malleable iron sockets, MSS Type 16 or 17.

F. Rods:

1. Size 3/8" and up: All thread steel rod electro galvanized. Sizing for pipe or equipment support as follows:

Copper Tube, Plastic	Steel, Cast Iron		
Pipe Size (Copper, Plastic)	Pipe Size (Steel, Cast Iron)	Rod Size	Max. Equip. Load
1/4" to 2"	1/4" to 2"	3/8"	730 lbs.
2-1/2" to 4"	2-1/2" to 3"	1/2"	1,350 lbs.
6"	4"	5/8"	2,160 lbs.
8" to 12"	6"	3/4"	3,230 lbs.

14"	8" to 12"	7/8"	4,480 lbs.
16"	14" to 16"	1"	5,900 lbs.
18" to 20"	18" to 20"	1-1/4"	9,500 lbs.
22" to 42"	22" to 42"	1-1/2"	13,800 lbs.

2. Rods may be reduced one size for double rod hangers with 3/8" minimum diameter, or when other paragraphs require a minimum of 2 hangers per section, provided the minimum diameter of 3/8" is maintained.

- G. For upper attachment for suspending pipe hangers from concrete: Concrete inserts MSS Type 18.
- H. For attachment to top flange of structural shape: Top beam C-clamps, MSS Type 19.
- I. For attachment to bottom flange of structural shape: Side beam or channel clamps, MSS Type 20 or 27.
- J. For attachment to center of bottom flange of beams: Center beam clamps, MSS Type 21.
- K. For attachment to bottom of beams where heavy loads are encountered and hanger rod sizes are large: Welded attachments, MSS Type 22.
- L. For attachment to structural shapes: C-clamps, MSS Type 23.
- M. For attachment to top of beams when hanger rod is required tangent to edge of flange: Top I-beams clamps, MSS Type 25.
- N. For attachment to bottom of steel I-beams for heavy loads: Steel I-beam/WF-beam clamps with eye nut, MSS Type 28 or 29.
- O. Steel brackets, for indicated loading:
  1. Light duty, 750 pounds, MSS Type 31.
  2. Medium duty, 1,500 pounds, MSS Type 32.
  3. Heavy duty, 3,000 pounds, MSS Type 33.
- P. For use on sides of steel beams: Side beam brackets, MSS Type 34.

#### 2.07. SPRING HANGERS AND SUPPORTS

- A. Select spring hangers and supports to suit pipe size and loading.
- B. For control of piping movement: Restraint control devices, MSS Type 47.
- C. For light loads where vertical movement does not exceed 1-1/4 inch: Springs cushion hangers, MSS Type 48.
- D. For equipping Type 41 roll hanger with springs: Spring cushion roll hangers, MSS Type 49.

- E. For retardation of sway or thermal expansion in piping systems: Spring way braces, MSS Type 50.
- F. For absorbing expansion and contraction of piping system from hanger: Variable spring hangers, MSS Type 51; preset to indicated load and limit variability factor to 25%.
- G. For absorbing expansion and contraction of piping system from base support: Variable spring base supports, MSS Type 52; preset to indicated load and limit variability factor to 25%; include flange.
- H. For absorbing expansion and contraction of piping system from trapeze support: Variable spring trapeze hangers, MSS Type 53; preset to indicated load and limit variability factor to 25%.
- I. Constant supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.
  - 1. Horizontal Type: MSS Type 54.
  - 2. Vertical Type: MSS Type 55.
  - 3. Trapeze Type: MSS Type 56.

#### 2.08. SUPPLEMENTARY SUPPORTS

- A. Where support spacing is more frequent than distance between structural members, provide steel angles, channels or beams sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer pipe support loads to structural members.
- B. Where deflection of center of trapeze support exceeds 1/240 of distance between hanger rods, provide additional hanger rods.
- C. Where multiple risers are supported within shafts, provide steel angles, channels or beams, sized to provide a deflection of less than 1/240 of span when fully loaded, to transfer loads to the concrete floor slab. Anchor supplemental supports to the slab, and provide resilient element where required by other Sections of this Division.

#### 2.09. ACCESSORIES

- A. Protective Shields, MSS Type 40: Carbon steel, galvanized minimum of 12" length sized for required insulation.
- B. Protective Saddles, MSS Type 39: Carbon steel plate, minimum of 12" length, sized for required insulation.
- C. Steel Turnbuckle, MSS Type 13: Forges steel, galvanized finish with locknuts. Rated at a minimum of 730 lbs. at 3/8" size.
- D. Steel Clevis, MSS Type 14: Forged steel, galvanized finish with steel pin and cotter pin. Rated for a minimum of 730 lbs. at 3/8" size.
- E. Weldless Eye Nut, MSS Type 17: Forges steel, galvanized finish. Rated for a minimum

of 730 lbs. at 3/8" size.

2.10. PIPE INSULATION HANGER SHIELDS

- A. Where hangers are placed outside the jackets of pipe insulation, provide shields equal to "Thermal Hanger Shields" as manufactured by Pipe Shields, Inc. or equivalent by Elcen Metal Products Company.
- B. Shields shall consist of a 360-degree insert of high-density, 100 psi, waterproof calcium silicate, encased in a 360-degree galvanized sheet steel shield. Insert shall be same thickness as adjoining pipe insulation, and shall extend 1 inch beyond sheet metal shield in each direction on cold lines. Shield lengths and minimum sheet metal gauges shall be as directed below:

<u>PIPE SIZE</u>	<u>SHIELD LENGTH</u>	<u>MINIMUM GAUGE</u>
1/2" to 1-1/2"	4"	26
2" to 6"	6"	20
8" to 10"	9"	16
12" to 18"	12"	16
20" & Larger	18"	16

- C. Shields shall be Model CS-CW, except for pipe roller applications: then provide Model CSX-CW.
- D. At the Contractor's option, shop-fabricated galvanized metal shields may be provided based on approved shop drawings. Length and gauge of sheet metal shall be as specified above.
- E. For all insulated piping 4" and larger, provide insulation insert at a minimum of 12" long. Insert shall extend a minimum of one inch beyond shield. Insulation inserts shall be minimum 12" long section of foam glass insulation.

2.11. METAL FRAMING: Provide products compliant with NEMA ML-1.

2.12. STEEL PLATES, SHAPES AND BARS: Provide products compliant with ANSI/ASTM A-36.

2.13. PIPE GUIDES: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base, with a two-section guiding spider bolted tight to pipe or as shown on Drawings. Size guides and spiders to clear pipe, cylinder and insulation, if any. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 EXECUTION

3.01. GENERAL REQUIREMENTS

- A. Where applicable, install in accordance with the manufacturer's written installation

instructions.

- B. Where supports are in contact with copper pipe, provide copper plated support.
- C. Where supports are in contact with glass, aluminum or brass pipe, provide plastic coating on supports.
- D. Interior hangers, supports, including attachments, that are plain steel shall be primed and painted.
- E. Hangers and supports, including attachments, exposed to weather or located in utility tunnels or accessible utility trenches or subject to spillage shall be hot dip galvanized after fabrication.
- F. Fabricated steel supports exposed to weather or located in utility tunnels and accessible utility trenches or subject to spillage shall be primed and painted. Cut, welded, drilled or otherwise damaged surfaces of coating shall be repaired.

### 3.02. PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including but not limited to proper placement of inserts, anchors and other building structural attachments.

### 3.03. INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure in compliance with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together in trapeze-type hangers where possible. Install supports with maximum spacing as specified in this Section. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for small diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Support fire protection water piping independently of other piping
- D. The location of hangers and supports shall be coordinated with the structural work to ensure that the structural members will support the intended load.
- E. Provide hex head nut on rod at top and bottom of clevis hanger yoke, and at each rod connection to intermediate and upper attachment. Rod nuts shall be securely locked in place.
- F. Hanger rods shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing.
- G. Hangers shall be fabricated to permit adequate adjustment after erection while still

supporting the load. Turnbuckles shall be provided where required for vertical adjustment of the piping.

- H. Supports for vertical piping shall be located at each floor or at intervals of not more than 15 feet and at intervals of not more than 8 feet from end of risers. Where supports are provided on intermediate floors spaced 15 feet or less between floors, no additional supports are required other than those specified for end of risers.
- I. A hanger or support shall be provided adjacent to each piece of equipment to ensure that none of the pipe weight is supported from the equipment.
- J. Provide protective shields on all piping required to be insulated.
- K. Provide protective saddles sized to match insulation thickness on all hot piping required to be insulated. Fill void between saddle and pipe with insulation as specified.
- L. Provide turnbuckles on all hangers that require leveling or aligning.
- M. Provide steel clevis where detailed and/or required.
- N. Provide weldless eye nuts on hanger terminations where disassembly or swing may be required. Use in combination with steel clevis.
- O. Supports
  - 1. Provide additional supports at:
    - a. Changes in direction.
    - b. Branch piping and runouts over 5 feet.
    - c. Concentrated loads due to valves, strainers and similar items.
    - d. At valves 4 inches and larger in horizontal piping.
    - e. Support piping on each side of valve.
    - f. Brace hubless piping to prevent horizontal and vertical movement.
    - g. Where number of grooved couplings exceeds 3 between supports or provide continuous steel between supports.
  - 2. Sanitary waste and vent, roof drains per UPC Section 316: Vertical supports are not required within 2.5 feet of wall penetrations for pipes 8 inches in diameter and smaller, and not more than 3 feet for 10 inches and larger.
  - 3. Other piping support spacing shall be as scheduled on Drawing or as required by referenced standard.

#### 3.04. HANGER SPACING

- A. The maximum spacing between pipe supports for straight runs shall be in accordance with the following chart. If any deviation from the table exists within the manufacturer's written installation instruction, whichever spacing reflecting the smaller centerline to centerline dimension shall be used.



MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING  
TABLE

1. Steel Pipe (Schedule 40 & 80):  
Up to 1" .....7 ft. on center  
1-1/4" and greater.....10 ft. on center
2. Copper Pipe (Types L, K and M):  
Up to 1" size:.....5 ft. on center  
1-1/4" to 2-1/2" .....7 ft. on center  
3" and larger .....10 ft. on center
3. Ductile Iron and Cast Iron: Two hangers per section length.
4. Polyvinyl Chloride (PVC):  
Up to 1-1/2" .....3 ft. on center  
2" to 4" .....4 ft. on center  
5" to 8" .....5 ft. on center  
10" and larger .....6 ft. on center
5. Sprinkler and Standpipe: Pipe hangers to be as per NFPA-13 and NFPA-14 standards.

- B. Hanger centerline spacing shall be reduced by 50% in areas of concentrated valves and/or fittings, also no more than a maximum distance of 12 inches from valves, fittings and/or couplings, or 24 inches from a change in direction.

3.05. ATTACHMENT TO STRUCTURE

- A. For plain steel devices, prime and paint.
- B. Adjust attachment location for proper alignment and no more than 4 degrees offset from a perpendicular alignment.
- C. If proper alignment cannot be achieved from the existing building structure, provide a trapeze type support sized to handle the design load with a minimum safety factor of 5.

3.06. INSERTS

- A. Contractor shall have inserts at site and dimensional location drawings ready at the beginning of the involved concrete work.
- B. Install inserts by securing to concrete forms and inserting reinforcing rod through the opening provided in the insert in accordance with shop drawings.
- C. Provide necessary supervision while concrete is being poured to correct any misalignment caused by the concrete.

3.07. INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B-31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bards to piping and to

structure. Comply with ANSI B-31, with AWS standards, and with the Details shown on the drawings.

- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required, accommodating both expansion and contraction of piping.
- E. Size anchor shell length to assure a minimum of 1" solid concrete remaining from shell and to concrete face.

### 3.08. INSTALLATION OF TRAPEZES OR PIPE RACKS

- A. Light/Medium Duty: Assemble from standard manufactured metal framing systems, in accordance with manufacturer's recommendations.
- B. Heavy Duty: Fabricate from structural steel shapes selected for loads required. Weld steel in accordance with AWS standards.

### 3.09. AUXILIARY STEEL

- A. Furnish all miscellaneous structural members necessary to hang or support ductwork, piping, and mechanical equipment.
- B. Notify Engineer of any adjustment necessary in main structural system for proper support of major equipment.
- C. Fabricated Steel Supports: Steel for supports shall be saw cut, with sharp edges ground smooth. After fabrication, remove all foreign material, including welding slag and spatter, and leave ready for painting.

END OF SECTION

## SECTION 230100 - VIBRATION ISOLATION AND SEISMIC RESTRAINT FOR MECHANICAL COMPONENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

The work under this section is subject to the requirements of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements.

Specifications throughout all Divisions are directly applicable to this Section, and this Section is directly applicable to them. In the event that this section conflicts with the requirements of other Sections, the more stringent criteria shall apply.

#### 1.2 DESCRIPTION

This section includes requirements for vibration isolation and seismic restraint of nonstructural components in Risk Category I, II, III, & IV structures, including, but not limited to:

1. Mechanical Components: heating, ventilating, and air-conditioning systems; hot/chilled water systems; boiler equipment and components; tanks and vessels, etc.

Work in this section includes the restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.

#### 1.3 DEFINITIONS

Active Equipment: Equipment with dynamic moving or rotating parts or parts that are energized.

Attachments / Anchorage: Means by which nonstructural components or supports for nonstructural components are secured or connected to the seismic-force resisting system of the structure. Such attachments may include anchor bolts, welded connections, mechanical fasteners or other approved attachment devices. Friction attachments do not constitute positive attachments.

Bracing: Struts, braces, cables, anchors or other structural elements providing restraint for nonstructural components to prevent excessive movement.

Certificate of Compliance: A certificate, supplied by the component manufacturer, stating that materials and products meet specified standards and project specific requirements.

Component Importance Factor ( $I_p$ ): Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5 in accordance with ASCE 7, Section 13.1.3.

Consequential Damage: Failure of an essential component caused by the failure of a separate essential or non-essential component due to the functional and physical interrelationship of the components, their supports, and their effect on each other.

Designated Seismic System: Those nonstructural components that require design in accordance with Chapter 13 of ASCE 7, for which the Component Importance Factor ( $I_p$ ) is 1.5 in accordance with Section 13.1.3 of ASCE 7.

Special Seismic Certification: A certificate of compliance, supplied by the manufacturer of Active Designated Seismic Systems, which certifies that the equipment will remain operable during the design seismic event. Components with hazardous contents shall be certified as maintaining containment following the design seismic event.

Structure: The load-bearing building elements designed by the Structural Engineer of Record. Non-load bearing partition walls, unreinforced slabs or other building elements that do not provide direct load transfer to the load-bearing building elements shall not be defined as part of the Structure and cannot be used for attachment of seismic restraints.

Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, snubbers, curbs, rails, hangers, saddles or struts, and associated fasteners that transmit loads between non-structural components and their attachments to the structure.

#### 1.4 REGULATORY REQUIREMENTS

Comply with the 2015 International Building Code (IBC) and applicable local adopted amendments, and the 2010 Edition on ASCE 7 (ASCE 7-10).

#### 1.5 DESIGN PERFORMANCE CRITERIA

Provide seismic restraint of components to withstand seismic forces and displacements without displacing or overturning. Design of seismic restraint shall be performed in accordance with the 2015 International Building Code and ASCE 7-10, as follows.

1. Seismic forces shall be determined in accordance with Chapter 13 of ASCE 7-10. The seismic design parameters shall be as noted in the project Structural drawing. The assigned Component Importance Factors ( $I_p$ ) for each component, shall be as noted on the project drawings and/or specifications.

2. For components installed on the exterior of the building, wind forces shall be determined in accordance with Chapter 29 of ASCE 7-10, except that the uplift forces per Equation 29.5-3 shall be considered regardless of the building height. Reference the Structural drawings for wind design criteria.
3. In addition to seismic and wind loads, consideration shall be given to other loads, including but not limited to dead, live, snow, etc., as applicable. All restraint design shall be based on the “worst case” combination of the applicable loads as prescribed by the referenced code and standards.
4. Consideration shall also be given to thermal stresses and expansion. Where thermal expansion applies, seismic restraint design shall be in accordance with the requirements of ASME B31.1 in addition to ASCE 7.

## 1.6 SUBMITTALS

Submit under the provisions of Division 1. Submittals shall include Product Data, Shop Drawings and the required Certificates of Compliance as described below.

Shop drawings shall be prepared and sealed by a professional engineer licensed in the state of the project, with a minimum of 5 years of experience in the design of vibration isolation and seismic restraint.

Vibration Isolation: submit the following, at a minimum, as applicable.

1. Detailed schedules of equipment requiring isolation, including clearly identified equipment identification or tag and equipment weight, and corresponding isolator type, manufacturer and model number.
2. Detailed drawings showing equipment, isolator bases and isolator spacing.
3. Descriptive data or cut sheets for each type of isolation mounting, including:
  - a. Dimensional data
  - b. Materials and finish
  - c. Rated loads
  - d. Rated deflection
  - e. Isolator free and operating heights
  - f. Detailed installations instructions

Seismic Restraint: submit the following, at a minimum, as applicable.

4. Catalog cut or data sheets on specific restraints detailing compliance with the project drawings and specifications.
5. Detailed schedules of components, showing seismic restraints by referencing numbered descriptive drawings.
6. Description, layout and location of items to be restrained with anchorage or brace points noted and dimensioned.
7. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, fasteners, bolts, welds etc. clearly identified and specified.
8. Numerical value of design seismic restraint loads, or controlling loads if different than load combinations with seismic, with all supporting calculations.
9. Detailed installation instructions for seismic restraints.
10. Acceptable attachment methods of seismic restraints to structural members.
11. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
12. Details for housekeeping pads for base-mounted equipment, including reinforcing and doweling requirements to the building structure.
13. Documentation verifying seismic prequalification for anchors in concrete per ACI 318 Appendix D.
14. Additional information as required to substantiate adequate design and installation of seismic restraints.
15. Manufacturer's Seismic Certificate of Compliance: Each manufacturer of a Designated Seismic System (with a Component Importance Factor,  $I_p = 1.5$ ) shall submit a ***Certificate of Compliance*** for review and acceptance by the design professional in responsible charge and the authority having jurisdiction, prior to installation.

## PART 2 - PRODUCTS

### 2.1 GENERAL

All materials and devices shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

Refer to the “Selection Guide” table in Section 4 to correlate the specification references listed below with the appropriate components.

## 2.2 MANUFACTURERS

Isolators and seismic restraints shall be from the following manufacturers, or approved equals. Unless otherwise noted, the isolators and seismic restraint systems listed in the following sections are as manufactured by Gripple and California Dynamics.

1. Gripple
2. California Dynamics
3. The VMC Group
4. Mason Industries
5. Kinetics Noise Control
6. Cooper B-Line
7. CADDY
8. Hilti
9. Twin City Hose
10. Imperial Metals

## 2.3 EQUIPMENT BASES

Specification B-1 (Integral Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-2 (Wide Flange Structural Steel Base): Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type XW as manufactured by California Dynamics Corporation or approved equal.

Specification B-3 (Concrete Inertia Base): Rectangular steel concrete pouring forms for floating concrete frames. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 12" centers running both ways in a layer 1 1/2" above the bottom. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Base shall be type CW as manufactured by California Dynamics Corporation or approved equal

Specification B-4 (Non-Isolated Curbs): Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchored to concrete deck, or bolted or welded directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. **Curb shall use minimum 18 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of calculated seismic forces and /or wind loading per local building code.** Design must be certified by registered professional engineer.

Specification B-5 (Isolated Curbs): Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter support for rooftop unit. The upper curb shall be supported by Spec SV-1 isolators welded or bolted to concrete deck to the structure to withstand seismic loading. An EPDM nylon reinforced air tight weatherproof seal shall consolidate the upper and lower curbs. The lower curb shall be weatherproof and provide a base that the roofing system may be flashed to. Weatherproof access panel shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. **Isolation curb shall be designed to withstand the greater of calculated seismic forces and / or wind loading per local building code.** Design must be certified by registered professional engineer.

Specification B-6 (Non-Isolated Rails): Non isolated seismically rated rooftop rail system that provides equipment support in one roof flashed assembly with all features as described for Non-Isolated Curbs.



Specification B-7 (Isolated Rails): Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment. Structural steel rails shall be type, WW as manufactured by California Dynamics Corporation or approved equal.

## 2.4 VIBRATION ISOLATION

Specification V-1 (Pad Type Elastomer Isolator): A pad type mounting consisting of two layers of ribbed elastomeric pads with a 1" sandwich pad in between. Where the equipment foot is less than 80 percent of the surface of the pad a load distribution plate must be added to the top of the pad. Pads shall be VT as manufactured by California Dynamics Corporation or approved equal.

Specification V-2 (Neoprene Mounting): Elastomeric mounts single or double-deflection type, oil-resistant rubber or Neoprene isolator element with factory-drilled, bonded in place top plate for bolting to equipment and factory drilled base plate for bolting to structure. Color-coded or otherwise identify to indicate capacity range. Mount shall be type RM/RMD as manufactured by California Dynamics Corporation or approved equal.

Specification V-3 (Spring Isolator, Free Standing): Spring isolators shall be free standing and laterally stable without any housing and complete with a Neoprene acoustical pad between the base plate and the spring support. All mountings shall have load transfer bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mountings shall be type SSL/K, as manufactured by California Dynamics Corporation or approved equal.

Specification V-4 (Elastomer Hanger Isolator): Hanger shall consist of a rigid steel frame and up to ½" deflection of a molded Neoprene element projecting thru the steel box so that no metal-to-metal contact occurs. Hanger shall be type RH/RHD as manufactured by California Dynamics Corporation or approved equal.

Specification V-5 (Spring Hanger Isolator): Hanger shall consist of a rigid steel frame containing a steel spring with a Neoprene sleeve to prevent steel to steel contact. Hanger shall be type CH as manufactured by California Dynamics Corporation or approved equal

Specification V-6 (Combination Spring/Elastomer Hanger Isolator): Hangers shall consist of rigid steel frames containing double deflection Neoprene element at the top and a steel spring and a Neoprene sleeve on bottom to position spring and prevent steel to steel contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side. Hangers shall be type HH30 as manufactured by California Dynamics Corporation or approved equal.

## 2.5 VIBRATION ISOLATION WITH SEISMIC RESTRAINT

Specification SV-1 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A steel housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. The housing shall be Zinc plated. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be CQA as manufactured by California Dynamics Corporation or approved equal. This product is an OSHPD/ DSA approved product. Product tested for IBS.

Specification SV-2 (Seismically Restrained Spring Isolator): Restrained spring isolators shall be free standing, laterally stable, springs with seismic restraints. A welded housing with cushioned lateral and vertical limit stops to restrict spring extension due to wind loads, or when weight is removed. A clearance of ¼" maximum shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Outside spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Isolator/Restraint shall be DLK as manufactured by California Dynamics Corporation or approved equal.

Specification SV-3 (Neoprene Mounting with Seismic Snubber) JQTQN Restrained Neoprene isolators shall be free standing, with a rated static deflection of .5". A steel housing with cushioned lateral and vertical limit stops to restrict extension due to wind loads, or when weight is removed. The housing shall be hot-dipped galvanized or zinc plated. Hot-Dipped zinc coating shall be not less than 2 ounces per square foot complying with ASTM A123. A clearance of ¼ "maximum shall be maintained around restraining bolts and between the housing and the Neoprene so as not to interfere with the isolator action. Limit stops shall be out of contact during normal operation. Isolator/Restraint shall be JQTQN as manufactured by California Dynamics Corporation.

## 2.6 SEISMIC RESTRAINTS

Specification S-1 (Seismic Snubbers): All directional seismic restraints shall consist of interlocking steel members. Neoprene shall have a minimum thickness of ¼". Incorporate a minimum air gap of 1/8", and a maximum air gap of ¼" in the design, before contact is made between the rigid and resilient surfaces. Provide removable end plate to allow inspection of internal clearances. Restraints shall be type RL-A/ RL-C as manufactured by California Dynamics Corporation.

Specification S-2 (Seismic Cable Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable Restraints shall be listed with any one of following evaluation agencies with certified break strength and shall be color-coded or include a tag for easy field verification.

1. IAPMO-UES
2. ICC-ES
3. OSHPD
4. Underwriters Laboratories (UL)

Secure cable to structure and braced component through bracket or stake eye specifically designed to meet or exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per ASTM A1023 or EN-12385 or other approved equivalent. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Gripple Inc. GS series.

Specification S-3 (Rigid Brace Restraints): A restraint assembly for suspended equipment, piping or ductwork consisting of steel angles or channels. Rigid braces and connecting elements shall be sized for the applied seismic loads. Connecting elements shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment. Restraint shall be CADDY Strut Seismic Hinge.

## 2.7 FLEXIBLE PIPE CONNECTIONS

Specification F-1 (Water Service Flexible Connection):

1. For flanged connections – A double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77” compression, 1.18” lateral and 1.18” extension. Connectors shall provide a minimum 35 degree angular movement up to 6”, minimum 30 degree up to 12” and minimum 20 degree up to 24”. Spring loaded control units shall be furnished to limit movement to within allowables. Flex connector shall be Twin City Hose Type MS2.
2. For threaded type – A double spherical rubber hose connector, minimum 8” long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8” compression, 7/8” lateral, ¼” extension and 20 degree angular through 1-1/4”, 13 degree through 2”, and 9 degree through 3”. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to ¼”. Flex connector shall be Twin City Hose Type MSFU.

Specification F-2 (Steam and Condensate Service):

3. For flanged connection – A metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Flex connector shall be Twin City Hose Type TCHS-FLG.
4. For threaded connections – A metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Flex connector shall be Twin City Hose Type TCHS-MMT.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

All areas that will receive components requiring vibration isolation and seismic restraint shall be thoroughly examined for deficiencies that will affect the installation or performance of the installed devices. Such deficiencies shall be corrected prior to the installation.

### 3.2 INSTALLATION, GENERAL

Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

All installation shall be in accordance with the requirements set forth in the project drawings and specifications, as well as the manufacturer's published instructions and all approved submittal data.

Do not anchor components to gypsum wallboard, plaster or other wall or ceiling finish that has not been engineered to resist imposed loads.

### 3.3 SEISMIC RELATIVE DISPLACEMENTS

Provide joints with sufficient flexibility capable of accommodating seismic relative displacements as follows.

1. Vertical ductwork, piping, etc. that pass between floors of the building,
2. Components that pass through a building seismic or expansion joint,
3. Rigidly supported components that connect to other components.

### 3.4 POST-INSTALLED ANCHORS:

Install all anchors in accordance with the manufacturer's written instructions for seismic applications.

Post-installed anchors in concrete shall be seismically prequalified for use in cracked concrete based on seismic testing in accordance with ACI 355.2 for mechanical anchors or ACI 355.4 for adhesive anchors.

### 3.5 HOUSEKEEPING PADS

Housekeeping pads shall be designed by the seismic restraint vendor with adequate reinforcing and doweling to the building structure, so as to withstand calculated seismic or wind forces. Frictional resistance due to the effects of gravity shall be neglected.

The size & thickness of the housekeeping pad shall be determined to ensure adequate edge distances & embedment depths in order to obtain the desired equipment anchor capacities.

1. If cast-in-place anchors are used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.
2. If post-installed anchors are used, the minimum edge distances, embedment depths and concrete/masonry member thicknesses specified by the anchor manufacturer shall be maintained.

### 3.6 MECHANICAL COMPONENTS

Floor and base-mounted components, vibration isolated equipment and associated system vibration and seismic controls for connections.

1. Design equipment anchorage to resist seismic design force in any direction.
2. Design vibration and seismic controls for equipment to include base and isolator requirements.
3. Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.
4. Where equipment is mounted on vibration isolators, use isolators designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
5. Provide supplemental steel or concrete base as required for mounting equipment on isolators. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
6. Where concrete floor thickness is less than required for expansion anchor installation per ICC-ESR, install through bolt in lieu of expansion anchor. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, furnish and install supplemental framing or blocking to transfer loads to structural elements.
7. Housekeeping pads shall be coordinated with the seismic restraint vendor based on the equipment anchorage specified in the seismic design.

#### Suspended mechanical equipment

8. Design support and bracing to resist seismic design force in any direction.
9. Provide flexible connections between equipment and interconnected piping to account for seismic relative displacements.
10. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.

#### Wall-mounted mechanical equipment

11. Design attachments to resist seismic design force in any direction.
12. Install backing plates or blocking as required to deliver load to primary wall framing members. Do not anchor to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads.

#### Piping

13. Provide supports, braces and anchors to resist gravity and seismic design forces.

14. Design piping and piping risers to accommodate interstory drift. Provide flexible connections wherever relative differential movements could damage pipe in an earthquake.
15. Brace every run (5' or more in length) with two transverse and one longitudinal bracing locations. For pipes and connections constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections) provide transverse bracing at not more than 40 feet on center and longitudinal bracing at spacing not more than 80 feet on center. For pipes and their connections constructed of nonductile materials (cast iron, no-hub pipe and plastic or non-UL listed grooved coupling pipe), provide transverse bracing at not more than 20 feet on center and longitudinal bracing at spacing not more than 40 feet on center.
16. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.
17. Where piping is explicitly exempt from seismic bracing requirements,
  - a. Install piping such that swinging of the pipes will not cause damaging impact with adjacent components. This will be considered satisfied if there is horizontal clear distance of at least  $\frac{2}{3}$  the hanger length between subject components.
  - b. Provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.

#### Ductwork

18. Provide supports, braces and anchors to resist gravity and seismic design forces.
19. Design ducts and duct risers to accommodate interstory drift. Provide flexible connections wherever relative differential movement could damage duct in an earthquake
20. Provide independent support and bracing for all in-line devices weighing more than 75 pounds.

### 3.7 QUALITY CONTROL

Do not install vibration isolators or seismic restraints until submittals have been reviewed and approved by the registered design professional in responsible charge.

Verify that multiple systems installed in the same vicinity can be installed without conflict.

Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the registered design professional in responsible charge of the project that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

Coordinate with the Structural Engineer of Record for confirming that the structure is capable of supporting the loads imposed by nonstructural components.

No work shall be concealed by the Contractor prior to the required inspections being performed and all discrepancies resolved. The Contractor shall be responsible for all repairs required to uncover uninspected or unapproved work.

Where Special Inspections are required per Sections 1704 and 1705 of the 2015 International Building Code, the owner shall engage a qualified agency to perform the required inspections for components listed in the project-specific Statement of Special Inspections.

#### PART 4 - EQUIPMENT ISOLATION AND SEISMIC RESTRAINT SCHEDULE

##### MECHANICAL EQUIPMENT

<b>EQUIPMENT TAG</b>	<b>Ip (Note 7)</b>	<b>ISOLATIO N SPEC.</b>	<b>ISOLATIO N DEFL.</b>	<b>SEISMIC REST. SPEC. (NOTE 1)</b>
PACKAGED RTU > 5 TONS	1.0	SPEC B-5	2"	SPEC B-5
PACKAGED RTU ≤ 5 TONS	1.0	N/A	N/A	SPEC B-4
GAS PACKAGED RTU > 5 TONS	1.5	SPEC B-5	2"	SPEC B-5
GAS PACKAGED RTU ≤ 5 TONS	1.5	N/A	N/A	SPEC B-4
SUSPENDED GAS FURNACE	1.5	V-6	1.5"	SPEC S-2
AIR HANDLING UNITS (FLOOR)	1.0	INTERNAL BY MANUF.	2"	NOTE 2
AIR HANDLING UNITS (SUSP)	1.0	SPEC V-6 SPEC F-1	1.5"	SPEC S-2
VAV (NON-FAN) TERM. < 20	1.0	NONE	N/A	NONE



<b>EQUIPMENT TAG</b>	<b>Ip (Note 7)</b>	<b>ISOLATIO N SPEC.</b>	<b>ISOLATIO N DEFL.</b>	<b>SEISMIC REST. SPEC. (NOTE 1)</b>
LB				
VAV (NON-FAN) TERM. ≥ 20 LB	1.0	NONE	N/A	SPEC S-2
FAN VAV TERMINAL	1.0	SPEC V-4	.5"	SPEC S-2
INLINE FANS	1.0	SPEC V-6	1.5"	SPEC S-2
CEILING FANS ≥ 20 LB	1.0	SPEC V-4	.5"	SPEC S-2
CEILING FANS < 20 LB	1.0	NONE	N/A	NONE
CEILING DIFFUSERS ≥ 20 LB	1.0	NONE	N/A	(2) 12 GA WIRES TO STRUCTURE, NOTE 3
WALL MOUNT FANS	1.0	NONE	N/A	NOTE 2
UTILITY SETS (FLOOR)	1.0	SPEC SV-2	1"	SPEC SV-2
UTILITY SETS (SUSP.)	1.0	SPEC V-6	1.5"	SPEC S-2
ROOF EXHAUST FANS	1.0	NONE	N/A	SPEC B-3
CHILLERS (ON GRADE)	1.0	SPEC V-1 SPEC F-1	.15"	NOTE 2
CHILLERS (ROOF OR UPPER FLOORS)	1.0	SPEC SV-1 SPEC F-1	2.0"	SPEC SV-1
BOILERS (ON GRADE)	1.5	SPEC V-1	.15"	NOTE 2
BOILERS (UPPER FLOORS)	1.5	SPEC SV-1	1"	SPEC SV-1
PUMPS (ON GRADE) < 7.5 HP	1.0	NONE SPEC F-1	.15"	NOTE 2
PUMPS (ON GRADE) ≥ 7.5 HP	1.0	SPEC B-3 & SV-2 SPEC F-1	1"	SPEC SV-2
PUMPS (UPPER FLOORS)	1.0	SPEC B-3 & SV-2 SPEC F-1	2"	SPEC SV-2
INLINE PUMPS < 5 HP	1.0	NONE	N/A	SPEC S-2

<b>EQUIPMENT TAG</b>	<b>Ip (Note 7)</b>	<b>ISOLATIO N SPEC.</b>	<b>ISOLATIO N DEFL.</b>	<b>SEISMIC REST. SPEC. (NOTE 1)</b>
INLINE PUMPS ≥ 5 HP	1.0	SPEC V-6	1.5"	SPEC S-2
AIR SEPARATORS & EXP. TANKS	1.0	NONE	N/A	NOTE 2
COOLING TOWERS (ON GRADE)	1.0	SPEC B-2 & V-1	.15"	NOTE 2
COOLING TOWERS (ROOF)	1.0	SPEC B-2 & SV-1	2.0"	SPEC SV-1
GAS PIPING	1.5	NOTE 6	N/A	SPEC S-2
GAS UNIT HEATERS (SUSP)	1.5	NONE	N/A	SPEC S-2
UNIT HEATERS (SUSP)	1.0	NONE	N/A	SPEC S-2
CABINET HEATERS (SUSP)	1.0	SPEC V-4	.5"	SPEC S-2
FAN COILS	1.0	SPEC V-6	1.5"	SPEC S-2
KITCHEN HOODS	1.5	NONE	N/A	SPEC S-2
WATER SOURCE HEAT PUMP (SUSP.)	1.0	SPEC V-6	1.5"	SPEC S-2
WATER SOURCE HEAT PUMP (FLOOR)	1.0	SPEC SV-2	1"	SPEC SV-2
STEAM TO WATER HEAT EXCHANGER	1.5	NONE	N/A	NOTE 2
WATER TO WATER HEAT EXHANGER	1.0	NONE	N/A	NOTE 2
EXPANSION TANK	1.0	NONE	N/A	NOTE 2
AIR SEPARATOR	1.0	NONE	N/A	NOTE 2
FLASH TANK	1.5	NONE	N/A	NOTE 2
CHILLED WATER PIPING	1.0	NOTE 6	N/A	SPEC S-2
HOT WATER PIPING	1.0	NOTE 6	N/A	SPEC S-2
STEAM PIPING	1.5	NOTE 6	N/A	NOTE 4
STEAM CONDENSATE PIPING	1.5	NOTE 6	N/A	NOTE 4

<b>EQUIPMENT TAG</b>	<b>I<sub>p</sub> (Note 7)</b>	<b>ISOLATIO N SPEC.</b>	<b>ISOLATIO N DEFL.</b>	<b>SEISMIC REST. SPEC. (NOTE 1)</b>
DUCT	1.0	NOTE 6	N/A	SPEC S-2
DUCT USED FOR SMOKE CONTROL	1.5	NOTE 6	N/A	SPEC S-2

**NOTES**

1. Seismic restraint to be provided only where required in the project drawings.
2. Anchor bolts for non-isolated and internally isolated equipment shall be sized by the seismic engineer. If required, Spec. S-1 snubbers or Spec. S-2 cable kits shall be provided.
3. Diffusers weighing less than 20 lbs must be mechanically attached to ceiling grid, but require no additional restraint.
4. Anchors and guides to be designed to accommodate thermal expansion and seismic loads.
5. Roof curbs provided by others must be certified by a professional engineer for the required seismic loads.
6. Provide Type V-6 isolator for the first three hangers from all equipment specified with spring isolation.
7. All components in a Risk Category IV building are assigned a Component Importance Factor  $I_p$  equal to 1.5.

END OF SECTION

## SECTION 230110

### BASIC VALVES FOR HVAC

#### PART 1 - GENERAL

1.01 Valves specified in this section are for general use. See specifications for specific systems and special valves.

#### 1.02 SUBMITTALS

A. Product Data: Provide for each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories. Provide valve schedule with product data listing valves used for each service application.

#### 1.03 QUALITY ASSURANCE:

- A. Single Source Responsibility: Where possible valves shall be by the same manufacturer.
- B. MSS Standard Practices: Comply with the MSS standards for valves specified.
- C. ASME: Comply with ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
- D. NSF: Comply with NSF 61 for valve materials for potable water service.

#### 1.04 DELIVERY, STORAGE, AND HANDLING:

A. Preparation for Transport:

- 1. Ensure valves are dry and internally protected against rusting and galvanic corrosion.
- 2. Protect valve ends against mechanical damage to threads, flange faces, and weld end preps.
- 3. Set valves in best position for handling. Globe and gate valves shall be closed to prevent rattling; plug valves shall be open to minimize exposure of functional surfaces; butterfly valves shall be shipped closed or slightly open; and swing check valves shall be blocked in either closed or open position.

B. Storage:

- 1. Do not remove valve end protectors unless necessary for inspection; reinstall for storage.
- 2. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement and protect in watertight enclosures.

- C. Handling: Valves whose size requires handling by crane or lift shall be slung or rigged to avoid damage to exposed valve parts. Handwheels and stems, in particular, shall not be used as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering valves which may be incorporated in the work include the following. For majority of valves, Milwaukee has been used as basis of design. Equal valves of other manufacturers may be submitted without substitution requests.

1. APCO
2. Apollo
3. CPV
4. Crane
5. DeZurick
6. Grinnell
7. Hammond
8. Jamesbury
9. Jenkins
10. Keflex
11. Metraflex
12. Milwaukee
13. Mueller
14. Nibco
15. Nordstrom
16. Powell
17. Stockham
18. Walworth
19. Watts

### 2.02 VALVE FEATURES:

- A. Valve Design: Valves shall have rising stem, or rising outside screw and yoke stems; except, non-rising stem valves may be used where headroom prevents full extension of rising stems.

- B. Pressure and Temperature Ratings: Not less than indicated and required to suit system pressures and temperatures.
- C. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- D. Operators: Provide the following special operator features:
  - 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
  - 2. Lever handle on quarter-turn valves 4 inch and smaller, except for plug valves. Provide one wrench for every 10 plug valves.
  - 3. Chain-wheel operators for valves 2-1/2 inch and larger installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
  - 4. Gear drive operators on quarter-turn valves 6 inches and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Provide bypass and drain connections required by manufacturer and as indicated on the drawings.
- G. End Connections: As specified in the individual valve specifications.
  - 1. Threads: Comply with ANSI B1.20.1.
  - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
- H. Valves for Condenser Water and Chilled Water.
  - 1. Gate Valves:
    - a. 2 inch and Smaller: Class 125, body and bonnet of ASTM B62 cast bronze, threaded ends, solid disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires. Milwaukee #105.
    - b. 2-1/2 Inch and Larger: Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and packing gland assembly. Milwaukee #F-2885A.
  - 2. Ball Valves:
    - a. Valves 2 Inches and Smaller: Threaded ends, rated for 400 psi WOG pressure; 3 piece construction, bronze body conforming to ASTM B 62, full port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide insulator type handle for chilled water and condensate drain. Milwaukee BA-300.
  - 3. Plug Valves:

- a. 2 Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends. Lunkenheimer 454.
  - b. 2-1/2 Inch and Larger: 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends. Nordstrom 143.
4. Globe Valves:
- a. 2 Inch and Smaller: Class 125, body and screwed bonnet of ASTM B 62 cast bronze, threaded ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires. Milwaukee #502T.
  - b. 2-1/2 Inch and Larger: Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze mounted, flanged ends, and packing gland assembly. Milwaukee F2981A.
5. Butterfly Valves: 2-1/2 Inch and Larger: 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with nickel-plated ductile iron disc (except valves installed in condenser water piping which shall have aluminum bronze disc), stainless steel stem, and EPDM O-ring stem seals. Valves shall have gear operator with extended wheel handle and position indicator. Valves shall be lug type, drilled and tapped. Valves shall be suitable for dead end service, Class I, tight shut off. Milwaukee CL 223E.
6. Check Valves:
- a. Swing Check Valves:
    - 1. 2 Inch and Smaller: Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded ends. Valve shall be capable of being reground while the valve remains in the line. Class 150 valves meeting the above specifications may be used where pressure requires or Class 125 are not available. Milwaukee #509.
    - 2. 2-1/2 Inch and Larger: Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line. Milwaukee #F2974A.
  - b. Spring Loaded (Non-Slam Check Valves for Pumps: Valves shall be iron body, globe typed silent check valves, bronze mounted, stainless steel spring with flanged (125-pounds drilling) end connections for installation between ASA 150 lbs. flat face steel slip on weld flanges. Valves shall be comparable to Mueller #105-AP, APCO Series 600, CPV Globe Type Silent Check Valve, Kelflex K-Check Silent Check Valve, or Metraflex Globe Style Silent Check Valve.

- I. Valves for Heating Hot Water, Low Pressure Steam, and Low Pressure Condensate Return (15 PSI and lower):
1. Gate Valves:
    - a. 2 Inch and Smaller: Class 150, body and union bonnet of ASTM B 62 cast bronze, threaded ends, solid disc, copper-silicon alloy stem, brass packing gland, and malleable iron handwheel. Milwaukee # 1151
    - b. 2-1/2 Inch and Larger: Class 125 iron body, body and bonnet conforming to ASTM A 126 Class B, flanged ends, and packing gland assembly. Milwaukee #F2885.
  2. Ball Valves (Hot Water only):
    - a. Valves 2 Inches and Smaller: Threaded ends, rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3 piece construction, bronze body conforming to ASTM B 62, full port, chrome-plated brass Butterfly Valves (Hot Water only): 2-1/2 Inch and Larger: 200 psi, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with nickel-plated ductile iron disc (except valves installed in condenser water piping which shall have aluminum bronze disc), stainless steel stem, and EPDM O-ring stem seals. Valves shall have gear operators with extended wheel handle with position indicator. Valves shall be lug type, drilled and tapped. Valves shall be suitable for dead end service, Class I, tight shut off. Milwaukee CL 223E.
  3. Check Valves:
    - a. Swing Check Valves:
      - (i) 1. 2 Inch and Smaller: Class 150, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded ends. Valve shall be capable of being reground while the valve remains in the line. Milwaukee #510.
      - (ii) 2. 2-1/2 Inch and Larger: Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line. Milwaukee #F2974A
    - b. Spring Loaded (Non-slam) Check Valves for Pumps: Valves shall be iron body, globe type silent check valves, bronze mounted, stainless steel spring with flanged (125-pounds drilling) end connections for installation between ASA 150 lbs. flat face steel slip on weld flanges. Valves shall be comparable to Mueller #105-AP, APCO Series 600, CPV Globe Type Silent Check Valve, Kelflex K-check Silent Check Valve, or Metraflex Globe Style Silent Check Valve.



## PART 3 - EXECUTION

### 3.01 EXAMINATION:

- A. Examine piping systems for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior, threads, and flanges for cleanliness, and signs of damage or corrosion. Remove all shipping materials.
- C. Actuate valve through an open-close cycle to determine if operation is proper.
- D. Examine the piping for cleanliness and alignment.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gaskets are of proper size, that material composition is suitable for service, and are free from defect.
- F. Do not attempt to repair a defective valve. Replace all defective valves with new valves.

### 3.02 VALVE SELECTION:

- A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:
  - 1. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.
- B. Valves shall be located in an accessible position, or made accessible through access panel.
- C. Where several valves are related as to function, they shall be grouped in a battery.
- D. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- E. Install a valved bypass around each pressure reducing valve, using a globe valve for throttling.
- F. Installation of check valves:
  - 1. Swing Check Valves: Install in horizontal position with hinge pin level.
  - 2. Wafer Check Valves: Install between two flanges in horizontal or vertical position.
  - 3. Lift Check Valves: Install in piping with stem upright and plumb.
- G. No valve shall be installed with stem below horizontal position without prior approval.
- H. Provide special handles or operators as required or as indicated on the drawings.

- I. Valves specified under specific systems shall take precedence over those as specified herein.
- J. Valves in copper pipe shall have threaded ends (except where size dictates flanged ends), use copper to MPT adapters as required.
- K. Provide non-slam type check valves at pumps.

3.03 FIELD QUALITY CONTROL:

- A. Testing: After piping systems have been tested and put into service but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

3.04 ADJUSTING AND CLEANING:

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

3.05 VALVE BOXES

- A. Valves located below slabs or grade shall be housed in cast iron boxes and covers. Covers shall be properly identified as to service controlled by the valves.
- B. Furnish Owner with proper key or valve operator extension.

END OF SECTION

## SECTION 23 0120

### PIPING SPECIALTIES

#### PART 1 - GENERAL

- 1.01 Specific requirements for specialties indicated on drawings or in other sections of these specifications shall take precedence over items as specified in this section.
- 1.02 Submit brochures and other supportive product data for all items.
- 1.03 Ranges for thermometer, gages, or similar instruments shall be selected so that normal operation will be near center of scale. Range shall not be longer than required. Use compound gage where vacuum may be encountered.
- 1.04 Combination instruments for thermometers and gages will not be acceptable.

#### PART 2 - PRODUCTS

##### 2.01 THERMOMETERS:

- A. Thermometers shall be equal to Terrice Series BX9, 9-inch, adjustable type. Stem length shall be a minimum of  $\frac{3}{4}$  of the pipe diameter, plus well extension length. Use 12-inch stem length in tanks.
- B. Provide brass wells and stems.

##### 2.02 THERMOMETER WELLS:

- A. Provide wells with extension neck for insulated piping.
- B. Wells shall be Terrice Series 138 type.
- C. Test wells to be Terrice Series 169 type with cap and chain.

##### 2.03 GAGES:

- A. Gages shall be equal to Terrice Series 800, 3-1/2-inch size.
- B. Provide snubber and cock for each gage.
- C. Provide coil syphon and cock for each steam gage.
- D. Gauges shall be liquid filled.

##### 2.04 TEST PLUGS:

- A. Test plugs shall be equal to Peterson Engineering Company #110, 1/4" size, with brass body, dust cap and "Nordel" valve core material.

#### 2.05 STRAINER:

- A. "Y" Type (Haywood, Muessco, or Sarco):
  - 1. 1/2" through 2": Haywood Model 80, bronze, 300 lb. WP, 500 lb. WOG or Haywood Model 80 iron body, 250 lb. WP, 900 lb. WOG. Provide Monel or stainless steel screen, blow-off outlet, screwed ends.
  - 2. 2-1/2" through 12": Haywood Model 80 iron body, 125 lb. SWP, 175 lb. WOG, brass screen, blow-off outlet, flanged ends.
- B. Screens - Steam:
  - 1. Monel or stainless steel.
  - 2. Perforations - .057 diameter, 144 per sq. in.
- C. Screens - Water:
  - 1. Brass.
  - 2. Perforations: Up to 2" - 1/10" diameter, 49 per sq. in.; 2-1/2" to 4" - 1/8" diameter, 32 per sq. in.; 5" up - 1/4" diameter, 8 per sq. in.

#### 2.06 FLEXIBLE CONNECTORS:

- A. Pumps and Chillers: Bellows Type 3, equal to Keflex #151-TR-1250, with 150 lb. flanges and tie rods. 150 psig maximum working pressure. 304 stainless steel. Bellows welded to flanges. Tie rods with chatter proof spacers. Unit rated at 800°F.
- B. Coils, Valves, And Miscellaneous Equipment: Stainless steel braided hose type.

#### 2.07 ELECTRICAL HEAT TAPE:

- A. Heat tape shall be equal to Emerson Chromalox.
- B. Electrical heat tape shall be installed where indicated on the drawings to prevent pipe freezing.
- C. Heat tape shall be approved for use in hazardous areas as indicated and U.L. listed.

#### 2.08 CALIBRATED BALANCE VALVE:

A. For valves 2" and smaller:

1. Bronze body.
2. Ball or globe type.
3. 250 psig at 250° F rating.
4. Threaded ends.
5. Calibrated orifice or venturi.
6. Meter connections with integral seals.
7. Memory stop.

B. For valves 2-1/2" and larger:

1. Iron or steel body.
2. Ball or globe type.
3. 125 psig at 250° F rating.
4. Flanged connection.
5. Calibrated orifice or venturi.
6. Meter connections with integral seals.
7. Memory stop.

C. Acceptable manufacturers:

1. Flow Design
2. Bell and Gossett
3. Taco
4. Armstrong
5. Nibco

PART 3 - EXECUTION

3.01 GAGES, THERMOMETERS, AND TEST PLUGS:

- A. Provide thermometers in inlet and outlet piping of chillers, boilers, water heaters, air handling unit coils, and elsewhere as indicated on the drawings.
- B. Provide gages on inlet and outlet piping of all pumps, except domestic hot water circulators, steam gages on boiler headers, and elsewhere as indicated on the drawings.
- C. Arrange thermometers and gages so they might be read standing in a normal position on the floor.
- D. Provide test plugs on inlet and outlet piping of all heat exchanger equipment not equipped with thermometers. This includes all heating and cooling coils in air handling units, fan coil units, and other terminal devices with coils.
- E. Locate gages, thermometers, and test plugs as close as possible to equipment being monitored.

### 3.02 FLEXIBLE PIPE CONNECTORS:

- A. Install flexible pipe connectors where indicated on the drawings.
- B. Install connectors as close as possible to equipment inlets and outlets.
- C. Support pipe work independently of flexible connectors. Brace and anchor piping as required to prevent movement of piping ends of flexible connectors and align all equipment, pipe work, and flanges so that no flexible connectors shall be misaligned and/or stressed beyond the manufacturer's recommended maximum limits.

### 3.03 HEAT TAPE:

- A. Install the heat tape below the pipe insulation in a uniform distribution to obtain the watts/linear foot as indicated.
- B. Wiring installation shall be done in accordance with the NEC and the manufacturer's requirements.
- C. Power for heat tape shall come from an emergency circuit. If no emergency circuit is available, the power shall come from a dedicated circuit, marked heat tape in the panel.
- D. Unless indicated otherwise on the plans, install heat tape with a minimum capacity of 5 watts/foot.
- E. Heat tape shall be thermostatically controlled and shall be preset to energize before freezing. An indicator light shall energize when the heat tape is "on."

END OF SECTION

## SECTION 230150 MECHANICAL HYDRONIC PIPING

### PART 1 – GENERAL

#### 1.01 SCOPE

- A. This Section includes piping for heating water, chilled-water, make-up water, and associated drain piping.
- B. Provide materials suitable for system pressures and temperatures.

#### 1.02 SUBMITTALS

- A. Product Data: For each type of pipe and specialty indicated.
- B. Welding Certificates: Copies of certificates for welding procedures and personnel.
- C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.
- D. Maintenance Data: Include hydronic specialties in maintenance manuals.

#### 1.03 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations, for exterior walls and floor assemblies.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base.
- F. Coordinate with requirements for fire stopping.

#### 1.04 DELIVERY AND STORAGE

- A. Deliver, store, and protect piping and devices.
- B. Maintain hydronic specialties in shipping containers with labeling left in place.

## PART 2 – PRODUCTS

### 2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.
- F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).
- H. ProPress Mechanical Joints, or equal.

### 2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, ERW, Grade B, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, ERW, Grade B, Schedule 40, black steel, plain ends.
- C. Steel Pipe, NPS 14 through NPS36: ASTM A 53, ERW, Grade B, standard weight, black steel, plain ends.
- D. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; ERW.
- E. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- F. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- G. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- H. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- I. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- J. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.



2. End Connections: Butt welding.
3. Facings: Raised face.

### PART 3 - EXECUTION

#### 3.01 PIPING APPLICATIONS

- A. Chilled Water and Heating Water, NPS 2 and Smaller: Type L drawn-temper copper tubing with soldered joints, or Schedule 40 steel pipe with threaded joints.
- B. Chilled Water and Heating Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded and flanged joints.
- C. Equipment Drains: Same as hydronic system connected to equipment, DWV copper, SCH 80 PVC, or clear vinyl tubing.

#### 3.02 PIPING INSTALLATIONS

- A. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- B. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- D. Unless otherwise indicated, install branch connections to new mains using tee fittings in main pipe. Use forged tees or forged weld-o-lets for branch connections to existing mains.
- F. Anchor piping for proper direction of expansion and contraction. Install anchors at minimum of 300 linear feet.
- G. Route piping plumb and square with the building structure.
- H. Install piping to conserve building space, and not interfere with use of space and other work.
- I. Group piping whenever practical at common elevations.
- J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Prepare pipe, fittings, supports, and accessories for finish painting.

- M. Install with proper access around device for service clearance.
- N. Set and level all floor mounted equipment.
- O. For systems requiring drains, install drain and route to nearest drainage point or as indicated on the drawings.
- P. Make-up water and relief:
  - 1. For each system, provide pressure-reducing valve for feeding make-up water and a pressure relief valve.
  - 2. Provide make-up water from nearest domestic water with reduced pressure backflow preventer.
  - 3. Operating pressures of PRV and relief valves shall be determined by required system pressures.

#### 3.04 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure and temperature gages at coil inlet connections.

#### 3.05 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush system with clean water. Clean strainers.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
  3. Check expansion tanks to determine that they are not air bound and that system is full of water.
  4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
  5. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  6. Prepare written report of testing.

### 3.06 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
1. Open valves to fully open position.
  2. Check pump for proper direction of rotation.
  3. Set automatic fill valves for required system pressure.
  4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  5. Set temperature controls so all coils are calling for full flow.
  6. Check operation of automatic bypass valves.
  7. Check and set operating temperatures of chilled water and hot water systems.

8. Lubricate motors and bearings.

3.07 CLEANING: Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 230150

## SECTION 23 0160 - MECHANICAL SYSTEMS INSULATION

### PART 1 GENERAL

1.01 Provide required insulation for HVAC ductwork and plumbing piping.

1.02 All ductwork and piping is insulated unless otherwise noted.

#### 1.03 SUBMITTTALS

A. Submit product data for each system. Product data shall include but not be limited to the following:

1. Manufacturer's name
2. Insulation material and thickness
3. Jacket
4. Adhesives
5. Fastening methods
6. Fitting materials
7. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
8. Insulation installation details (manufacturer's installation instructions/details, Contractor's installation details, MICA plates where applicable)
9. Other appropriate data

#### 1.04 QUALITY ASSURANCE

A. All ductwork and piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

B. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this Section of the Specifications. No material may be used that, when

tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

- C. Application Company Qualifications: Company performing the Work of this Section must have a minimum of three (3) years' experience specializing in the trade.
- D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.
- E. All insulation shall be applied in strict accordance with these Specifications and with adequate factory-printed recommendations on items not herein mentioned. Unsightly, inadequate, damaged or water-soaked Work will not be acceptable.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

### 2.02 HVAC PIPING:

- A. Condensate Drain (Above Ground): Armstrong's "Armaflex AP" pipe insulation, 1/2" thick.
- B. Refrigerant
  - 1. Insulate with "Armaflex AP" pipe insulation, 1/2" thick for the following:
    - a. All Suction Lines.
    - b. Mixed Phase lines for ductless split systems.
    - c. Suction and Liquid lines for dedicated 100% outside air split systems.

### 2.03 MANUFACTURERS

- A. CertainTeed Corporation.
- B. Johns Manville Corporation.
- C. Knauf Corporation.
- D. Owens-Corning.
- E. Unifrax 1 LLC (FyreWrap).
- F. Armacell

## 2.04 INSULATION MATERIALS

- A. Type D1: Flexible glass fiber; ASTM C553 and ASTM C1290; commercial grade; 'k' value of 0.25 at 75 degrees F; 1.5 lb/cu ft minimum density; 0.002 inch foil scrim kraft facing for air ducts.
- B. Type D2: Rigid glass fiber; ASTM C612, Class 1; 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; 0.002 inch foil scrim kraft facing for air ducts.
- C. Type D3: Ductliner (to be used in return air sound boots only), flexible glass fiber; ASTM C1071; Type II, 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable acrylic surface coating specifically formulated to:
  - 1. Be no more corrosive than sterile cotton when tested in accordance with the test method for corrosiveness in ASTM C665.
  - 2. Absorb no more than 3 percent by weight when tested in accordance with the test method for moisture vapor sorption in ASTM C1104.
  - 3. Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM C1071, ASTM C1338, ASTM G21, and ASTM G22.
  - 4. Show no signs of warpage, cracking, delaminating, flaming, smoking, glowing, or any other visibly negative changes when tested in accordance with the test method for temperature resistance in ASTM C411.
  - 5. Have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.
  - 6. Meet the sound absorption requirements when tested in accordance with the test method for sound absorption in ASTM C423.
  - 7. Show no evidence of continued erosion, cracking, flaking, peeling, or delamination when tested in accordance with the test method for erosion resistance in UL181.
- D. Type D4: Fire Rated Grease Duct Insulation (High Temperature Flexible Blanket); 1-1/2-inch thick refractory grade fibrous fire barrier material with minimum service temperature design of 2,000 degrees F; aluminum foil laminated on both sides; with a minimum 'k' value of 0.25 and a minimum density of 6 lbs/cu ft; containing no asbestos. Listed by a nationally recognized testing laboratory (NRTL) UL to meet ASTM E 2336, ASTM E119, and with flame spread/smoke minimum rating of 25 / 50 when tested as per ASTM E84/UL 723.

- E. Type D5: Outdoor Duct Insulation (Closed Cell Flexible Elastomeric Insulation); 1 inch thick material that has a service temperature range from –60 degrees F to 180 degrees F. This outdoor duct insulation meets ASTM C 177 or C 518 and shall have minimum ‘k’ value of 0.27 Btu-in. / hr-ft<sup>2</sup>- degrees F at minimum density measurement of 3 lb/cu ft. The insulation and outside surface must be protected with a white Thermo Plastic Rubber Membrane formulated to:
1. Be resistant to UV, and ozone, acid rain, and physical elements produced from outdoor weather per ASTM E 96 Procedure A.
  2. Have aflame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with the test method for surface burning in ASTM E 84.
  3. Show no evidence of continued erosion, delaminating, cracking, flaking, or peeling when tested in accordance with the test method for erosion resistance in UL181. Be resistant to mold growth resistance, ASTM G 21/C 1338 resistant to fungi, and resistant to bacteria growth per ASTM G 22.
- F. Type D6: Ductliner (to be used in return air sound boots only), flexible glass fiber; ASTM C1071; Type II, ‘k’ value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity. The airstream surface must be protected with a durable polyacrylate copolymer emulsion specifically formulated to:
1. Not support the growth of fungus or bacteria, when tested in accordance with the test method for fungi resistance in ASTM D 5590 with “0” growth rating.
  2. Act as a fungicidal protective coating: water based, VOC < 50 g/l. Fungicidal coating must be EPA registered for use in HVAC duct systems. Manufacturer: H.B. Fuller Construction Products Inc., Foster 40-20 (white) or 40-30 (black) Fungicidal Protective Coating or approved equal. Coatings may also be used to repair damage to duct liner insulation.
- G. High Density Duct Insulation Insert, see Type D2.

## 2.05 INSULATION ACCESSORIES

- A. Adhesives: Waterproof vapor barrier type, meeting requirements of ASTM C916; Childers CP-82 or Foster 85-20/85-60.
- B. Weather Barrier: Breather Mastic: Childers CP-10/CP-11 or Foster 46-50 White.
- C. Vapor Barrier Coating: Permeance - ASTM E 96, Procedure B, 0.08 perm or less at 45-mil dry film thickness, tested at 100F and 50%RH; Foster 30-65 or Childers CP-34



1. When higher humidity levels may be of concern, only specify the following fungus/mold resistant coating: Foster 30-80 AF (anti-fungal). Coating must meet ASTM D 5590 with 0 growth rating\*\*
- D. Reinforcing Mesh: 10x10 or 9x8 glass mesh; Foster Mast a Fab or Childers #10
- E. Jacket: Pre-sized glass cloth, minimum 7.8 oz/sq yd.
- F. Type D4 Insulation Adhesive: Fire resistive to ASTM E84, Childers CP-82 or Foster 85-20.
- G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- H. Joint Tape: Glass fiber cloth, open mesh.
- I. Tie Wire and Wire Mesh: Annealed steel, 16 gage.
- J. Stainless Steel Banding: 3/4-inch wide, minimum 22 gage, 304 stainless.
- K. Armaflex 520, 520 BLV, or Foster 85-75 contact adhesive.
- L. Armatuff 25 white seal seam tape.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The application of all insulation shall be performed by experienced mechanics, regularly employed in the trade, in a neat and workmanlike manner. Unless otherwise specified to a greater quality, the application of all insulation shall be in accordance with the manufacturer's recommendations.
- B. Omit insulation from the following items:
  1. Exposed plated plumbing pipe.
  2. Vents to atmosphere, discharge from safety and relief valves, overflow pipes, and hot only drain pipes.
  3. Valves, unions, flanges, traps, strainers, and devices in HOT ONLY piping.
- C. Foil-Faced (FF) Duct Insulation shall comply with NFPA Standards 90A and 90B.
- D. All exposed ends of pipe insulation shall be pointed up neatly with appropriate insulating cement, or use pre-molded PVC end caps on cold only piping and preformed aluminum end caps on dual-temp, hot or steam piping.
- E. Provide high density insert at duct hangers. Maintain vapor barrier between insulation and duct hanger. Do not insulate duct hangers or supports.

### 3.02 DUCT AND PIPE PREPARATION

- A. Verify that piping and ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.
- C. Maintain required ambient temperature during and after installation for a minimum period of 24 hours.

### 3.03 ARMAFLEX PIPE INSULATION

- A. Apply in strict accordance with latest edition of Armstrong's "Installation Instructions to the Contractor". Joints and seams shall be sealed moisture tight without gaps and openings in the insulation

### 3.04 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Extend duct insulation without interruption through walls, floors, and similar penetrations, except where otherwise indicated.
- D. Provide external insulation on all round ductwork connectors to ceiling diffusers and on top of diffusers as indicated in the Ductwork Insulation Application and Thickness Schedule and the Drawings. Secure insulation to the top of ceiling diffusers with UL181B-FX listed polypropylene duct tape Do not insulate top of ceiling diffuser if it is used in ceiling return air plenum or in an open space with no ceiling.
- E. Flexible and Rigid fiberglass insulation (Types D1 and D2) application for exterior of duct:
  - 1. Secure flexible insulation jacket joints with vapor barrier adhesive, tape. Tape shall be UL181B-FX listed polypropylene duct tape.
  - 2. Install without sag on underside of ductwork. Use 4-inch wide strips of adhesive on 8-inch centers and mechanical fasteners where necessary to prevent sagging. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
  - 3. Insulate standing seams and stiffeners that protrude through the insulation with 1-1/2 inch thick, unfaced, flexible blanket insulation. Cover with reinforcing mesh and coat with vapor barrier finish coating.

4. On circumferential joints, the 2-inch flange on the facing shall be secured with 9/16 inch outward clinch steel staples on 2-inch centers, and taped with minimum 3-inch wide strip of glass fabric and finish coating.
  5. Vapor seal all seams, joints, pin penetrations and other breaks with vapor barrier coating reinforced with reinforcing mesh.
- F. Duct Liner (Type D3 or D6) application for interior of return air sound boots or return air plenums:
1. Secure insulation with 100 percent coverage of duct liner adhesive, pins and clips not more than 18 inches on center.
  2. Secure bottom of duct insulation using alternate single and double clips. The first pin will secure the insulation and the second clip will be used to secure the cladding. Isolate the exterior clip from the cladding by using two 1/8 inch closed cell neoprene (Armaflex) washers on either side of the cladding. Pre-drill holes in cladding and avoid contact with pin during installation.
  3. For round duct, secure insulation with 100 percent coverage of duct liner adhesive. Secure cladding with 3/4 inch, 0.020 inch stainless steel bands on 12-inch centers.
  4. For joints and overlaps, fold cladding to form a double thickness hem 2 inches minimum. Seal with a non-shrink, non-hardening sealing compound.
  5. Type D6: Provide fungicidal coating in air handlers ten feet on either side, first ten feet downstream of cooling coils, ten feet downstream of mix boxes, in mechanical rooms or as otherwise specified in potentially high humidity areas in the duct system shall be coated with a fungicidal coating; EPA registered for use in HVAC duct systems at a coverage rate of 80 ft<sup>2</sup>/gallon.
- G. Insulation (Type D4) application for exterior of grease ducts:
1. External duct wrap system requires two (2) 1.5-inch layers of lightweight, flexible wrap overlapped to provide an effective fire barrier. The barrier is installed in 24-inch or 48-inch wide sections. Insulation pins are welded in certain locations to maintain the fire barrier material up against the duct.
  2. Grease duct doors to be installed so the door can be removed and re installed and meet code requirements.
  3. Install duct wrap as tested per manufacturer's instructions to assure the duct wrap is mechanically attached per the manufacturer's spacing of bands or weld pins.
  4. Vertical and horizontal members of the support hanger system shall be wrapped with one layer of the insulation. Vertical and horizontal portions shall be wrapped independent of one another. The horizontal hanger shall be removed from the

vertical support rods and wrapped and then immediately replaced so that an adjacent horizontal support can be removed, wrapped, and reinstalled. The end of the threaded vertical rod shall extend 6-inch past the horizontal member at the beginning of the installation.

5. Penetrations: Where ducts penetrate fire rated walls, floors and roofs, the duct wrap shall be used in conjunction with a firestop system that is listed by a nationally recognized laboratory and rated for penetration of a rated wall or floor by the fire rated grease duct system used.
- H. Insulation (Type D5) application for outdoor ducts:
1. Horizontal ductwork located outdoors shall be sloped at a minimum 2-degree angle to prevent the accumulation of water on top of the finished insulated duct. Support members that connect directly to the ductwork are to be insulated with this same material. Keep compression or sharp creases of outdoor insulation to a minimum by distributing the weight of the duct resting on horizontal duct support members.
  2. Follow the insulation manufacturer's installation instructions and procedures to assure the ductwork is properly insulated and that the insulation will meet the manufacturer's warranty requirements.
- I. All ductwork, accessories, and all plenums including metal and masonry construction, etc., shall be insulated as indicated on the Drawings, as specified herein and as required for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.
- J. Flexible ductwork connections to equipment shall not be insulated.
- K. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.
- L. Extreme care shall be taken in insulating high and medium pressure ductwork including all ductwork between the fan discharge and all mixing boxes to ensure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these Specifications are classified as high velocity ductwork.
- M. Where canvas finish is specified use lagging adhesive/coating to prevent mildew in securing canvas. Do not use wheat paste. Use only anti-fungal lagging adhesive that adheres to ASTM D 5590 with 0 growth rating. (Foster 30-36AF, Childers CP-137AF). In addition, cover all exterior canvas-covered insulation with a fire retardant weather barrier mastic.

- N. All supply ductwork in the Project shall be insulated; all exhaust and fume hood exhaust ductwork shall not be insulated, unless used for energy recovery purposes or noted on drawings.
- O. Flexible round ducts shall be factory insulated.

3.05 INSPECTION

- A. Visually inspect the completed insulation installation per manufacturers recommended materials, procedures and repair or replace any improperly sealed joints.
- B. Where there is evidence of vapor barrier failure or “wet” insulation after installation, the damaged insulation shall be removed, duct surface shall be cleaned and dried and new insulation shall be installed.

3.06 DUCTWORK INSULATION APPLICATION AND THICKNESS SCHEDULE

Ductwork System	Application	Insulation Type	Insulation Thickness
Supply Air (Hot, Cold, Combination)	Outside of Mechanical Rooms	D1	2"
	Inside of Mechanical Rooms	D2	1-1/2"
Return Air, Relief Air, and Exhaust Air	All	D1	1"
Outside Air	Treated and Untreated	D1	2"
Kitchen Grease Hood Exhaust Air	All	D4	3"
Duct mounted coils	Inside of Mechanical Rooms	D2	2"
Terminal Unit Heating Coils	All	D1	2"
Supply Air Diffusers	Top of Diffuser	D1	2"
Supply Air Duct	Outdoor Environment	D5	2"
Return, Exhaust Air Duct	Outdoor Environment	D5	1-1/2"
Return Air Sound Boots/Elbows/Return Air Plenums	All	D6	1"

END OF SECTION 23 0160

## SECTION 230184 - REFRIGERANT PIPING

### PART 1 - GENERAL

- 1.01 Do not vent refrigerants to the atmosphere. Install new systems using recovering methods. Evacuate and recover existing systems to be modified or removed.
- 1.02 Submit piping materials, fittings, and refrigeration accessories.

### PART 2 - PRODUCTS

- 2.01 REFRIGERANT PIPING:
  - A. Pipe: Type "K" copper, soft-drawn. Soft-drawn may be used where bending is required on 1-3/8" O.D. and smaller. All other shall be Type "L" Copper, hard-drawn, marked "ACR".
  - B. Fittings: Wrought copper or forged brass for refrigerant use.

### PART 3 - EXECUTION

- 3.01 REFRIGERANT PIPING:
  - A. To be installed by machine mechanics skilled in this type work, and in accordance with recognized industry standards.
  - B. Make joints with "Sil-Fos" backed with nitrogen.
  - C. Piping and specialties to be sized and installed as recommended by the manufacturer of refrigerant piping.
  - D. Pre-charged lines may be used with approval of Engineer. These lines shall be installed as recommended by the unit manufacturer. Check and adjust charge after installation.
  - E. Isolate piping from building structure to prevent transmitting equipment vibration.
  - F. Installation:
    - 1. Minimum Requirements: Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
    - 2. Testing:

- a. General: Every refrigerant containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively.
- b. Test Medium: Oxygen, or any combustible gas, or combustible mixture of gases shall not be used within the system for testing. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-relief device, and a gage on the outlet side. Set the pressure-relief device above the test pressure but low enough to prevent permanent deformation of the system components.
- c. System Test and Charging: Recommended by the equipment manufacturer or as follows:
  - 1) Connect source or refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 10 psig. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
  - 2) Connect a source of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Refer to Table For Test Pressures. Test entire system again for leaks.
  - 3) Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in microns. Pull the system down to 100 microns and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

END OF SECTION

## SECTION 230705

### HIGH PRESSURE DUCTWORK

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK:

- A. Extent of high pressure ductwork is indicated on drawings and in schedules, and by requirements of this section. High pressure ductwork is hereby defined as supply ductwork between air handling units and terminal air boxes, see drawings for pressure classes.

##### 1.02 QUALITY ASSURANCE:

- A. Installer: A firm with at least 3 years of successful installation experience on projects with high pressure ductwork systems work similar to that required for project.
- B. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards" for fabrication and installation of high pressure ductwork.
- C. ASHRAE Standards: Comply with ASHRAE Handbook, 1988 Equipment Volume, Chapter 1 "Duct Construction," for fabrication and installation of high pressure ductwork.
- D. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
- E. Field Reference Manual: Have available at project field office, copy of "SMACNA HVAC Duct Construction Standards - current edition."

##### 1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork and duct sealants, used for work of this section.
- B. Submit duct leakage tests.

##### 1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosure with waterproof wrapping.

#### PART 2 - PRODUCTS

##### 2.01 DUCTWORK MATERIALS:



- A. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lock-forming quality, with ANSI/ASTM A 525, G90 zinc coating; mill phosphatized for exposed locations.

## 2.02 MISCELLANEOUS DUCTWORK MATERIAL:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch take-off connections. Where 90 degree branches are indicated, provide conical type tees.
- C. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
- D. Duct Cement: Non-hardening, migrating mastic or liquid neoprene based cement (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
- E. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
  - 1. Except where space is indicated as "High-Humidity area, interior support materials of not less than 1/4" diameter or 3/16" thickness may be plain (not galvanized).
  - 2. For exposed stainless steel ductwork, provide matching stainless steel support materials.
- F. Flexible Duct: Furnish and install where indicated on the drawings semi-rigid lightweight aluminum duct. Duct to be manufactured using a soft aluminum strip which is spirally wound and mechanically joined. Duct to be listed under UL #181 Class 1 and NFPA 90A. Insulation shall be 1-1/2" thick, 3/4 lb. density fiberglass blanket, maximum "K" value of 0.25 btu-in/hr.-ft-F and vapor barrier shall be metalized Mylar film. Semi-rigid duct shall be rated for 12" positive and 12" negative static pressure. Duct to be equal to Flexmaster Type TL-M. Vinyl or non-aluminized vapor barriers will not be allowed. Maximum runouts shall not exceed lengths indicated on drawings.
- G. Access Doors: Access doors in high velocity ducts shall be equal to Semco Type 5-3L. Door shall be rated for installation in duct systems with pressures up to 8 in w.g. Where required for fire dampers, door shall be furnished as a factory fabricated unit along with extended sleeve and fire damper (installed downstream of fire reinforced corners). Door shall be 20 gage galvanized steel sheet with 1" inch thick foil faced duct liner insulation, sandwiched to 22 gage perforated inner liner. Door panel shall have spring clips designed to relieve a minimum of 150 cfm at 2-1/2" negative. Panels shall be: 12" x 12" on ducts less than 12" diameter; 12" x 18" on ducts from 12" to 24" diameter; and 18" x 18" on ducts from 26" to 36" diameter.

2.03 FABRICATION:

- A. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs.
- B. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Standards."
- C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with centerline radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
- D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.

2.04 FACTORY-FABRICATED DUCTWORK:

- A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Round Ductwork:

- 1. Construct of galvanized sheet steel complying with ANSI/ASTM A 527 by the following methods and in minimum gages listed.

<u>DIAMETER</u>	<u>MINIMUM GAGE</u>	<u>METHOD OF MANUFACTURE</u>
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam
51" to 60"	18	Spiral Lockseam
over 60"	16	Longitudinal Seam

- 2. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.
- 3. Fittings and Couplings: Construct of minimum gages listed. Provide continuous welds along seams.

<u>DIAMETER</u>	<u>MINIMUM GAGE</u>
3" to 36"	20
38" to 50"	18
Over 50"	16

- C. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lockseam construction, in minimum gages listed.

<u>MAXIMUM WIDTH</u>	<u>MINIMUM GAGE</u>
Under 25"	24
25" to 48"	22
49" to 70"	20
Over 70"	18

1. Fittings and Couplings: Construct of minimum gages listed. Provide continuous weld along seams.

<u>MAXIMUM WIDTH</u>	<u>MINIMUM GAGE</u>
Up to 8"	22
8" to 37"	20
37" to 50"	18
Over 50"	16

- D. Internally Insulated Duct and Fittings: Construct with outer pressure shell, 1" thick insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lockseam construction (use longitudinal seam for over 59"), in minimum gages listed.

<u>ROUND NOMINAL DUCT</u>		
<u>DIAMETER</u>	<u>OUTER SHELL</u>	<u>INNER LINER</u>
3" to 12"	26 ga.	28 ga.
13" to 24"	24 ga.	28 ga.
25" to 34"	22 ga.	28 ga.
35" to 48"	20 ga.	28 ga.
49" to 58"	18 ga.	28 ga.
Over 59"	16 ga.	28 ga.

<u>FLAT OVAL OUTER DUCT</u>		
<u>MAJOR AXIS</u>	<u>OUTER SHELL</u>	<u>INNER LINER</u>
To 12"	26 ga.	28 ga.
13" to 24"	24 ga.	28 ga.
25" to 34"	22 ga.	28 ga.
35" to 48"	20 ga.	28 ga.
49" to 58"	18 ga.	28 ga.

1. Fittings and Couplings: Construct of minimum gages listed. Provide continuous weld along seams of outer shell.

2. NOMINAL DUCT

<u>DIAMETER</u>	<u>OUTER SHELL</u>	<u>INNER LINER</u>
3" to 34"	20 ga.	20 ga.
36" to 48"	18 ga.	20 ga.
Over 48"	16 ga.	20 ga.

3. Inner Liner: Perforate with 3/32" holes for 22% open area. Provide metal spacers welded in position to maintain spacing and concentricity.
4. Hospital grade insulation shall completely fill the 1" space between the liner and the outer shell and shall have the following UL ratings:

<u>Flame Spread</u>	<u>10-20</u>
<u>Fuel Contributed</u>	<u>10-15</u>
<u>Smoke Developed</u>	<u>10-20</u>

5. At the end of an insulated section or run, where internally insulated duct connects to insulated spiral duct or fittings, fire damper or flex, a manufactured insulation end fitting shall be installed to bring the outer pressure shell down to nominal size.

E. Fittings shall be equal to Semco Mfg., Inc. machine formed fittings as follows:

1. 90 degree elbow - 10 inch and smaller ..... E901
2. 45 degree elbow - 10 inch and smaller ..... E451
3. 90 degree elbow - over 10 inch..... E905
4. 45 degree elbow - over 10 inch..... E453
5. 90 degree conical tee..... CT
6. 90 degree reducing conical tee..... CTR
7. 180 degree conical cross ..... CC
8. 180 degree conical cross, reducing ..... CCR
9. 45 degree lateral..... L
10. 45 degree double lateral cross..... LC
11. 45 degree reducing lateral..... LR
12. 45 degree double reducing lateral ..... LDR
13. Two-way "Y" ..... WYE
14. Concentric Reducer..... RC
15. Non-Concentric Reducer ..... RE
16. Coupling (Male)..... CPL-M
17. Coupling (Female) ..... CPL-F
18. Offset ..... OFF
19. Round to Oval Transition (Concentric) ..... RC
20. Round to Oval Transition (Non-Concentric) ..... RE

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:

1. Semco, Inc.
2. McGill Airflow, LLC.
3. Spiral Pipe of Texas

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF DUCTWORK:

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve an airtight system and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true-to-shape and to prevent buckling.

### 3.02 DUCT SEALING

A. Seal supply, return and exhaust ductwork per SMACNA high pressure standards with mastic equal to "Hard Cast" FTA-20 with DT tape for indoor use and RTA-50 with DT tape for outdoor use.

1. Seal per SMACNA Standards to achieve airtight system.

2. Duct Seal Levels:

Duct Location	Duct Type		
	Supply	Exhaust	Return
Outdoors	A	A	A
Unconditioned Spaces	A	B	B
Conditioned spaces (concealed ductwork)	B	B	B
Conditioned spaces (exposed ductwork)	B	B	B
Lab and Animal Room Exhaust		A	A

3. Seal Level Description:

Seal Level	Sealing Requirements
A	All transverse joints, longitudinal seams, and duct wall penetration
B	All transverse joints and longitudinal seams
C	Transverse joints only

4. Seal ductwork, after installation, in accordance with recommendations of SMACNA Standards.

5. All high velocity ductwork joints shall be either welded or joint shall be sealed.

6. Water-Based Joint and Seam Sealant:

- a. Application Method: Brush on.
- b. Solids Content: Minimum 65 percent.
- c. Shore A Hardness: Minimum 20.
- d. Water Resistant.
- e. Mold and Mildew Resistant.
- f. VOC: Maximum 75g/L (less water).
- g. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- h. Service: Indoor or Outdoor.
- i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

7. Flanged Joint Sealant: Comply with ASTM C 920.

- a. General: Single-component, acid curing, silicone, elastomeric.
- b. Type: S.

- c. Grade: NS.
  - d. Class: 25.
  - e. Use: O.
- B. Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work. Drilled expansion anchors selected and installed as directed by manufacturer may be used. Expansion anchors shall be equal to "Phillips Red Head", verify with structural engineer that drilled anchors are suitable for the deck design.
  - C. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
  - D. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Where possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
  - E. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.
  - F. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2".
  - G. Where ducts pass through fire-rated floors, walls, or partitions, install fire dampers, provide firestopping between duct and substrate.
  - H. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
  - I. Support ductwork in manner complying with SMACNA "HVAC Duct Standards."

### 3.03 CLEANING AND PROTECTION:

- A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

- C. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.04 TESTING FOR LEAKAGE:

- A. General: After each duct system is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual, 1995 Edition. Repair leaks and repeat test until total leakage is less than limits outlined in the manual.

END OF SECTION

## SECTION 23 0710 - HVAC SHEET METAL

### PART 1 - GENERAL

#### 1.01 SCOPE:

- A. All low pressure duct work including supply, exhaust, and outside air to complete the systems as shown on the Drawings or specified herein.

#### 1.02 SUBMITTALS:

- A. Submit the following:
  - 1. Air distribution devices.
  - 2. Life safety dampers and doors.
  - 3. Flexible duct.
  - 4. Flexible connections.
  - 5. Access doors and duct access doors.
  - 6. Turning vanes.
  - 7. Duct take-off, fittings.
  - 8. Roof outside air intake.
  - 9. Duct sealants.
  - 10. Duct leak tests.

#### 1.03 GOVERNING PUBLICATIONS AND AUTHORITIES:

- A. ASHRAE "Guide".
- B. SMACNA "Low Velocity Duct Construction Standards".
- C. Underwriters' Laboratories, Inc.
- D. NFPA Pamphlets No. 90A, 90B, 91 and 96.

### PART 2 - PRODUCTS

#### 2.01 DUCT MATERIALS:

- A. Unless noted otherwise, galvanized steel sheets shall be lock-forming quality (LFQ), shall have a galvanized 690 zinc coating of 1-1/4 oz. total for both sides of one square foot, and the gauge of galvanized steel sheets shall be as prescribed by the latest edition of SMACNA for pressure classification of ductwork.
- B. Stainless steel ducting shall be used from fume hood connections to exhaust main



downstream of general exhaust point of dilution.

- B. Aluminum sheets shall be made from an aluminum base alloy having not more than 0.5% copper (for corrosion resistance), a minimum tensile strength of 16,000 psi and the ability to satisfactorily make a Pittsburgh lock seam without splitting.

#### 2.02 FLEXIBLE CONNECTIONS:

- A. Flexible connections shall be made on duct connections of air moving equipment greater than 2000 CFM or as required for equipment installation.
- B. Connections shall be made of 30 ounce woven glass fabric; fire-, water-, and weather-resistant fabric equal to "Ventfab", double coated with neoprene "Ventglas", or equal. Canvas connections to give no less than 3" clear break between metals jointed. Insulate with 1" minimum fiberglass duct wrap with a vapor barrier facing of foil reinforced kraft. Seal with reinforced aluminum tape.
- C. Flexible connections on exterior shall be protected from weather with sheetmetal cover which shall be coated for protection same as ductwork.
- D. Connections in high pressure systems, fume hoods, and for those exposed to the weather shall be made from "Ventglas", neoprene coated glass fabric.

#### 2.03 ACCESS DOORS:

- A. Access doors to 16" by 24" size shall be "Ventlock" stamped insulated access doors.
- B. Larger access doors shall be double panel construction with one inch thick 1.5 pcf density rigid insulation between panels. Doors with largest dimension over 24", but less than 48", shall use "Ventlock" series 200 latches, hinges and gasketing, and construction shall be 22 gage galvanized steel. Doors with largest dimension over 48" shall use "Ventlock" series 300 latches, hinges and gasketing, and construction shall be 20 gage galvanized steel.
- C. Provide vision panels on access doors for fire dampers and control dampers.

#### 2.04 FLEXIBLE DUCT:

- A. Low Pressure: furnish and install, where indicated on the drawings, flexible metal insulated round ductwork, factory fabricated, listed under U.L. #181, Class 1 and NFPA 90A, capable of a minimum centerline bend radius equal to duct inside diameter. Insulation shall be 1-1/2" thick, 3/4 lb. density fiberglass blanket, maximum "K" value of 0.25 btu-in/hr-ft<sup>2</sup>-EF., and vapor barrier shall be neoprene coated fiberglass fabric laminated to aluminized polyester film. Flexible duct shall be rated for 10" positive and 2" negative static pressure.
- B. Vinyl or non- aluminized vapor barriers will not be allowed. Maximum runouts shall not exceed length indicated on drawings in notes or details.

#### 2.05 AIR DISTRIBUTION DEVICES:

- A. General:

1. All outlet grilles shall have gaskets.
2. Furnish opposed blade volume controls on all supply outlets and return grilles.

B. Devices: Devices shall be as scheduled on the drawings.

#### 2.06 LIFE SAFETY DAMPERS:

- A. Dampers shall be equal to those manufactured by the Ruskin Corporation or Greenheck.
- B. Dampers shall be U.L. listed.
- C. Fire, smoke or combination fire/smoke dampers shall be provided in rated assemblies requiring them.
- D. All dampers, methods and location of installation shall comply with the requirements of the International Building Code, National Fire Protection Association and all authorities having jurisdiction. In the case of discrepancies, most stringent requirements shall dictate installation.
- E. Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. Access shall be provided on either side of damper assemblies.
- F. Access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly.
- G. Provide access door minimum 12" x 12".
- H. Access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch (12.7 mm) in height reading: fire/smoke damper, smoke damper or fire damper.
- I. Access doors in ducts shall be tight fitting and suitable for the required duct construction. Contractor shall install dampers in accordance with the following:
- J. Fire dampers shall be constructed and tested in accordance with UL Safety Standard 555. Dampers shall have an hourly rating as indicated on the drawings, a 212°F fusible link, and shall include a UL label.
- K. All outlet grilles shall have gaskets.
- L. Contractor shall furnish opposed blade volume controls on all supply outlets and return grilles.
- M. Dampers shall be equipped for vertical or horizontal installation as required by the location.
- N. Manufacturer's integral sleeves and frames may be used at the contractor's option.
- O. Dampers shall be provided which are tested and rated for design duct velocity and pressure.

- P. Dampers rating shall meet or exceed the rating of the wall in which it is housed.
- Q. Contractor shall install fire or smoke or combination dampers in all rated walls as necessary to maintain the integrity of all rated walls whether indicated on the plans or not.

2.07 ACCESSORIES:

- A. Manufactured Turning Vanes: Furnish and install single thickness, multiple radius, airfoil steel turning vanes. Static pressure loss for square ducts shall be no more than 20% of velocity head. Turning vanes shall be furnished with a mounting plate to facilitate installation in ductwork.
- B. Manual Balancing Damper:
  - 1. Square or Rectangular: Minimum 16 ga. body and 18 ga. blades, equal to Ruskin or Greenheck with vinyl blade seal and locking hand operator quadrant.
  - 2. Round: Minimum 20 ga. body and 22 ga. blades, equal to Ruskin or Greenheck with locking hand operator
- C. Control Dampers:
  - 1. Control dampers shall be furnished by AHU Manufacturer or Control System.
- D. All dampers shall be capable of 100% seal off.

PART 3 - EXECUTION

3.01 GENERAL:

- A. All ductwork not specifically indicated on drawings or specified elsewhere to be high- pressure duct shall be fabricated, braced and erected in accordance with SMACNA "Low Velocity Duct Construction Standard" or the latest edition of ASHRAE "Guide".
- B. Ductwork shall be galvanized steel unless otherwise noted.
- C. Stainless steel and aluminum ductwork shall welded seam.
- D. Adhere to drawings as closely as possible. However, where required to meet structural or other interferences vary the run and shape of ducts and make offsets during progress of work. Duct routes shall be established and field measurements shall be taken before duct work is fabricated. Where pipes or other items are "taken-in" to the duct, streamline collars shall be formed and placed around the item. If collar obstructs more than 20% of the cross sectional area, the duct shall be enlarged to accommodate obstruction.
- E. All changes of direction and elbows shall be fitted with turning vanes. Standard radius elbows may be used if space permits.
- F. Ductwork shall be free of any objectionable self-generating noise or rattles.

- G. Furnish and install shop fabricated ductwork. Pre-assemble work in shop to the greatest extent possible, so as to minimize field assembly of systems. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.
- H. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
- I. Duct Sealing: All ductwork, regardless of system pressure classification, shall be sealed in accordance with Seal Class A, as referenced in SMACNA Standards. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
  - 1. All seams and joints in shop and field fabricated ductwork shall be sealed by applying duct sealant complying with manufacturer's recommendations. Tapes recommended by the sealant manufacturer may be used in addition to sealant to achieve leakage limit requirements.
  - 2. Sealant shall be water based latex UL 181A-M sealant with flame spread of 0 and smoke developed of 0. Sealants shall be Hard Cast Iron Grip 601, Ductmate Pro Seal, Foster 32-19, Childers CP-146 or Design Polymerics DP 1010.
  - 3. Sealing tapes shall be from the same manufacturer as duct sealants.
  - 4. Sealer shall be rated by the manufacturer and shall be suitable for use at the system pressure classification of applicable ductwork.
  - 5. Except as noted, oil or solvent-based sealants are specifically prohibited.
  - 6. For exterior applications, "Uni-Weather" (United McGill Corporation), solvent-based sealant, or Foster 32-19 shall be used.
- J. Support materials shall be hot dipped galvanized steel fasteners, anchors, rods, straps, trim and angles. (Support duct with all thread rods and unistrut as equal trapeze hangers).
- K. Install air flow measuring stations, furnished by Control Contractor, where indicated on the drawings.

### 3.02 MANUAL BALANCING DAMPERS:

- A. All low pressure branch ducts on either supply, return or exhaust shall be provided by some means of balancing in addition to dampers at registers.
- B. Splitter dampers shall be made of at least the same thickness material as duct (minimum thickness 22 gage). They shall be securely hinged at air leaving edge and made of 2 thicknesses so that entering edge presents a rounded surface to air flow.
- C. Butterfly dampers shall be made of 16 gage galvanized steel. Butterfly dampers may be used in widths up to 10" wide. Dampers that require blades over 10" wide shall be multi-blade louver dampers.
- D. Multi-blade louver dampers used for balancing shall be of the opposed blade type.

Damper blades shall be constructed of 16 gage steel. Individual blade width shall not exceed 10" and blade length shall not exceed 48".

- E. All dampers shall be so constructed and installed that there shall be no vibration due to air flow over damper.
- F. Extend all handles and levers to outside of insulation.

3.03 ACCESS DOOR:

- A. Access doors shall be provided at all dampers, equipment in duct and as indicated on drawings.
- B. Access doors shall be minimum of 12" X 12" unless a larger size is required for maintenance of equipment or a smaller size must be used because of small duct size.
- C. Provide access doors at all fire dampers, smoke dampers, humidifiers, and as indicated on the drawings.

3.04 FLEXIBLE CONNECTIONS:

- A. Furnish and install sound isolating flexible connections on the inlet and outlet of each fan and unit to which duct connectors are made.
- B. At least one inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork.
- C. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

3.05 FLEXIBLE DUCT

- A. Maximum runout shall not exceed lengths indicated on drawings.
- B. Ducts shall be supported at intervals indicated in SMACNA and not laid on top of ceiling.
- C. Minimum bend radius shall be as recommended by manufacturer.
- D. Ducts shall be run straight and true with minimum offsets, and with excess duct lengths removed.
- E. Connections to ducts and air devices shall be with minimum of one duct diameter straight into connection (kinked or pinched installations restricting flows are not acceptable).
- F. Connections to duct and air devices shall be air tight.

3.06 TESTS:

- A. Test duct systems in accordance with SMACNA latest edition of HVAC Air Duct Leakage Test Manual to achieve air tight systems not exceeding the limits outlined in the manual. Submit test results.

END OF SECTION

## SECTION 230895

### AIR TERMINAL DEVICES

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK:

- A. Extent of air terminals work required by this section is indicated on drawings and schedules and by requirements of this section.

##### 1.02 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Codes and Standards:**
  - 1. **ADC Compliance:** Provide air terminals which have been tested and rated in accordance with ADC standards, and bear ADC Seal.
  - 2. **AHRI Compliance:** Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.
  - 3. **NFPA Compliance:** Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems."

##### 1.03 SUBMITTALS:

- A. **Product Data:** Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.
- B. **Shop Drawings:** Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
- C. **Maintenance Data:** Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual.

##### 1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

- B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air terminals which may be incorporated in the work include, but are not limited to, the following or equal:
  - 1. Manufacturer: Subject to compliance with requirements, provide air terminals of one
    - a. Price
    - b. Titus Products Div.; Philips Industries, Inc.
    - c. Kreuger

### 2.02 AIR TERMINALS – SUPPLY AND EXHAUST

- A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.
- B. Terminals shall be pressure independent type. Provide with cross-shaped flow sensor, and factory damper ready for installation of box damper actuator and electronic controller provided by control system manufacturer.
- C. The casing shall be constructed of coated steel meeting SMACNA or ASHRAE Standards. Internal insulation shall meet the requirements of NFPA Bulletin 90A and UL 181. Boxes shall have solid galvanized sheet metal liner.
- D. Terminal box shall have 24 volt control voltage provided by control system manufacturer.
- E. Furnish each supply air terminal with heating coil as specified on the drawings. Hot water coils shall be a minimum of two rows.
- F. Control system contractor shall provide readout at the graphical computer interface of the following points:
  - 1. Airflow, CFM
  - 2. Box damper position, and commanded % open.
  - 3. Leaving air temperature, supply terminal only.
  - 4. Heating valve position, and commanded % open, supply terminal only.

### 2.03 Air Terminals – LABORATORY Fume Hood AND GENERAL EXHAUST:

- A. The exhaust terminal shall have an orifice-style sensor with inside diameter not more than one inch smaller than the mounting duct's inside diameter and with at least two sets of pressure taps 90 degrees apart, offset from vertical by 45 degrees. Sensor shall be accurate to +/-1% of flow signal over the duct velocities of 600 FPM to 3000 FPM. Material of construction shall match duct material with series 304 or 316 stainless steel for stainless steel ductwork, or Teflon-coated steel for PVC-coated, PVC or FRP. The exhaust terminal will use a simple butterfly blade type damper and actuator. Damper will be constructed of 304 series stainless steel.
- B. Each exhaust terminal will have a factory-mounted airflow transmitter with output of 4-20 mA proportional to velocity pressure. The airflow transmitter will have an accuracy of at least +/-0.5% of the transmitter range. Any electronic (hot-wire or cool-wire, thermistor, etc.) airflow sensor directly exposed to exhaust airflow shall be UL 913 listed.
- C. The terminal will have a mounted, galvanized steel equipment enclosure with exterior supply connection. The actuator and transmitter will all be housed within this enclosure.
- D. Venturi metering devices are not acceptable.
- E. All volume damper actuators shall be electric.
- F. Terminal box shall have 24 volt control voltage provided by control system manufacturer.
- G. Control system contractor shall provide readout at the graphical computer interface of the following points:
  - 1. Airflow, CFM
  - 2. Box damper position, and commanded % open.

## PART 3 - EXECUTION

### 3.01 INSPECTION:

- A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.02 INSTALLATION OF AIR TERMINALS:

- A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.
- B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.
- C. Label: Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 2300075 "Mechanical Identification" for equipment labels and warning signs and labels.



3.03 FIELD QUALITY CONTROL:

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.
- B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.04 CLEANING:

- A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

## SECTION 23 0990 - TESTING, ADJUSTING, AND BALANCING

### PART 1 - GENERAL

#### 1.01 SUMMARY:

- A. This section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities and temperatures of the mechanical systems as required to meet design specifications, and recording and reporting the results.
1. Test, adjust, and balance the following mechanical systems:
    - a. Supply air systems, all pressure ranges.
    - b. Return air systems.
    - c. Exhaust air systems.
    - d. Outside air systems.
    - e. Verify control system operation.
    - f. Hydronics systems.
  2. Contractor shall:
    - a. Put heating, ventilating, and air conditioning systems and equipment into full operation and continue the operation of same during each working day of testing and balancing.
    - b. Allow the air balance agency to schedule this work in cooperation with other trades involved and comply with the completion date.
    - c. Make available to the balance agency a complete copy of submittal data on mechanical equipment including pump performance curves, fan curves, manufacturer's balancing factors and other manufacturers ratings for installed equipment.
    - d. Make any changes in pulleys, belts, and dampers or the addition of dampers as required for correct balance as recommended by TAB Contractor, at no additional cost to the Owner.
    - e. Have strainers and filters clean prior to starting of testing and balancing activity.
- B. This section does not include:
1. Specifications for materials for patching mechanical systems.
  2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

3. Requirements and procedures for piping and ductwork systems leakage tests.

#### 1.02 DEFINITIONS:

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting building environmental systems to produce design objectives. It includes:
  1. Balance of air and water distribution;
  2. Adjustment of total system to provide design qualities;
  3. Electrical measurement;
  4. Verification of performance of equipment and automatic controls;
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttle valves and dampers to proportion flows within the distribution system (mains, branches, and terminals) according to specified design quantities.
- D. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting and balancing.
- E. Terminal: The point where controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

#### 1.03 SUBMITTALS:

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Technicians Data: Submit proof that the Test and Balance Staff assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.
- D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems.
- E. Sample Forms: Submit sample forms.
- F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Technician. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities

measured, to establish normal operating values of the systems. Follow the procedures and format specified below.

- G. Draft Reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
- H. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
- I. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide contents of binder into the below listed divisions, separated by divider tabs:
  - 1. General Information and Summary
  - 2. Air Systems
  - 3. Hydronic Systems
  - 4. Temperature Control Systems
- J. Report Contents: Provide the following minimum information, forms and data:
  - 1. General Information And Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor and Project. Include addresses, and contact names and telephone numbers. Also include a sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Technician. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
  - 2. The remainder of the report shall contain the appropriate forms for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
  - 3. Air systems report shall include the following:
    - a. blower RPM;
    - b. motor full load amperes and voltages; system static pressures, suction and discharge;
    - c. cfm outside air (for demand controlled ventilation with CO2 sensors, provide airflow readings at 2 different CO2 levels;
    - d. entering air temperatures; DB/WB
    - e. leaving air temperatures; DB/WB

- f. main supply, return, and exhaust air ducts cfm, (pitot transverse);
- g. each diffuser, grille and register cfm. (Balance to within +/-10% of design requirements and pressure relationships shown on drawings.)
- h. each grille, diffuser, and register shall be identified as to location and area;
- i. copies of start-up logs;
- j. space temperatures and humidity readings; DB/WB
- k. pressure drops across coils, filters, dampers, and other equipment in ducts.
- l. pressure profiles of each system.
- m. sheave size, brand name, and number.
- n. belt quantity, stock name, and number.

4. Water systems report shall include the following:

- a. operating temperatures of equipment;
- b. pump flows;
- c. water flow through equipment;
- d. leaving water temperatures and return water temperature of equipment;
- e. water temperatures at inlet side and leaving side of coils. Note rise or drop of temperatures from source;
- f. flow rate on coils for full flow.
- g. pumps operating suction and discharge pressure and final TDH;
- h. rated and actual running amperage of pump motor;
- i. copies of start-up logs.

K. Calibration Reports: Submit proof that required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of 6 months prior to starting the project.

1.04 QUALITY ASSURANCE:

A. Agency Qualifications:

- 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical

systems as required to meet design specifications, and recording and reporting the results.

2. The independent testing, adjusting, and balancing agency shall be certified by National Environmental Balancing Bureaus (NEBB) or Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Technician, certified by NEBB or AABC.

B. B. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
2. AABC: "National Standards for Total System Balance".
3. ASHRAE: ASHRAE Handbook, Current Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

- C. Pre-Balancing Conference: Prior to beginning testing, adjusting, and balancing procedures, schedule and conduct a conference with the Contracting Officer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.05 PROJECT CONDITIONS:

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.06 ACCEPTANCE:

The Contracting Officer will not accept the building until the systems have been properly started, balanced, and the TAB Report is approved.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION

3.01 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:

Before operating the system, perform these steps:

- A. Obtain design drawings and specifications and become thoroughly acquainted with design intent.
- B. Obtain copies of approved shop drawings of air handling equipment, outlets (supply and return) and temperature control diagrams.
- C. Compare design to installed equipment and field installations.
- D. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
- E. Check filters for cleanliness.
- F. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

- G. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- H. Determine best locations in main and branch ductwork for most accurate duct traverses.
- I. Place outlet dampers in full open position.
- J. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
- K. Verify that motors and bearings have been lubricated.
- L. Check fan belt tension.
- M. Check fan rotation.

### 3.02 PRELIMINARY PROCEDURES FOR HYDRONIC SYSTEM BALANCING:

Before operating the system, perform these steps:

- A. Open valves to full open position. Close coil bypass valves.
- B. Verify that all strainers have been cleaned.
- C. Examine hydronic systems and determine if water has been treated and cleaned.
- D. Check pump rotation.
- E. Clean and set automatic fill valves for required system pressure.
- F. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- G. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- H. Set temperature controls so all coils are calling for full flow.
- I. Check operation of automatic bypass valves.
- J. Check and set operating temperatures of equipment to design requirements.
- K. Verify that pump motors and bearings have been lubricated.

### 3.03 3.03 MEASUREMENTS:

- A. A. Provide required instrumentation to obtain proper measurements, calibrated to the tolerances specified in referenced standards. Instruments shall be properly maintained and protected against damage.
- B. B. Provide instruments meeting the specifications of the referenced standards.
- C. C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. D. Apply instrument as recommended by the manufacturer.

- E. E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

3.04 PERFORMING TESTING, ADJUSTING, AND BALANCING:

- A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- B. extent necessary to allow adequate performance of procedures.
- C. Patch insulation, ductwork, and housings, using materials identical to those removed.
- D. Seal ducts and piping, and test for and repair leaks.
- E. Seal insulation to re-establish integrity of the vapor barrier.
- F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar control and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.05 CONTROL SYSTEM VERIFICATION:

- A. In conjunction with Control System Vendor, during the process of TAB work, manipulate control system devices as required to facilitate necessary system TAB. Provide listing of control system components and/or sequences that are not operating properly in TAB report and to Control System Vendor.

3.06 RECORD AND REPORT DATA:

- A. Record data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by referenced standards, and as approved on sample report forms.
- B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.07 DEMONSTRATION:

- A. Training:
  - 1. Train maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with personnel the information contained in Operating and Maintenance Data.
  - 2. Schedule training through the Owner with at least 7 days' prior notice.

END OF SECTION



## INDEX OF SPECIFICATIONS

### DIVISION 26 ELECTRICAL

<u>SECTION</u>	<u>SECTION TITLE</u>
260000	ELECTRICAL GENERAL PROVISIONS
260519	LOW-VOLTAGE CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
260573	ARC-FLASH HAZARD ANALYSIS
262213	LOW-VOLTAGE DISTRIBUTION TRANSFORMERS
262416	PANELBOARDS
262726	WIRING DEVICES
282816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
264810	ENGINE GENERATOR
264820	AUTOMATIC TRANSFER SWITCH
265119	GENERAL LIGHTING
266650	LIGHTNING PROTECTION SYSTEM
271323	COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
271513	COMMUNICATIONS COPPER HORIZONTAL CABLING
283111	DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

## SECTION 260000 - ELECTRICAL - GENERAL PROVISIONS

### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required and install complete and make operational, electrical system as shown on the Drawings and as specified herein.
- B. The work shall include the following:
  - 1. Provide conduit, wire and field connections for all equipment, HVAC systems, panelboards, transformers, and electrical equipment furnished under Divisions 1, 11, 21, 22, 23, and 26.
- C. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work under this sub-bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the buildings and structures and noted the locations and conditions under which the work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work.

#### 1.2 SUBMITTALS

- A. As a minimum all equipment specified in each Section of Division 26 shall be submitted at one time. As an example all lighting fixtures shall be submitted together, all motor control centers shall be submitted together, etc. Submittals that do not comply will be returned disapproved.
- B. Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude parts not applicable to the project. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submittal piece of literature and each submittal drawing shall clearly reference the Project Specification and/or Contract Drawing that the submittal is to cover. General catalogs will not be accepted as cut sheets to fulfill submittal requirements.
- C. Check shop drawings for accuracy prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to this Section and the Drawings. This statement shall also list all exceptions to this Section and the Drawings. Mark submittals to identify proposed equipment including accessories, options and features being proposed for approval and exclude parts not to be used. Shop drawings not so checked and noted shall be returned marked NOT APPROVED.
- D. The Engineer's check shall be for conformance with the design concept of the project and compliance with this Section and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by this Section and the Drawings.

- E. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
- F. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."
- G. Operation and Maintenance Data
  - 1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 017823. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists including replacement part numbers, to instruct operating and maintenance personnel unfamiliar with such equipment.
  - 2. Manuals shall include the following as a minimum:
    - a. A complete "As-Built" set of approved shop drawings.
    - b. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
    - c. Detailed service, maintenance and operation instructions for each item supplied.
- H. Exceptions for Submittals
  - 1. Exceptions to the Specifications or Drawings shall be clearly defined by the Electrical Subcontractor in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the Specifications shall be at the sole discretion of the Engineer.
- I. Submittals will be returned to the Contractor under one of the following codes.

Code 1 - "APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 - "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 - "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may, at his own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 10 calendar days of the date of the Engineer's transmittal requiring the confirmation.

Code 4 - "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

Code 5 - "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 - "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Code 7 - "RECEIPT ACKNOWLEDGED" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval; and, is being filed for informational purposes only. This code is generally used in acknowledging receipt of *means and methods of construction* work plan, field conformance test reports, and Health and Safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

### 1.3 REFERENCE STANDARDS

- A. Electric equipment, materials and installation shall comply with the National Electrical Code (NEC).
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

### 1.4 PRIORITY OF THE CONTRACT DOCUMENTS

- A. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.
- B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.
- C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.
- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times

#### 1.5 SERVICE AND METERING

- A. Service will be obtained at 480 Volts, 3Phase, 4Wire, 60 Hz from the campus primary loop.

#### 1.6 CODES, INSPECTION AND FEES

- A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.
- B. Obtain all necessary permits and pay all fees required for permits and inspections.

#### 1.7 INTERPRETATION OF DRAWINGS

- A. Unless specifically stated to the contrary, the Drawings do not show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.
- B. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.
- C. Conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed. Unless otherwise indicated install branch circuit conduits exposed in process/ industrial type spaces and concealed in finished spaces.
- D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation. Where home-runs indicate conduit is to be installed concealed or exposed the entire branch circuit shall be installed in the same manner.
- E. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- F. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

- G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials to install and place in satisfactory operation all power, lighting and other electrical systems shown.
- H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.
- I. Raceways and conductors for low voltage (120 Volts) thermostats controlling HVAC unit heaters, exhaust fans and similar equipment are not shown on the Drawings. Provide raceways and conductors between the thermostats, the HVAC equipment and the motor starters for a complete and operating system. Raceways shall be installed concealed in all finished space and may be installed concealed or exposed in process spaces. Refer to the HVAC drawings for the locations of the thermostats.

#### 1.8 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which electrical equipment furnished under Division 26 must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

#### 1.9 RECORD DRAWINGS

- A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings."

#### 1.10 MATERIALS AND EQUIPMENT

- A. Materials and equipment furnished under this contract shall be new.
- B. Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

#### 1.11 EQUIPMENT IDENTIFICATION

- A. Identify equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 26 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.
- B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.
- C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided

foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

## PART 2 EXECUTION

### 2.1 INSTALLATION

- A. Work not installed according to the Drawings and Specification shall be subject to change as directed by the Engineer at Contractor's expense.
- B. Electrical equipment shall be protected against mechanical and water damage. Store all electrical equipment in dry permanent shelters. Do not install electrical equipment in place until structures are weather-tight.
- C. Damaged equipment shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion and at the Contractor's expense.
- D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer.

### 2.2 WORK SUPERVISION

- A. The Contractor shall designate in writing the qualified electrical supervisor who shall provide supervision to all electrical work on this project. The minimum qualifications for the electrical supervisor shall be a master electrician as defined by the Arkansas Board of Electrical Examiners. The supervisor or his appointed alternate possessing at least a journeyman electrician license shall be on site whenever electrical work is being performed. The qualifications of the electrical supervisor shall be subject to approval of the Owner and the Engineer.
- B. All master and journeyman electricians shall be licensed in accordance with Arkansas Code Title 17 Chapter 28 - Electricians. The website located at <http://www.arkleg.state.ar.us> publishes the text of this statutory requirement. No unlicensed electrical workers shall perform work on this project. Apprentice electricians in a ratio of not more than one apprentice per journeyman electrician will be allowed if the apprentices are licensed and actively participating in an apprenticeship program recognized and approved by the Arkansas Board of Electrical Examiners.

END OF SECTION 260000

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

##### B. Related Requirements:

1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
2. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Product Schedule: Indicate type, use, location, and termination locations.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 COPPER BUILDING WIRE

##### A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

##### B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cerro Wire LLC.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

##### C. Standards:



1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  2. RoHS compliant.
  3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
  2. Type RHH and Type RHW-2: Comply with UL 44.
  3. Type USE-2 and Type SE: Comply with UL 854.
  4. Type THHN and Type THWN-2: Comply with UL 83.
  5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  6. Type XHHW-2: Comply with UL 44.

## 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
  2. Type: One hole with long barrels.
  3. Termination: Compression.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- B. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

#### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 3. Thomas & Betts Corporation; A Member of the ABB Group.

#### 2.3 CONDUCTORS

- A. Conductors shall be as specified under Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with stainless-steel bolts.
    - a. Material: Die-cast zinc alloy.
    - b. Listed for direct burial.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install barecopper conductor, **No. 4/0** AWG minimum.
  - 1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

### PART 2 - PRODUCTS

#### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

##### A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.



- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 6. Toggle Bolts: All-steel springhead type.
  - 7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA 101

- B. Comply with requirements in "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS AND FITTINGS

##### A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Allied Tube & Conduit; a part of Atkore International.
  - b. Republic Conduit.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - a. Comply with NEMA RN 1.
  - b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Allied Tube & Conduit; a part of Atkore International.
  - b. Republic Conduit.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: Compression.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. CANTEX INC.
  - b. RACO; Hubbell.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.
2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. CANTEX INC.
  - b. RACO; Hubbell.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 based on installation location, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Crouse-Hinds, an Eaton business.
  2. Hoffman; a brand of Pentair Equipment Protection.
  3. Hubbell Incorporated; Wiring Device-Kellems.
  4. Thomas & Betts Corporation; A Member of the ABB Group.
  5. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
  - 1. Material: Cast metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- L. Gangable boxes are prohibited.

## 2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Quazite: Hubbell Power Systems, Inc.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: GRC.
  3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
  1. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Electrical rooms
    - e. Gymnasiums.
  2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  4. Damp or Wet Locations: GRC.
  5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

- 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.
- H. Panel feeders shall not be installed on roofs unless specifically noted on plans or approve via RFI to engineer.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Raceways installed on roof shall be kept a minimum of 1" above roof deck and shall be supported using Dura-Blok rooftop supports with maximum spacing of 10' between supports.
- D. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- E. Do not fasten conduits onto the bottom side of a metal deck roof.
- F. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- G. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- K. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- L. Support conduit within 12 inches of enclosures to which attached.



M. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

N. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

P. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
  - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
  - d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC in damp or wet locations not subject to severe physical damage.
- U. Mount boxes at heights indicated on Drawings or in Specification 262726 "Wiring Devices". If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- X. Locate boxes so that cover or plate will not span different building finishes.
- Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- AA. Set metal floor boxes level and flush with finished floor surface.
- BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit.
  2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified.
  3. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Tapes and stencils.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.

#### 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
  - a. Phase A: Brown.
  - b. Phase B: Orange.
  - c. Phase C: Yellow.
4. Color for Neutral: White.
5. Color for Equipment Grounds: Green.
6. Colors for Isolated Grounds: Green with white stripe.

B. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

C. Equipment Identification Labels:

1. Black letters on a white field.
2. Provide labels on all equipment including panels, transformers, and disconnects. Labels shall include:
  - a. Name of equipment
  - b. Voltage/Phase of Equipment
  - c. Where equipment is fed from

## 2.3 TAPES AND STENCILS

A. Underground-Line Warning Tape:

1. Tape:
  - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
  - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
  - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
  - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE"

## 2.4 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
  - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.

- b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
- c. Engraved legend with black letters on white face.
- d. Self-adhesive.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
  - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.

### 3.2 IDENTIFICATION SCHEDULE

- A. Equipment Identification Labels:
  - 1. Indoor Equipment: Self-adhesive label.
  - 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

## SECTION 260573 - ARC-FLASH HAZARD ANALYSIS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 DEFINITIONS

- ##### A. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. For power system analysis software to be used for studies.

##### B. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form:
  - a. Arc-flash study input data, including completed computer program input data sheets.
  - b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
  - c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

#### 1.5 QUALITY ASSURANCE

- A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

### PART 2 - PRODUCTS

#### 2.1 COMPUTER SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

#### 2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data

F. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

G. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

## 2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.
  - a. Arc-flash boundary.
  - b. Restricted approach boundary.
  - c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.

7. Working distance.
  8. Engineering report number, revision number, and issue date.
- C. Labels must be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform Short-Circuit study prior to starting Arc-Flash Hazard Analysis.
- C. Calculate maximum and minimum contributions of fault-current size.
1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
  2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
- D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.
- F. Calculate limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
1. Fault contribution from induction motors must not be considered beyond three to five cycles.
  2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).
- H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:

1. When circuit breaker is in separate enclosure.
  2. When line terminals of circuit breaker are separate from work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
  2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.

### 3.4 LABELING

- A. Apply one arc-flash label on front cover of each section of equipment for each equipment included in study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below must have arc-flash label applied to it:
1. Medium-voltage switchgear.
  2. Medium-voltage switches.
  3. Medium voltage transformers
  4. Low-voltage switchgear
  5. Switchboards.
  6. Panelboards.
  7. Motor-control centers.
  8. Low voltage transformers.
  9. Safety switches.
  10. Control panels.
- C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
1. Indicate arc-flash energy.
  2. Indicate protection level required.

### 3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573

## SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Eaton.
  - 2. SIEMENS Industry, Inc.; Energy Management Division.
  - 3. Square D; by Schneider Electric.

#### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- E. Coils: Continuous windings except for taps.
1. Coil Material: Aluminum.
  2. Internal Coil Connections: Brazed or pressure type.
  3. Terminal Connections: Bolted.
- F. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70.
- B. Cores: One leg per phase.
- C. Indoor Enclosure: Ventilated.
1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
  2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  3. Wiring Compartment: Sized for conduit entry and wiring installation.
- D. Outdoor Enclosure: Ventilated.
1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
  2. Wiring Compartment: Sized for conduit entry and wiring installation.
- E. Taps for Transformers 3 kVA and Smaller: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- H. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- J. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

- K. Wall Brackets: Manufacturer's standard brackets.

## 2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Construct concrete bases according to Concrete Specifications and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Secure transformer to concrete base according to manufacturer's written instructions.
- D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

- E. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Provide grounding connection for secondary to building ground system. Size grounding conductor per NEC.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 FIELD QUALITY CONTROL

- A. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- B. Remove and replace units that do not pass tests or inspections and retest as specified above.

### 3.5 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213



## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Include evidence of NRTL listing for SPD as installed in panelboard.
  - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 8. Include wiring diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

## 1.6 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.

## 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush or Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Wash-Down Areas: NEMA 250, Type 4X,.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Height: 84 inches maximum.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- E. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

- 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- G. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2 as shown on drawings.

## 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Eaton.
  - 2. SIEMENS Industry, Inc.; Energy Management Division.
  - 3. Square D; by Schneider Electric.
    - a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.
- B. Panelboards: NEMA PB 1, distribution type.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Eaton.
  - 2. SIEMENS Industry, Inc.; Energy Management Division.
  - 3. Square D; by Schneider Electric.
    - a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. SIEMENS Industry, Inc.; Energy Management Division.

3. Square D; by Schneider Electric.
  - a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.
  
- B. All circuit breakers 1200A and higher shall be equipped with energy-reducing maintenance switching with local status in order to provide arc energy reduction per NEC 240.87
  
- C. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  
  3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  
  5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  
  6. Subfeed Circuit Breakers: Vertically mounted.
  
  7. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
  
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
  
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount panelboard cabinet plumb and rigid without distortion of box.
- D. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- G. Install filler plates in unused spaces.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:

1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Straight-blade convenience receptacles.
  - 2. USB charger devices.
  - 3. GFCI receptacles.
  - 4. Toggle switches.
  - 5. Wall plates.

#### 1.2 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
  - 1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
  - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
  - 3. Leviton: Leviton Mfg. Company, Inc.
  - 4. Pass & Seymour: Pass& Seymour/Legrand.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  - 2. All receptacle devices in childcare facilities and all education facilities shall be tamper-resistant. All devices shall meet requirements of NEC 406.12.

## 2.3 USB CHARGER DEVICES

- A. Tamper-Resistant, USB Charger Receptacles: 12 V, 2.0 A, USB Type A and 20V, 3A, Type C; Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour/Legrand (Pass & Seymour).
  - 2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
  - 3. USB Receptacles: Dual, Type A and Type C.
  - 4. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.



## 2.4 GFCI RECEPTACLES

### A. General Description:

1. 125 V, 20 A, straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

### B. Duplex GFCI Convenience Receptacles:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Hubbell Incorporated; Wiring Device-Kellems.
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour/Legrand (Pass & Seymour).

### C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hubbell Incorporated; Wiring Device-Kellems.
  - b. Pass & Seymour/Legrand (Pass & Seymour).

## 2.5 TOGGLE SWITCHES

### A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

### B. Switches, 120/277 V, 20 A:

#### 1. Single Pole:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Hubbell Incorporated; Wiring Device-Kellems.
  - 2) Leviton Manufacturing Co., Inc.
  - 3) Pass & Seymour/Legrand (Pass & Seymour).

#### 2. Two Pole:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Hubbell Incorporated; Wiring Device-Kellems.
  - 2) Leviton Manufacturing Co., Inc.
  - 3) Pass & Seymour/Legrand (Pass & Seymour).

3. Three Way:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Hubbell Incorporated; Wiring Device-Kellems.
    - 2) Leviton Manufacturing Co., Inc.
    - 3) Pass & Seymour/Legrand (Pass & Seymour).

## 2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Coordinate with architect for finish and color selection.
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.7 FINISHES

- A. Device Color:
  1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red.
  3. SPD Devices: Blue.
  4. Isolated-Ground Receptacles: Orange.
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1 unless otherwise indicated.
- B. Mount Devices at the heights listed below unless listed specifically on drawings:
  1. Exterior Outlet Boxes: 24" Above Finished Grade
  2. Interior Outlet Boxes: 18" Above Finished Floor (AFF)
  3. Device Boxes for Switches, Fire Alarm Pull Stations, Intercom Call Stations, etc.: 48" AFF
  4. Outlet Boxes for Wall-mounted clocks: 96" AFF or 6" below the ceiling when not possible. Center clock outlets located above doors between the ceiling and the top of the door trip.

5. Above Counter Outlet and Junction Boxes: 8" above countertop surfaces or at backsplash level.
6. Coordinate mounting height of specific-use receptacles with equipment and finishes.
7. Coordinate mounting height to match mechanical devices (thermostats).

C. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

E. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan-speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.2 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Perform the following tests and inspections:
1. Tests for Convenience Receptacles:
    - a. Line Voltage: Acceptable range is 105 to 132 V.
    - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
    - c. Ground Impedance: Values of up to 2 ohms are acceptable.
    - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
    - e. Using the test plug, verify that the device and its outlet box are securely mounted.
    - f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Molded-case switches.
  - 5. Horsepower Rated Toggle Disconnect Switch
  - 6. Enclosures.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

## 2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Eaton.
  - 2. SIEMENS Industry, Inc.; Energy Management Division.
  - 3. Square D; by Schneider Electric.
    - a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.
- B. Type HD, Heavy Duty:
  - 1. Single throw.
  - 2. Three pole.
  - 3. 600-V ac.
  - 4. 1200 A and smaller.
  - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
  - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories (as required per plans):
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 5. Service-Rated Switches: Labeled for use as service equipment.

## 2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Eaton.
  - 2. SIEMENS Industry, Inc.; Energy Management Division.

3. Square D; by Schneider Electric.
  - a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories (as required per plans):
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  5. Service-Rated Switches: Labeled for use as service equipment.

#### 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Eaton.
  2. SIEMENS Industry, Inc.; Energy Management Division.
  3. Square D; by Schneider Electric.
    - a. If Square D, project shall be quoted, ordered, and managed by Randall Robinette in Little Rock Field Office. Phone# 501-803-9494.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated or series rated as indicated on the Drawings. combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. \_\_\_\_\_ Amps Available. Identical Replacement Component Required."
- E. MCCBs shall be equipped with a device for locking in the isolated position.

- F. Lugs shall be suitable for 167 deg F rated wire.
- G. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the field-adjustable settings as indicated on drawings.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

#### 2.5 Horsepower Rated, Toggle Switch Type Disconnect Switch

- A. Toggle type disconnect switches shall be manufactured of thermoplastic materials with screw-type terminals. The switches shall be rated 600 VAC and 20A at 600 VAC.
- B. Toggle type disconnect switches shall be similar to a manual non-reversing starter without overloads and shall be 3 Pole, capable of “on-off” control of a 10 horsepower motor at 460 VAC.
- C. Enclosure shall be provided with lock off provisions.
- D. NEMA 4 enclosures shall be die-cast zinc.
- E. Switches shall be as manufactured by the Square D Co.; Siemens Electrical Products; Cutler-Hammer or equal.

#### 2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure rating shall be equal to or greater than the fuse or circuit breaker rating.
- C. Enclosure Finish: The enclosure shall be as indicated on drawings.
- D. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.



- E. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- F. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- G. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

### PART 3 - EXECUTION

#### 3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

#### 3.2 INSTALLATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.
- B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices. Fuse Ratings for mechanical equipment or transformers shall match the rating of the upstream circuit breaker feeding the equipment.
- F. Comply with NFPA 70 and NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.
    - a. Label on each disconnect means shall include both purpose and source, such as "AHU-1. Fed from Panel MDP"

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - i. Verify correct phase barrier installation.

- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

END OF SECTION 262816

## SECTION 264810 - ENGINE GENERATOR

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This section includes the following items from a single supplier:
  - 1. Engine Generator Set.
  - 2. Enclosure
  - 3. Related Accessories as specified
- B. Related Requirements
  - 1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
  - 2. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
  - 3. All equipment shall be new and of current production by an international, power system manufacturer of generators. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

#### 1.2 SUBMITTALS

- A. Action Submittals
  - 1. Product Data
    - a. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
- B. Informational Submittal
  - 1. Certificates
    - a. The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
- C. Closeout Submittal
  - 1. Maintenance Contracts
  - 2. Operation And Maintenance Data
  - 3. Warranty Documentation

4. Record Documentation

1.3 QUALITY ASSURANCE

A. Regulatory Agency

1. The generator set shall conform to the requirements of the following codes and standards:
  - a. CSA C22.2, No. 14-M91 Industrial Control Equipment.
  - b. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
  - c. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  - d. IEC8528 part 4, Control Systems for Generator Sets.
  - e. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
  - f. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
  - g. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
  - h. NFPA 99, Essential Electrical Systems for Health Care Facilities.
  - i. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
2. Qualifications
  - a. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
  - b. The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
1. Manufacturers
  - a. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
  - b. The generator set shall be a Kohler model 25CCCL OR Equal by CAT.

1.2 WARRANTY OR BOND

A. Manufacturer's Warranty

1. The generator set shall include a standard warranty covering one (1) year or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract

programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

#### A. Equipment

1. The generator set shall be a Kohler model 25CCL with a 4D8.3 alternator, or Equal by CAT. It shall provide 31 kVA and 25 kW when operating at 120/208 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 77 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage.

#### B. Engine

1. The minimum 2.2 liter displacement engine shall deliver a minimum of 64.1HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
  - a. Electronic isochronous governor capable of 0.5% steady-state frequency regulation
  - b. 12-volt positive-engagement solenoid shift-starting motor
  - c. 90-ampere automatic battery charging alternator with a solid-state voltage regulation
  - d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
  - e. Dry-type replaceable air cleaner elements for normal applications
  - f. The engine shall be turbo charged and fueled by Natural Gas.
  - g. The engine shall have a minimum of 4 cylinders and be liquid-cooled.
2. The engine shall be EPA certified from the factory.
3. The generator must accept rated load in one-step.

#### C. Cooling System

1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.

#### D. Standard Air Cleaner

1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

#### E. Battery

1. Each genset requires a BCI group 31 batteries which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall

comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 630 amps and a minimum reserve capacity of 185 Minutes at 80F. The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery elements must be anchor-locked with full-frame grids and tight-packed commercial plates to resist the effects of vibration. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity.

2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

#### F. Housing

##### 1. Level 1 Sound Attenuated Enclosure

- a. The generator set shall be supplied with a Sound Attenuated Enclosure, providing a sound pressure of 67.4 dB(A) while the generator is operating at 100% load at 7 meters (23 feet) – free field – using acoustic insulation and acoustic-lined inlet hoods, constructed from a minimum of 0.125 inch thick formed heavy duty aluminum panels. The acoustic insulation used shall meet UL 94 HF1 flammability classification. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement. The enclosure shall use external vertical air inlet and outlet hoods with 90 degree angles to discharge air up and reduce noise. The enclosure shall have an integral rodent guard and skid end caps and shall have bracing to meet 241 kph (150 mph) wind loading.
- b. The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion. All enclosure parts shall receive a 100% epoxy primer electrocoat (e-coat) with high-edge protection. Following the e-coat process, the parts shall be finish coated with powder baked paint for superior finish, durability, and appearance with a Power Armor™ industrial finish that provides heavy duty durability in harsh conditions, and is fade-, scratch- and corrosion-resistant.
- c. The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.
- d. Enclosures will be finished in the manufacturer's standard color.
- e. The enclosures shall allow the generator set to operate at full load in an ambient temperature of 50°C with no additional derating of the electrical output of the generator set.
- f. Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.
- g. Doors shall be fitted with hinges, hardware, and the doors shall be removable.
- h. Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.

- i. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
- j. The complete exhaust system shall be internal to the enclosure.
- k. The critical silencer shall be fitted with a tailpipe and rain cap.
- l. The generator set enclosure shall be furnished with a wall mounted 800 CFM Shutter-Mounted Exhaust Fan.

#### G. Controller

1. APM402 Generator Set Controller
  - a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software.
  - b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
2. Codes and Standards
  - a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
  - b. The controller shall meet NFPA 99 and NEC requirements.
  - c. The controller shall be UL 508 listed.
3. Applicability
  - a. The controller shall be a standard offering in the manufacturer's controller product line.
  - b. The controller shall support 12-volt and 24volt starting systems.
  - c. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
  - d. The controller shall mount on the generator or remotely within 40 feet with viewable access.
4. Controller Buttons, Display and Components
  - a. The generator set controller shall include the following features and functions:
    - 1) Push button Master Control buttons. The buttons shall be tactile-feel membrane with an indicator light to initiate the following functions:
      - a) Run Mode: When in the run mode the generator set shall start as directed by the operator.
      - b) Off/Reset Mode: When in the Off/Reset mode the generator set shall stop, the reset shall reset all faults, allowing for the restarting of the generator set after a shutdown.
      - c) Auto Mode: When in Auto the mode the generator set shall be ready to accept a signal from a remote device.



- 2) Emergency Stop Switch. The remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
  - 3) Push Button/Rotary Selector dial. This dial shall be used for selection of all Menus and sub-menus. Rotating the dial moves you through the menus, pushing the dial selects the menu and function/features in that menu. Pushing the button selects the feature/function and sub-menus.
  - 4) Digital Display. The digital display shall be alphanumeric, with 2 lines of data and approximately 24 characters. The display shall have back lighting for ease of operator use in high and low light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. While the generator set is running, the display shall scroll all-important information across the screen for ease of operator use. The scroll can be stopped by pushing the rotary dial. The display shall fall asleep when the generator set is not running and will wake-up when the generator set starts or the rotary dial is depressed.
  - 5) Fault Light. The controller shall have an annunciator fault light that glows red for faults and yellow for warnings. These faults and warnings shall be displayed in the digital display. The fault light will also glow yellow when not in AUTO.
  - 6) Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.
  - 7) Alarm Silence/Lamp Test Button. When this button is depressed, it shall test all controller lamps. This button will also silence the alarm horn when the unit is not AUTO.
  - 8) USB Connection. The controller shall have a USB connection on the face of the controller. This connection shall allow for updating of all software and firmware. This port shall also allow for all servicing of generator set parameters, fault diagnostics and viewing of all controller information via use a laptop computer.
  - 9) Dedicated user inputs. The controller shall have dedicated inputs for remote emergency stop switch, remote 2-wire star for transfer switch and auxiliary shutdown.
  - 10) The controller shall have auto resettable circuit protection integral on the circuit board.
5. System Controller Monitoring and Status Features and Functions
- a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:
    - 1) Overview menu
      - a) Active shutdowns and warnings shall be displayed if present and without the need of operator interface
      - b) Engine runtime with total hours
      - c) Average line to line voltage

- d) Coolant temperature
  - e) Fuel level or pressure
  - f) Oil pressure
  - g) Battery voltage
  - h) Software version
  - i) Frequency
  - j) Average current
- 2) Engine metering menu.
- a) Engine speed
  - b) Oil pressure
  - c) Coolant temperature
  - d) Battery voltage
- 3) Generator metering menu.
- a) Total power in VA
  - b) Total power in W
  - c) Rated power % used
  - d) Voltage L-L and L-N for all phases
  - e) Current L1, L2, L3
  - f) Frequency
- 4) Generator set information.
- a) Generator set model number
  - b) Generator set serial number
  - c) Controller set number
- 5) Generator set run time.
- a) Engine run time total hours
  - b) Engine loaded total hours
  - c) Number of engine starts
  - d) Total energy in kW
- 6) Generator set system
- a) System voltage
  - b) System frequency 50/60Hz
  - c) System phase, single/three phase
  - d) Power rating kW
  - e) Amperage rating
  - f) Power type standby/prime

- g) Measurement units, metric/English units adjustable
- h) Alarm silence, always or auto only
- 7) Generator set calibration, the following are adjustable at the controller.
  - a) Voltage L-L and L-N all phases
  - b) Current L1, L2, L3
  - c) Reset all calibrations
- 8) Voltage regulation, +/-0.5% regulation, the following is adjustable at the controller.
  - a) Voltage Adjustable +/- 10%
- 9) Digital and Analog Inputs and outputs
  - a) Displays settings and status
- 10) Event Log
  - a) Stores event history, up to 1000 events
- 6. Controller Engine control features and functions
  - a. Automatic restart - the controller has automatic restart feature that initiates the start routine and re-crank after a failed start attempt.
  - b. Cyclic cranking - the controller shall have programmable cyclic cranking
  - c. Engine starting aid - the controller shall have the capability of providing control for an optional engine starting aid.
  - d. The control system shall include time delays for engine start and cool down.
  - e. The control system shall interface with the engine ECM and display engine fault codes and warnings. The ECM shall also include sender failure monitoring to help distinguish between failed senders and actual failure conditions.
  - f. The controller shall monitor and display engine governor functions with include steady state and transient frequency monitoring.
- 7. Controller Alternator control features and functions
  - a. Integrated hybrid voltage regulator. The system shall have integral microprocessor based voltage regulator system that provides +/- 5% voltage regulation, no-load to full load with three phase sensing. The system is prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 10% adjustable of nominal voltage.
  - b. AC output voltage regulator adjustment. The system shall allow for adjustment of the integral voltage regulator with maximum of +/- 10% adjustment of the system voltage.
  - c. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
  - d. Power metering. The controller digitally displays power metering of kW and kVA.
- 8. Other control features and functions

- a. Event logging. The controller keeps a record of up to 1000 events, for warning and shutdown faults. This fault information becomes a stored record of systems events and can be reset.
  - b. Historical data logging. The controller total number of generator set successful start shall be recorded and displayed.
  - c. Programmable access. The control system shall include a USB port that gives service technicians the ability to provide software and firmware upgrades. The system shall also be capable of allowing setting of all critical parameters using the service software and a laptop computer. All parameters and setting should be capable to being stored on a laptop for future upgrades of printing for analysis.
9. Generator Set Warning, Shutdown Alarm and Status
- a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
    - 1) Engine functions
      - a) Critical high fuel level (alarm)
      - b) ECM communication loss (shutdown)
      - c) ECM diagnostics (alarm & shutdown)
      - d) Engine overspeed (shutdown)
      - e) Engine start aid active
      - f) Engine under speed (shutdown)
      - g) Fuel tank leak (alarm & shutdown)
      - h) High DC battery voltage (alarm)
      - i) High coolant temperature (alarm & shutdown)
      - j) High fuel level (alarm)
      - k) Low DC battery voltage (alarm)
      - l) Low coolant level (shutdown)
      - m) Low coolant temperature (alarm)
      - n) Low cranking voltage (alarm)
      - o) Low engine oil level (alarm & shutdown)
      - p) Low fuel level (alarm & shutdown)
      - q) Low fuel pressure (alarm)
      - r) Low oil pressure (alarm & shutdown)
      - s) No coolant temperature signal (shutdown)
      - t) No oil pressure signal (shutdown)
      - u) Overcrank (shutdown)

- v) Speed sensor fault (alarm)
- 2) Generator functions
  - a) AC sensing loss over & under current (alarm & shutdown)
  - b) Alternator protection (shutdown)
  - c) Ground fault input (alarm)
  - d) kW overload (shutdown)
  - e) Locked rotor (shutdown)
  - f) Over-frequency (shutdown)
  - g) Over AC voltage (shutdown)
  - h) Under-frequency (shutdown)
  - i) Under AC voltage (shutdown)
  - j) Emergency stop (shutdown)
- 3) Other General functions
  - a) Battery charger fault (alarm)
  - b) Common fault (shutdown)
  - c) Common warning (alarm)
  - d) Master switch not in auto (alarm)
  - e) Generator running
  - f) Input/Output fault (alarm)
- 4) The generator set controller shall also be capable of meeting all necessary NFPA 110 level 1 requirements that include several of the above along with; EPS supplying load, Master switch “not in auto”, and contacts for local and remote common alarm.

#### 10. Communications

- a. The controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards
- b. Kohler proprietary RBUS communication shall be available.
- c. A RBUS shall be able to monitor and alter parameters, and start or stop a generator.
- d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) and appropriate application software
- e. A variety of connections shall be available based on requirements:
- f. A single control connection to a PC via USB
- g. Internet connection via Ethernet
- h. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.

#### H. Generator Overcurrent and Fault Protection

1. The generator shall be provided with a factory installed, 80% rated line circuit breaker rated at 125 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.
2. The circuit breaker(s) shall incorporate a thermo-magnetic electronic trip unit.
3. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts. Load side breaker connections made at the factory shall be separated from field connections.
4. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the other generator-set alarms.
5. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

#### I. Alternator

1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 120 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

#### J. Vibration Isolation

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

#### K. Accessories

1. The generator set shall be supplied with a 6-ampere automatic float/equalize battery charger capable of charging both lead-acid and gel-cell type batteries, with the following features:

- a. Automatic 3-stage float to equalization charge
  - b. 1% steady-state voltage regulation from no load to full load over 10% AC input line voltage variation
  - c. Indicator LED lamps for charge state indication (bulk charge/absorption/float)
  - d. Ambient temperature operating range: -40°C to 70°C
  - e. Potting for durability and waterproofing
  - f. Short-circuit and reverse polarity protection
  - g. UL 1236 listed
  - h. UL 2200 compliant
  - i. CSA certified
  - j. Ring terminals for battery connection.
2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
  3. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
  4. The generator set shall be provided with a run relay which shall provide a three-pole, double-throw relay with 10-amp/ 250 VAC contacts to indicate that the generator is running. The run relay dry contacts can be used for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)
  5. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows and includes the flex exhaust tube and the mounting hardware.
  6. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.
  7. Block Heater - The block heater shall be thermostatically controlled, 500 watt, 110-120 VAC - single phase, with isolating valves, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
  8. Input/Output Module Board -- Generator controller shall be provided with board providing two analog or digital inputs and 5 digital outputs.
  9. Remote annunciator panel Single ATS – The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Panel shall provide ATS source availability, contactor position, and loaded or unloaded test for one transfer switch. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.

## 2.2 SOURCE QUALITY CONTROL

### A. Non-Conforming Work

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
  - a. Design Prototype Tests. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
    - 1) Maximum power (kW)
    - 2) Maximum motor starting (kVA) at 35% instantaneous voltage dip.
    - 3) Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
    - 4) Governor speed regulation under steady-state and transient conditions.
    - 5) Voltage regulation and generator transient response.
    - 6) Harmonic analysis, voltage waveform deviation, and telephone influence factor.
      - a) Three-phase short circuit tests.
      - b) Alternator cooling air flow.
      - c) Torsional analysis to verify that the generator set is free of harmful torsional stresses.
      - d) Endurance testing.
  - b. Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
    - 1) Single-step load pickup
    - 2) Safety shutdown device testing
    - 3) Rated Power @ 0.8 PF
    - 4) Maximum power
    - 5) Upon request, a witness test, or a certified test record sent prior to shipment.
  - c. Site Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
    - 1) Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
    - 2) Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
    - 3) Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting



and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.

- 4) Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
- 5) NFPA 110 Testing. The test shall consist of 2 hours of continuous operation at 100% load using a portable resistive load bank and 1.5 hours of building load. Furnish the portable load bank, all connecting cables, metering equipment, and other equipment or devices required to perform the on-site testing. During the test, readings shall be taken every 15 minutes showing % load, voltage, amps, oil pressure, water temperature, and battery charge.

END OF SECTION

## SECTION 264820 - AUTOMATIC TRANSFER SWITCH

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This section includes the following items from a single supplier:
  - 1. Automatic transfer switch
  - 2. Related Accessories as specified
- B. Related Requirements
  - 1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
  - 2. It is the intent of this specification to secure an automatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.

#### 1.2 SUBMITTALS

- A. Action Submittals
  - 1. Product Data
    - a. The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
- B. Closeout Submittals
  - 1. Operation And Maintenance Data
  - 2. Warranty Documentation

#### 1.3 QUALITY ASSURANCE

- A. Regulatory Agency
  - 1. The automatic transfer switch shall conform to the requirements of the following codes and standards:
    - a. UL 1008 - Standard for Transfer Switch Equipment

- b. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  - c. NFPA 70 - National Electrical Code
  - d. NFPA 99 - Essential Electrical Systems for Health Care Facilities
  - e. NFPA 110 - Emergency and Standby Power Systems
  - f. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
  - g. NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.
  - h. EN61000-4-4 Fast Transient Immunity Severity Level 4
  - i. EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
  - j. IEEE 472 (ANSI C37.90A) Ring Wave Test
  - k. IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
  - l. CSA C22.2 No. 178 certification
2. Qualifications
- a. The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
  - b. A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year shall produce the automatic transfer switch.
3. Manufacturers
- a. The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
  - b. The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
  - c. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

#### 1.4 WARRANTY OR BOND

##### A. Manufacturer's Warranty

1. The ATS shall include a standard warranty covering one (1) year to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The ATS manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

#### A. Equipment

1. Furnish and install an automatic transfer switches system(s) with 3-Pole/ 4-Wire, Solid Neutral, 125Amps, 208V/60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

#### B. Manufacturer

1. Automatic transfer switches shall be Kohler Specific Breaker Rated - Standard Transition KSS-ACTA-0125S, or Equal by ASCO.

#### C. Construction

1. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism.
2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
3. The switch shall be positively locked and unaffected by momentarily outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amperes and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

7. For two and three pole switches, where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.
8. For four pole switches with a switching neutral, where neutral conductors must be switched as shown on the plans, the contactor shall be provided with fully rated switched neutral transfer contacts. Overlapping neutral contacts may be used as an alternative.

D. Enclosure

1. The ATS shall be furnished in a NEMA 1 enclosure.
2. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

2.2 OPERATION

A. Controls

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
  - a. Nominal line voltage and frequency
  - b. Single or three phase sensing
  - c. Operating parameter protection
  - d. Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

B. Voltage and Frequency

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored. Voltage on both normal and emergency sources and frequency on the emergency sources shall be adjustable with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

a. Parameter	Dropout/Trip	Pickup/Reset
b. Under voltage	75 to 98%	85 to 100%
c. Over voltage	06 to 135%	95 to 100% of trip
d. Under frequency	95 to 99%	80 to 95%
e. Over frequency	01 to 115%	105 to 120%

- f. Voltage unbalance      5 to 20%      3 to 18%
2. Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of  $-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .
  3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
  4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
  5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.
  6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
  7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

C. Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.
2. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.
6. All time delays shall be adjustable in 1 second increments.

7. All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB.
8. Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications interface port or USB.

D. Additional Features

1. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.
2. The display shall provide for the test functions, allowed through password security. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.
3. A contact closure shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
4. Auxiliary contacts shall be provided consisting of a minimum of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
5. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
6. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.
7. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
8. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad, communications interface port or USB. A "not-in-auto" LED shall indicate anytime the controller is inhibiting transfer from occurring.
10. An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents,

and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled from the user interface, communications interface port or USB.

11. A time based load control feature shall be available to allow the prioritized addition and removal of loads based during transfer. This feature may be enabled for either or both sources. The user shall be able to control up to nine loads with independent timing sequences for pre and post transfer delays in either direction of transfer.
12. The controller shall provide 2 inputs for external controls that can be programmed from the following values:
  - a. Common fault, Remote test, Inhibit transfer, Low battery voltage, Peak shave, Time delay bypass, Load shed forced to OFF position (Programmed transition only)
13. The controller shall provide two form "C" contact outputs rated for up to 12A @ 240VAC or 2A @ 480VAC that can be programmed from the following values:
  - a. Aux switch open, Transfer switch aux contact fault, Alarm silenced, Alarm active, I/O communication loss, Contactor position, Exercise active, Test mode active, Fail to transfer, Fail to acquire standby source, Source available, Phase rotation error, Not in automatic mode, Common alarm, In phase monitor sync, Load bank control active, Load control active, Maintenance mode active, Non-emergency transfer, Fail to open/close, Loss of phase, Over/under voltage, Over/under frequency, Voltage unbalance, Start signal, Peak shave active, Preferred source supplying load, Standby source supplying load
14. The controller shall be capable of expanding the number of inputs and outputs with additional modules.
15. Optional input/output modules shall be furnished which mount on the inside of the enclosure to facilitate ease of connections.
16. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
  - a. Enable or disable the routine
  - b. Enable or disable transfer of the load during routine.
  - c. Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every)
  - d. Set the duration of the run.
  - e. At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be



display when the exercise is active. It shall be possible of ending the exercise event with a single button push.

17. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.
18. System Status - The controller shall have a default display the following on:
  - a. System status
  - b. Date, time and type of the next exercise event
  - c. Average voltage of the preferred and standby sources
  - d. Scrolling through the displays shall indicate the following:
    - 1) Line to line and line to neutral voltages for both sources
    - 2) Frequency of each source
    - 3) Load current for each phase
    - 4) Single or three phase operation
    - 5) Type of transition
    - 6) Preferred source
    - 7) Commit or no commit modes of operation
    - 8) Source/source mode
    - 9) In phase monitor enable/disable
    - 10) Phase rotation
    - 11) Date and time
19. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
20. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
21. Communications Interface - The controller shall be capable of interfacing, through a standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration). This module shall allow for seamless integration of existing or new communication transfer devices and generators.
22. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.

23. The controller shall contain a USB port for use with a software diagnostic application available to factory authorized personnel for downloading the controller's parameters and settings; exercise event schedules; maintenance records and event history. The application can also adjust parameters on the controller.
24. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be accessible via the communications interface port or USB.
  - b. Event Logging
    - 1) Data, date and time indication of any event
  - c. Statistical Data
    - 1) Total number of transfers\*
    - 2) Total number of fail to transfers\*
    - 3) Total number of transfers due to preferred source failure\*
    - 4) Total number of minutes of operation\*
    - 5) Total number of minutes in the standby source\*
    - 6) Total number of minutes not in the preferred source\*
    - 7) Normal to emergency transfer time
    - 8) Emergency to normal transfer time
    - 9) System start date
    - 10) Last maintenance date
    - 11) \* The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.
25. External DC Power Supply: An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

## 1.2 ACCESSORIES

- A. Padlockable User Interface Cover. The user interface cover shall protect the controller user interface from the environment.
- B. Standard I/O Module. The standard I/O Module shall have two programmable inputs and six programmable outputs.
  1. Inputs Available (2)

- a. Contact Closure
  - b. Current 5mA Max.
  - c. Connection Type Terminal Strip
  - d. Wire Size #14-24 AWG
  - e. Max Distance 700 feet
2. Outputs Available (6)
- a. Contact Type Form C (SPDT)
  - b. Contact Rating 2A @ 30VDC, 500mA @ 125VAC
  - c. Connection Type Terminal Strip
  - d. Wire Size #14-24

### 1.3 SOURCE QUALITY CONTROL

#### A. Test and Inspection

1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

END OF SECTION

## SECTION 265119 - GENERAL LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Lowbay.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.
13. Exit and Emergency Lighting

#### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Product Schedule: Refer to light fixture schedule on the plans.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Product Schedule: Refer to light fixture schedule on the plans.
- B. Fixture Schedule included in plans is basis of design. Equivalent alternates that meet all technical and aesthetics requirements are allowed and will be reviewed for equivalence by A/E team during submittal phase. Alternates shall include the following with their submittal, in addition to standard product data:
  - 1. Photometric lighting calculations for each space and exterior area.
  - 2. Control Device Layout showing part numbers and device locations.
  - 3. Lighting Fixture schedule including substituted fixture model number, voltage, wattage, and color temperature
- C. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Diffusers, and Globes:
  - 1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

## 2.2 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.3 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Exit Signs: Exit signs shall be roughed-in to be centered over or above door they are indicating as exit, or in hallways they are installed in. Exit signs in hallways shall be aligned with other lights in the area. Exit signs observed to be installed and not centered with doors or hallways shall be relocated at no additional cost.
- F. Flush-Mounted Luminaire Support: Secured to outlet box.
- G. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.
- H. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount per manufacturer's recommendations.

I. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod, or wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

J. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

L. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16553 "Identification for Electrical Systems."

M. Where 0-10V dimming is indicated in controls requirements, contractor shall furnish and install 0-10V dimming cabling to each fixture to accomplish dimming control.

N. Where a light fixture is indicated via plan or fixture schedule to be an emergency fixture, contractor shall route unswitched power to light fixture in addition to normal circuit such that fixture will sense an outage and automatically illuminate in an emergency situation.

O. All site lighting pole lights shall be installed to maintain 36" clear from back of curb to edge of concrete pole-base. Field verify final locations with final civil plan and edge of parking lots.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

## SECTION 266650 - LIGHTNING PROTECTION SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes lightning protection for the building(s) or structures included on the contract drawings. Master Labeled system shall consist of air terminals on roofs, roof-mounted mechanical equipment, chimneys and stacks, and penthouse roofs; bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors
- B. The lightning protection system shall be installed by a firm actively engaged in the installation of Master Labeled Lightning Protection Systems and shall be so listed by Underwriters Laboratories Inc. The completed system shall comply with the latest editions of the Installation Requirements for Lightning Protection Systems, UL96A and of the National Fire Protection Association's Lightning Protection Standard NFPA 780.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
  - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
  - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.
- B. System Certificate:
  - 1. UL Master Label.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.



## PART 2 - PRODUCTS

### 2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780, LPI 175, and UL 96A..
- B. Materials:
  - 1. Copper materials shall not be mounted on aluminum surfaces including Galvalume, galvanized steel and zinc; this includes these materials that have been painted.
  - 2. Aluminum materials shall not come into contact with earth or where rapid deterioration is possible. Aluminum materials shall not come into contact with copper surfaces.
- C. Roof-Mounted Air Terminals: NFPA 780, Class I copper unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
    - a. ERICO International Corporation.
    - b. Harger.
    - c. Robbins Lightning, Inc.
    - d. Thompson Lightning Protection, Inc.
  - 2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
  - 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.
  - 4. Air terminals shall project a minimum of 12 inches above the area protected and shall be located at intervals not exceeding 20'-0" along ridges and around the perimeter of flat or gently sloping roofs. Flat or gently sloping roofs exceeding 50'-0" in width shall be protected with additional air terminals located at intervals into exceeding 50'-0" in the flat or gently sloping area. Air terminals shall be located within two feet of roof edges and outside corners of protected areas. Air terminal spacing exceeding these dimensions are permitted so long as the area protected lies within a zone of protection.
    - a. Air terminals shall not be less than 12 inches above the object to be protected.
  - 5. Air terminals shall be installed for stacks, flues, mechanical equipment, and other objects not located within a zone of protection. Non-metallic objects or metal objects having a metal thickness of less than 3/16" require the installation of air terminals and required conductors. Objects having a metal thickness 3/16" or greater shall be connected to the lightning protection system per code requirements using main size conductor and connector fittings having 3 square inches of surface contact area.
  - 6. Air terminal mounting bases shall be of cast construction and securely fastened to the structure in accordance with code requirements.
  - 7.
- D. Main and Bonding Conductors: Copper
  - 1. Main conductors shall be sized in accordance with the material requirements above and shall provide a two-way path from each air terminal horizontally or downward to connections with ground terminals. Conductors shall be free of excessive splices and sharp bends. No bend of a conductor shall form an included angle of less than 90 degrees nor have a radius of bend of less than 8 inches. Conductors shall be secured to the structure at intervals not exceeding 3'-0".

2. Down conductors shall be copper and shall be concealed in the exterior wall construction. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure. In no case shall a structure have fewer than two down conductors.
  3. In the case of structural steel frame construction, down conductors may be omitted and roof conductors shall be connected to the structural steel frame at intervals averaging not more than 100 feet around the perimeter of the structure. Connections to the steel frame shall be made with bonding plates having 8 square inches of contact or by exothermic weld connections.
- E. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- F. Ground Rods: Copper-clad 3/4 inch (19 mm) in diameter by 10 feet (3 m) long.
- G. Fasteners: Conductor fasteners shall be an approved type of non-corrosive metal, having ample strength to support conductors and shall be spaced not to exceed 3'-0" center. Fasteners shall be suitable configuration of the intended application and of the same material as the conductor or of electrolytically compatible material. Galvanized or plate steels are not acceptable.
- H. Roof Penetrations: Roof penetrations required for down conductors or for connections to structural steel framework shall be made using thru-roof assemblies with solid bars and appropriate roof flashing. Conductors shall not pass directly through the roof. Roof flashings compatible with the roofing system shall be furnished and installed by the roofing contractor.
- I. Cable Connectors:
1. All above ground cable connectors shall be cast bronze with screw pressure type stainless steel bolts and nuts.
  2. Exothermic welds.
- J.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Conceal the following conductors:
1. System conductors.
  2. Down conductors.
  3. Interior conductors.
  4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.
- C. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.
- D. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

### 3.2 INTERCONNECTION OF METALS

- A. All metal bodies within 6 feet of the conductor shall be bonded to the system with approved fittings and conductor. Connections between dissimilar metals shall be made with approved bi-metallic connections.
1. Bonding of all metallic objects and systems at roof levels and elsewhere on the structure shall be complete. Primary bonds for metal bodies of conductance shall be bonded with appropriate fittings and fill-size conductor; and shall consist of, but not limited to the following: Roof exhaust fans, HVAC units with related piping ductwork, exhaust vents and any other roof piping systems, cooling towers, and rails systems, antenna mast for T.V., radio or microwave, roof ladders, skylights, metal plumbing stacks, etc.
  2. Metal bodies of inductance located within six feet of a conductor or object with secondary cable and fittings. Typical of these are: roof flashings, parapet coping caps, gravel guards, isolated metal building panels or siding, roof drains, down spouts, roof insulation vents and any other sizeable miscellaneous metals, etc.

### 3.3 GROUNDING

- A. Grounding terminals shall be located at the base of the structure. Ground connections to the structural steel frame shall be made around the perimeter of the structure and in no case shall average over 60'-0" apart. Ground connections shall be made using bronze bonding plates having 8 square inches of contact or by exothermic (Cadweld) connections. Class II copper conductors shall be used from the ground connections to the ground rods.
- B. Ground rods shall be not less than 3/4 inch diameter and not less than 8 feet long. Ground rods shall be driven to a minimum depth of 10 feet and more if necessary to reach permanent moisture. One ground shall have connection to the water system where the water supply enters the building - in addition to artificial ground.
1. Ground rods shall be located 3 feet minimum/6 feet maximum from the building wall.
- C. All ground terminals shall be interconnected with a ground loop conductor. Size No. 4/0 AWG minimum, unless otherwise noted on drawings.
- D. All underground connections, other than inside an access well if provided, shall be exothermic welds.

### 3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.5 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

### 3.6 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 266650

## SECTION 271323--COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. 9/125 micrometer single-mode, indoor-outdoor optical fiber cable (OS1).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Cabling identification products.

#### 1.2 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:
  - a. Telecommunications rooms plans and elevations.
  - b. Telecommunications pathways.
  - c. Telecommunications system access points.
  - d. Telecommunications grounding system
  - e. Cross-connects.
  - f. Patch panels.
  - g. Patch cords.
4. Cross-connects and patch panels.

##### C. Optical fiber cable testing plan.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Product Certificates: For each type of product.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings] by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of [Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as a Technician.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- D. Grounding: Comply with TIA-607-B.

#### 2.2 SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

- A. Fiber Optic System: Leviton OPT-X SDX
- B. Description: Single mode, tight buffered, indoor/outdoor, yellow jacket optical fiber cable.

- C. Standards:
  - 1. Comply with TIA-492CAAA for detailed specifications.
  - 2. Comply with TIA-568-C.3 for performance specifications.
  - 3. Comply with ICEA S-104-696 for mechanical properties.
- D. Maximum Attenuation: 0.5dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- E. Jacket:
  - 1. Jacket Color: Yellow
  - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
  - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
  - 1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
  - 2. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.

### 2.3 OPTICAL FIBER CABLE HARDWARE

- A. Standards:
  - 1. Comply with Optical Fiber Connector Intermateability Standard specifications of the TIA-604 series.
  - 2. Comply with TIA-568-C.3.
- B. Patch Cords: OM3 LC-LC, 2M
- C. Enclosure: 2000i, 1RU, White with Sliding Tray Part No. 5R1UH-WH03
- D. Connector Type: FASTCam
- E. Splice Module: TBD by owner.

### 2.4 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

### 2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- C. Cable will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
  - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
  - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding **30 inches (760 mm)** and not more than **6 inches (150 mm)** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 9. In the communications equipment room, provide a **10-foot-** long service loop on each end



of cable.

10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable **6 feet** long not less than **12 inches** in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
  1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

### 3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:
  - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - b. Link End-to-End Attenuation Tests:
    - 1) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

## SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Category 6 twisted pair cable.
  - 2. Twisted pair cable hardware, including plugs and jacks.
  - 3. Cable management system.
  - 4. Grounding provisions for twisted pair cable.

#### 1.2 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
  - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
  - 1. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.
- C. Twisted pair cable testing plan.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

## 1.6 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

### 2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
  - 1. Communications, Plenum Rated: Type CMP complying with UL 1685.
  - 2. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
  - 3. Communications, Non-plenum: Type CMR complying with UL 1666.
  - 4. Communications, Non-plenum: Type CMP or Type CMR in listed plenum or riser communications raceway.
  - 5. Communications, Non-plenum: Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

## 2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Cable System: CX 6300 : Leviton CAT 6 Premium+ UTP
- B. Cable: Berk-Tek LANMARK 2000, Plenum, Part No. 10170669 (Green)
- C. Patch Cables:
  - 1. Cat 6 SlimLine Boot UTP Part No. 6D560-03G
  - 2. Cat 6 SlimLine Boot UTP Part No. 6D560-05G
  - 3. Cat 6 SlimLine Boot UTP Part No. 6D560-07G
- D. Cable Rating: Plenum.

## 2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements of cabling being connected, spliced, and/or terminated.
  - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- D. Connecting Blocks:
  - 1. 110-style IDC for Category 6.
  - 2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Patch Panel: Leviton CAT 6 Flat 110 style Part No. 69586-U24Features:
- F. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
- G. Plugs and Plug Assemblies:
  - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Standard: Comply with TIA-568-C.2.
- H. Jacks: ATLAS-X1 CAT 6 UTP Part No. 61UJK-RC6 (Crimson)
- I. Faceplate:

1. Two, Four, or Six port (per drawings), vertical single gang faceplates designed to mount to single gang wall boxes.
2. Eight, Ten, or Twelve port (per drawings), vertical double gang faceplates designed to mount to double gang wall boxes.
3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
  - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

J. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

## 2.5 GROUNDING

- A. Comply with TIA-607-B.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
1. Install plenum cable in environmental air spaces, including plenum ceilings.
  2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- C. Wiring that is not installed in raceways and cable trays shall be installed in J-hooks mounted to walls above accessible ceiling. Maximum j-hook spacing shall be 5'. Cabling homeruns above accessible ceiling in corridors shall not be laid on ceiling grid.
- D. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.
- E. General Requirements for Cabling:
1. Comply with TIA-568-C.1.

2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

### 3.2 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

### 3.3 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.



- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Equipment grounding conductors.
- C. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
  - 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- D. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection. Provide test reports for owner and engineer's review upon completion of testing.
- C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

END OF SECTION 271513

## SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Magnetic door holders.
8. Remote annunciator.
9. Addressable interface device.
10. Digital alarm communicator transmitter.

#### 1.2 ACTION SUBMITTALS

##### A. General Submittal Requirements:

1. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.
  - b. NICET-certified, fire-alarm technician; Level IV minimum.

##### B. Product Data: For each type of product, including furnished options and accessories.

##### C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.

10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
  - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
  - b. Show field wiring required for HVAC unit shutdown on alarm.
  - c. Locate detectors according to manufacturer's written recommendations.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.
- C. Field quality-control reports.
- D. Sample warranty.

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  1. Include the following:
    - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between all devices and equipment.
    - d. Riser diagram.
    - e. Record copy of site-specific software.
    - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) Equipment tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.

- g. Manufacturer's required maintenance related to system warranty requirements.
- h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- B. Automatic sensitivity control of certain smoke detectors.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Duct smoke detectors.
  - 5. Carbon monoxide detectors.
  - 6. Automatic sprinkler system water flow.
  - 7. Fire-extinguishing system operation.
  - 8. Fire standpipe system.
  - 9. Dry system pressure flow switch.
- B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate preaction system.
9. Recall elevators to primary or alternate recall floors (if applicable).
10. Activate elevator power shunt trip(if applicable).
11. Activate emergency lighting control.
12. Activate emergency shutoffs for gas and fuel supplies.
13. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.
3. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.

## 2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

## 2.4 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Gamewell - FCI by Honeywell.
  2. GE UTC Fire & Security; A United Technologies Company.
  3. Notifier.
  4. Siemens Industry, Inc.; Fire Safety Division.
  5. SimplexGrinnell LP.
- B. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
  2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
  3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
  2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
  3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.
- F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.
- G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

- H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

## 2.5 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
  - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  - 2. Station Reset: Key- or wrench-operated switch.

## 2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
  - 1. Comply with UL 268; operating at 24-V dc, nominal.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  - 3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  - 6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.
    - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    - c. Multiple levels of detection sensitivity for each sensor.
    - d. Sensitivity levels based on time of day.

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- B. Photoelectric Smoke Detectors:



1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.7 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

## 2.8 NONSYSTEM SMOKE DETECTORS

A. General Requirements for Nonsystem Smoke Detectors:

1. Nonsystem smoke detectors shall be listed as compatible with the fire-alarm equipment installed or shall have a contact closure interface listed for the connected load.
2. Nonsystem smoke detectors shall meet the monitoring for integrity requirements in NFPA 72.

B. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac.
2. Auxiliary Relays: One.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
4. Visible Notification Appliance: 177-cd strobe.
5. Heat sensor, 135 deg F combination rate-of-rise and fixed temperature.
6. Test Switch: Push to test; simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

C. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
  - a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; listed for use with the supplied detector.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.9 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.

1. Mounting: Adapter plate for outlet box mounting.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature.
1. Mounting: Adapter plate for outlet box mounting.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.10 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Chimes: Vibrating type.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.
- D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
1. Mounting: Wall mounted unless otherwise indicated.
  2. Flashing shall be in a temporal pattern, synchronized with other units.
  3. Strobe Leads: Factory connected to screw terminals.
  4. Mounting Faceplate: Factory finished, red.

## 2.11 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
  2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  3. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

## 2.12 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.13 ADDRESSABLE INTERFACE DEVICE

- A. General:
  - 1. Include address-setting means on the module.
  - 2. Store an internal identifying code for control panel use to identify the module type.
  - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall (as required), to circuit-breaker shunt trip for power shutdown.
  - 1. Allow the control panel to switch the relay contacts on command.
  - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
  - 1. Operate notification devices.
  - 2. Operate solenoids for use in sprinkler service..

## 2.14 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.
  - 5. Communications failure with the central station or fire-alarm control unit.
  
- D. Digital data transmission shall include the following:
  - 1. Address of the alarm-initiating device.
  - 2. Address of the supervisory signal.
  - 3. Address of the trouble-initiating device.
  - 4. Loss of ac supply.
  - 5. Loss of power.
  - 6. Low battery.
  - 7. Abnormal test signal.
  - 8. Communication bus failure.
  
- E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- C. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
  - 2. Mount manual fire-alarm box on a background of a contrasting color.
  - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

- F. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

### 3.2 PATHWAYS

- A. Pathways shall be installed in EMT.
- B. Exposed EMT shall be painted red enamel.

### 3.3 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  1. Smoke dampers in air ducts of designated HVAC duct systems.
  2. Magnetically held-open doors.
  3. Electronically locked doors and access gates.
  4. Alarm-initiating connection to elevator recall system and components.
  5. Alarm-initiating connection to activate emergency lighting control.
  6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  7. Supervisory connections at valve supervisory switches.
  8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  9. Supervisory connections at elevator shunt-trip breaker.
  10. Supervisory connections at fire-extinguisher locations.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

### 3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

## SECTION 31 00 00

### EARTHWORK

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Perform earthwork.
- B. Meet requirements for excavation safety, or to facilitate construction due to wet conditions.
- C. Perform excavation regardless of type, nature, or condition of materials encountered.
- D. Contractor shall make his own estimate of the type and extent of the various materials to be excavated in order to accomplish the work.
- E. There will be no extra compensation for dewatering.

##### 1.02 RELATED SECTIONS

- A. Section 31 10 00 - Site Clearing.
- B. Section 31 23 33 - Trenching and Backfilling.

##### 1.03 REFERENCES

- A. Arkansas Department of Transportation, Standard Specifications for Highway Construction, latest edition.
  - 1. ARDOT Section 303 - Aggregate Base Course.
- B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA Phone: (610) 832-9585 Fax: (610) 832-9555.
  - 1. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb Rammer and 12-in. Drop.
  - 2. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb Rammer and 18-in. Drop.
  - 4. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
  - 5. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 6. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place of Nuclear Methods (Shallow Depth).
- C. Occupational Safety and Health Administration (OSHA) Standard for Excavation and Trenches Safety System, 29 CFR 1926, Subpart P: Excavations.
- D. Arkansas Statute 291 of 1993.

##### 1.04 DEFINITIONS

- A. Relative Compaction:
  - 1. The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Standard Proctor Test, ASTM D698, or as determined by the Modified Proctor Test, ASTM D1557, as applicable.
  - 2. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer.



- B. Optimum Moisture Content:
  - 1. Moisture content of the material for which the maximum dry density is obtained as determined by ASTM D698 or D1557.
  - 2. Field moisture contents shall be determined on the basis of the fraction passing the 3/4-inch sieve.
- C. Completed Course: A course or layer that is ready for the next layer or the next phase of construction.

#### **1.05 SUBMITTALS**

- A. Submit in accordance with Specifications.
- B. Provide the following:
  - 1. Samples of imported material.
  - 2. Samples of onsite material to be used as fill.
  - 3. Certification that imported materials conform to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory.
  - 4. Proctor curves on fill material as prepared by approved laboratory.

#### **1.06 PROJECT CONDITIONS**

- A. Beginning work of this Section means acceptance of existing conditions.

### **PART 2 PRODUCTS**

#### **2.01 FILL**

- A. Free from roots, organic matter, trash, and debris with maximum particle size of 1-1/2 inches.
- B. It is intended that structural backfill material be obtained from on site to the maximum extent possible.

#### **2.02 IMPORTED GRANULAR FILL**

- A. Provide granular fill beneath structures as noted on Drawings.
- B. Imported granular fill to consist of a natural or artificial mixture of gravel and soil mortar, uniformly well graded from coarse to fine.
- C. Conform to the ARDOT Section 303 classifications for Class 7 as designated on the Drawings.

#### **2.03 TOPSOIL**

- A. Selected topsoil at the site, properly stored and protected, free from roots, sticks, hard clay, and stones which will not pass through a 2-inch square opening.
- B. Provide imported topsoil of equal quality if required to accomplish the work.

#### **2.04 COMPACTION EQUIPMENT**

- A. Provide compaction equipment of suitable type and adequate to obtain the densities specified.
- B. Operate compaction equipment in strict accordance with the manufacturer's instructions and recommendations.
- C. Hand-operated equipment shall be capable of achieving the specified densities.

## **2.05 MOISTURE CONTROL EQUIPMENT**

- A. Provide equipment for applying water of a type and quality adequate for the work; it shall not leak; and be equipped with a distributor bar or other approved device to assure uniform application.
- B. Provide equipment for mixing and drying out material consisting of blades, discs, or other approved equipment.

## **2.06 WATER REMOVAL EQUIPMENT**

- A. Provide and operate equipment adequate to keep excavation and trenches free of water.

## **2.07 IMPORTED MATERIAL ACCEPTANCE**

- A. Import only if insufficient material is available on-site.
- B. Locate and arrange use of a site near the construction area for obtaining borrow material.
- C. Additional tests required at the borrow area:
  - 1. Standard Proctor.
  - 2. Remolded permeability.
  - 3. Atterberg limits.
- D. Upon completion of removal of borrow material, grade the site to drain, place topsoil on disturbed areas, and establish grass.
- E. Cost for testing and imported material shall be the responsibility of the Contractor.

## **2.08 SELECTED MATERIAL ACCEPTANCE**

- A. Provide samples for testing representative of the actual material to be installed in the work. Take samples from each 2,000 cubic yards of material stockpiled. Depending on the uniformity of the material, Engineer may request more frequent samples.
- B. Forward test results to the Engineer at least 10 days before the material is required for use. If tests indicate that the material does not meet Specification requirements, the material shall not be installed in the work.
- C. Material which is placed in the work but does not conform to the Specification requirements shall be removed and replaced at the Contractor's sole expense.

## **PART 3 EXECUTION**

### **3.01 CLEARING AND GRUBBING**

- A. Complete clearing and grubbing work as specified in Section 31 11 00 prior to beginning work in this Section.

### **3.02 STRIPPING TOPSOIL**

- A. Remove existing grass and overburden before excavating topsoil.
- B. Prior to beginning excavation or fill, strip the topsoil to a depth of at least 6 inches or to a depth sufficient to remove organic material and stockpile for future use.
- C. In general, remove topsoil where structures are to be built, trenches dug, and roads, parking lots, walks, and similar improvements constructed within the areas presently covered with topsoil.
- D. Store topsoil clear of the construction area.
- E. Take reasonable care to prevent the topsoil from becoming mixed with subsoil or eroding.

### **3.03 STRUCTURAL EXCAVATION**

- A. Contractor shall be solely responsible for trench and excavation safety systems in accordance with ACT 291 of 1993 and OSHA requirements.
- B. Identify required lines, levels, and grades.
- C. Identify known underground utilities. Contractor will be responsible for locating utilities.
- D. The method of excavation is optional, however, no equipment shall be operated in a manner that will endanger existing structures and their integrity.
- E. Use excavation support system such as sheet piling where ever necessary.
- F. Allow for forms, working space, granular base, and finish topsoil where shown on Drawings or required.
- G. Do not carry excavation for footings and slabs deeper than the elevation shown on Drawings after allowing for base material. Excavation of material to depths below the grades indicated, unless so directed by the Engineer or Owner's representative, will be deemed unauthorized excavation.
- H. If undercutting occurs below the planned dirt grade, the same fill material as specified for backfill shall be placed and compacted to 100 Percent Standard Proctor Density as defined in this Section up to the planned dirt grade in 8 inch lifts, at no additional cost to the Owner. Do not attempt to over compact excessively wet soil. Allow to dry first by scarifying and aerating before remolding.

### **3.04 DEWATERING EXCAVATION**

- A. Remove water during periods when concrete is being deposited, pipe is being laid, and placing of backfill unless water settling is required, and at other times as required for efficient and safe execution of the work.
- B. Accomplish removal of groundwater in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures.
- C. Where necessary to these purposes, lower the water level in advance of excavation, utilizing wells, well points, or similar methods.
- D. Maintain the water level in the gravel stratum as measured in piezometers, a minimum of 3 feet below the prevailing excavation level or as needed to prevent bottom heave of the excavation.
- E. Open pumping, sumps, and ditches: If these result in boils, loss of fines, softening of the ground or instability of slopes, areas shall not be accepted.
- F. Install wells and well points with suitable screens and filters so that continuous pumping of fines does not occur.
- G. Operate well points continuously to prevent boils and loss of consolidation.
- H. Arrange discharge to facilitate collection of samples by Engineer.
- I. Avoid settlement or damage to adjacent property.
- J. Dispose of water in a manner that will not damage adjacent property, as approved.

### **3.05 GRANULAR FILL MATERIAL UNDER FACILITIES**

- A. Place fill granular material as specified in this Section within the influence area beneath slabs, walks, structures, roads, and parking areas, and as shown on the Drawings.
- B. Do not exceed loose lifts of 6 inches.

- C. Compact each lift to not less than 95 Percent Modified Proctor Density.
- D. Place and compact a 6-inch layer of granular fill to at least 95 Percent Modified Proctor density immediately beneath spread footings, slabs on grade, or other concrete structures.
- E. Moisten material as required to aid compaction ( $\pm 2$  percent optimum moisture).
- F. Place material in horizontal lifts and in a manner to avoid segregation.
- G. Correct and repair subsequent damage to slabs, piping, concrete structures, facilities, or other structures caused by settlement of fill material.

### **3.06 BACKFILL AND STRUCTURES**

- A. Remove form materials and trash from excavation before placing backfill.
- B. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material.
- C. Compact backfill adjacent to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.
- D. Backfill water-holding basins only after satisfactory leakage tests have been conducted.
- E. Place earth fill in areas not designated to be structural fill or granular fill.
- F. Deposit material in maximum 6-inch loose lifts, and compact each lift to not less than 95 Percent Standard Proctor.

### **3.07 FILL NOT BENEATH STRUCTURES OR FACILITIES**

- A. Place earth fill to the lines and grades shown.
- B. Place fill material in maximum 6-inch loose lifts and compact each lift to not less than 95 Percent Standard Proctor.
- C. Make proper allowance for topsoil where required.

### **3.08 MOISTURE CONTROL**

- A. During compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of fill.
- B. Maintain moisture content uniform throughout the lift.
- C. Add water to the material at the site of excavation. Supplement, if required, by sprinkling the fill.
- D. At the time of compaction, maintain the water content of the material at optimum moisture content, plus or minus 2 percentage points, except as otherwise specified for embankments.
- E. Do not attempt to compact fill material that contains excessive moisture.
- F. Aerate material by blading, discing, harrowing, or other methods, to hasten the drying process.

### **3.09 FIELD DENSITY TESTS**

- A. Test Methods: ASTM D2922, D1556, D2216, and D3017.
- B. Cooperate with testing work by leveling small test areas designated by the Engineer.
- C. Backfill test areas.
- D. Field density test shall be performed for every 3,000 cubic yards of fill material placed.
- E. Engineer may order testing of lift of fill at any time, location, or elevation.

### **3.10 SITE GRADING**

- A. Perform earthwork to lines and grades as shown on Drawings with proper allowance for topsoil where specified or shown on Drawings.
- B. Shape, trim, and finish slopes to conform with the lines, grades, and cross sections shown.
- C. Slopes shall be free of loose exposed roots and stones exceeding 3-inch diameter.
- D. Round tops of banks to circular curbs, in general, not less than a 6-foot radius.
- E. Neatly and smoothly trim rounded surfaces; over-excavating and backfilling to the proper grade are not acceptable.
- F. Finished site grading shall be reviewed by the Engineer.

### **3.11 DISPOSAL OF EXCESS EXCAVATION**

- A. Dispose of excess excavated materials, not required or suitable for use as backfill or fill, outside of the area of work.
- B. Compact excess material as specified for fill, dress the completed disposal area to slopes no greater than 4:1 (horizontal:vertical), and slope to drain.

### **3.12 SETTLEMENT**

- A. Settlement in backfill, fill, or in structures built over the backfill or fill, that may occur within the 1-year guarantee period in the General Conditions shall be considered to be caused by improper compaction methods.
- B. Restore structures damaged by settlement to original condition.

**END OF SECTION**

## SECTION 31 10 00

### SITE CLEARING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Remove interfering or objectionable material from designated areas of Work.
- B. Preserve vegetation and existing objects designated to remain from injury or defacement.
- C. Cut trees only at direction of Engineer.
- D. Contractor shall be responsible for implementing and following a Storm Water Pollution Prevention Plan as required by the Arkansas Department of Environmental Quality and in accordance with NPDES ARR150000. The successful Bidder (Contractor) shall develop a Storm Water Pollution Prevention Plan to meet all State and Federal regulations and submit to the Engineer for review and approval prior to commencing work.

##### 1.02 DEFINITIONS

- A. Clearing:
  - 1. Cutting, removing, and disposing of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth.
  - 2. Removing evidence of their presence from the surface, inclusive of sticks and branches greater than 2 inches in diameter or thickness.
  - 3. Removing and disposing of trash piles, rubbish, and fencing.
- B. Grubbing:
  - 1. Removing and disposing of wood or root matter below the ground surface remaining after clearing.
  - 2. Includes stumps, trunks, roots, or root systems greater than 2 inches in diameter or thickness to a depth of 18 inches below the ground surface.
- C. Stripping: Removing and disposing of organic sod, topsoil, grass and grass roots, and other objectionable material from the areas designated to be stripped that remain after clearing and grubbing.

##### 1.03 RELATED SECTIONS

- A. Section 31 00 00 - Earthwork.

#### PART 2 MATERIALS

##### 2.01 GENERAL

- A. Provide materials, suitable and in adequate quantity, required to accomplish Work of this Section.

#### PART 3 EXECUTION

##### 3.01 PREPARATION

- A. Review with Engineer's representative the location, limits, and methods to be used prior to commencing Work under this Section.

### **3.02 CUTTING TIMBER**

- A. Exercise care when clearing near the clearing limits to avoid damage to existing trees, vegetation, structures, or utilities which are outside of the clearing limits.
- B. Trees shall be leveled into the area to be cleared.
- C. Flush cut stumps not designated for grubbing by cutting to within 2 inches of the ground surface.
- D. Timber is the property of the Contractor.
- E. Dispose of stumps, limbs, brush, snags, non-marketable timber, and other vegetative growth off-site.

### **3.03 PRESERVATION OF TREES, SHRUBS, AND OTHER VEGETATION**

- A. Trees, shrubbery, and other vegetation not designated for removal shall be protected from damage.
- B. Cut and remove tree branches only where, in the opinion of the Engineer, cutting is necessary to effect construction operation.
- C. Remove branches other than those required to effect the Work to provide a balanced appearance of any tree, as approved prior to removal.
- D. Treat scars resulting from the removal of branches with an approved tree sealant.

### **3.04 CLEARING AND GRUBBING LIMITS**

- A. Clear and grub areas within the limits of construction.
- B. Clear and grub in stages as the construction area is increased to avoid unnecessary clearing and grubbing.

### **3.05 DISPOSAL OF CLEARING AND GRUBBING DEBRIS**

- A. Haul the material from the Work site and dispose of in accordance with state, federal, and local laws. Off-site disposal shall be at the Contractor's sole expense.

### **3.06 AREAS TO BE STRIPPED**

- A. The exact depth of stripping shall be determined by the Engineer.
- B. Topsoil requirements are specified in Section 31 00 00.
- C. Strip areas that are cleared and grubbed.
- D. Strip areas in stages to avoid unnecessary stripping.

### **3.07 DISPOSAL OF STRIPPINGS**

- A. Do not mix strippings with borrow excavation.
- B. Stockpile topsoil from the strippings for use in landscape grading.
- C. Dispose of excess topsoil.
- D. Strippings not suitable for use as topsoil shall become the property of the Contractor and shall be removed from the site.

**END OF SECTION**

**SECTION 31 11 00**  
**CLEARING AND GRUBBING**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. Work shall consist of cutting, removing from the ground, and properly disposing of trees, stumps, hedge, brush, roots, logs, weeds, rubbish, sod refuse dumps, sawdust piles, lumbering slash, and other materials within the designated area.
- B. The work shall also include selective clearing, preserving existing vegetation, scalping, and the preservation of objects designated to remain.

**1.02 DEFINITIONS**

- A. Clearing - The removal of all trees, brush, and other objectionable growth, and the removal and disposal of logs, rubbish piles, refuse dumps, sawdust piles, lumbering slash, and other objectionable matter from the surface of the ground in the areas shown on the plans or as designated by the Engineer.
- B. Grubbing - The grubbing and removal of all stumps, roots, and other objectionable matter, lying wholly or in part below the surface of the ground.
- C. Selective Clearing - The trimming of selected trees and shrubs, the removal from the ground and disposal of logs, root pods, brush, refuse dumps, and other undesirable debris, and the cutting, removal, and disposal of all undergrowth, stumps, and standing trees, except those trees and shrubs designated to be preserved. The selective clearing areas will be shown on the plans.
- D. Scalping - Areas not classified as clearing and grubbing and that are within construction limits shall be scalped, if appropriate. Scalping shall include the removal and disposal of material such as saplings less than 4-inches in diameter measured 12-inches above the ground, logs, brush, roots, grass, residue of agricultural crops, refuse dumps, and decayed matter.
- E. Clearing and Grubbing Trees - The cutting, grubbing and removal of individual, isolated trees and stumps greater than 4-inches diameter measured 12-inches above the ground as shown on the plans or designated by the Engineer to be removed.

**PART 2 MATERIALS**

**2.01 GENERAL**

- A. Provide materials suitable and in adequate quantity required to accomplish the work of this Section.

**PART 3 EXECUTION**

**3.01 CONSTRUCTION REQUIREMENTS**

- A. The project site shall be cleared as defined above, except those objects designated to remain shall be carefully protected from abuse, marring, or damage during construction operations.
- B. Trees shall be felled and removed in such a manner as to avoid injury to other trees or objects designated to remain. In case of injury to bark, limbs, or roots of vegetation designed to remain, the Contractor shall repair such damage by corrective pruning or other appropriate methods. Trees or other debris falling outside the construction area shall be removed and disposed of according to these specifications.
- C. Holes remaining after removal of trees, stumps, etc. shall be backfilled with material approved by the Engineer and compacted as directed except in areas to be excavated. The Contractor shall complete the operation by blading, bulldozing, or other approved methods so that the site



shall be free of holes, ditches, or other abrupt changes in elevations that resulted from the clearing and grubbing operations.

### **3.02 CLEARING AND GRUBBING**

- A. The site shall be cleared of stumps, brush, logs, rubbish, trees, and shrubs, with the exception of such trees, shrubs, and areas designed on the plans or by the Engineer for preservation. Grubbing will not be required in areas that will have a fill height of 3-feet or more above disturbed stumps cut within 6-inches of the natural ground. Sound stumps may be left outside the construction limits when they are severed flush with or below the natural ground, or the slope line in areas to be rounded at the top of the back slopes.
- B. Merchantable timber in the clearing area shall become the property of Contractor, unless otherwise provided.
- C. When perishable material is burned, it shall be under the constant care of a competent watcher. Contractor is responsible for obtaining any and all permits for burning. Burning shall be accomplished at such times and in such manner that the surrounding vegetation, adjacent property, or anything designated to remain on the site will not be jeopardized. Upon notice from the Engineer that meteorological conditions render burning undesirable, the Contractor shall cease all burning until notified by the Engineer that meteorological conditions are suitable for a resumption of burning operations.
- D. When specified, burning will not be permitted unless the material to be burned is placed in an incineration pit and an acceptable forced air combustion device is used that will minimize the emission of smoke, fly ash, and other pollutants. This device shall be constructed so that the forced air is directed over the fire by plenums or ducts. The use of open fans or mulch blowers will not be permitted.
- E. The Contractor shall comply with all Federal, State, County, and City laws, regulations, or ordinances applicable to the disposal of clearing and grubbing material. Materials and debris that cannot be burned shall be removed from the project site and disposed of at locations off the project, outside the limits of view from any public road, street, park, or other public facility. The Contractor shall make all necessary arrangements with the property owner for obtaining suitable disposal locations.
- F. Disposal operations and final cleanup of the site, including seeding and stabilization, shall comply with these specification requirements. When requested by the Engineer, the Contractor shall furnish copies of all agreements with property owners.

### **3.03 SELECTIVE CLEARING**

- A. This work shall be performed in such a manner as to leave the designated areas in a park-like condition and susceptible to economical mowing. Disposal of all material shall comply with the methods set out in the Clearing and Grubbing requirements.
- B. Stumps, trees, and shrubs, except those designated to be preserved, shall be severed flush with or below the ground.
- C. Movement and operation of equipment shall be such that roots, branches, and trunks of trees and shrubs selected for retention will not be scarred, broken, or otherwise damaged to the extent that the life of the plant is endangered.

### **3.04 PRESERVED VEGETATION**

- A. Trees, shrubs, brush, vines, and other natural perennial vegetation shall be protected in the areas designated as Preserved Vegetation.
- B. Areas designated as Preserved Vegetation shall not be used for parking, storage, or other construction support activities that will damage vegetation or compact the soil. Care shall be taken to prevent spills of materials hazardous to vegetation such as oil, hydraulic fluid, salts,

etc.. Erosion and sedimentation control shall be such that sediment is not deposited in depths greater than 2-inches within any portion of the Preserved Vegetation area.

- C. Clearing and grubbing may be required through preserved vegetation areas for drainage outlets, channels, or other required construction.

### **3.05 SCALPING**

- A. The Contractor shall scalp areas where excavation or embankment is to be made, except that mowed sod need not be removed where the embankment to be constructed is more than 3-feet in height.
- B. All suitable material resulting from the scalping operation shall be placed on finished slopes, adjacent to the area from which it is obtained, after excavation or embankment operations are complete.
- C. Unsuitable material shall be disposed of as specified for Clearing and Grubbing.

**END OF SECTION**

## SECTION 31 23 16.16

### STRUCTURAL EXCAVATION AND BACKFILL

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

- A. This item shall govern for all excavation required for the construction of all structures, except pipe or box sewers but including sewer structures and appurtenances; for the disposal of all excavated material; and for backfilling around completed structures to the original ground level or as required by the plans. The work shall include all necessary pumping, bailing, sheathing, drainage, and the construction and removal of any required cofferdams. Unless otherwise provided, the work included herein shall provide for the removal of old structures or portions thereof (abutments, wingwalls, piers, etc.), trees and all other obstructions to the proposed construction.
- B. Excavation will not be classified, but will be considered as "Structural Excavation", which will include the removal of all materials encountered regardless of their nature or the manner in which they are removed as well as any required backfill.

##### 1.02 RELATED SECTIONS

- A. Section 31 23 33 - Trenching and Backfilling.

##### 1.03 STRUCTURAL EXCAVATION

- A. Unless specified on the plans, or approved otherwise by the Engineer, structural excavation shall be designated as follows:
  - 1. Width and Length - From a vertical plane outside the structure equal to the thickness of the footing or slab.
  - 2. Depth - From bottom of footing or slab to the finished groundline or natural groundline, whichever is lower in elevation.
  - 3. When caissons are provided, excavation is not permitted outside the outer face of the caissons.
- B. By definition, a cofferdam is a temporary or removable structure to keep surrounding earth, water, or both out of the excavation and may be earth, timber, steel, concrete or a combination thereof.
- C. A caisson is a permanent part of the substructure which sinks gradually into place as material is excavated within the area protected by its sidewalls. It may be either open well type or a pneumatic type caisson.

#### PART 2 PRODUCTS

##### 2.01 BACKFILLING

- A. All backfills shall be constructed in layers approximately parallel to the finished grade. After completion of the backfill, it shall be continuously maintained to its finished grade, until the project is accepted.
- B. Each layer of embankment or backfill shall be uniform as to material, density and moisture content before beginning compaction. Water required to bring the material to the moisture content necessary for the required compaction shall be the responsibility of the Contractor.
- C. Unless otherwise indicated, backfill compacted mechanically shall be in loose lifts not exceeding 8- inches. Backfill shall be clean bank sand, unless otherwise directed by the Engineer, free from clay and clay lumps, shale, loam, organic matter, salts and other deleterious materials and having a plasticity index less than 3. Backfill shall be compacted to ninety-five (95)

percent of Standard Proctor Density (ASTM D698) at a moisture content ranging from -2 to +3 percentage points above optimum.

- D. Do not place backfill against walls for a minimum of 7 days after structure has been in place. Place backfill against walls of partially completed structure only after approval of the Engineer. Backfill around abutments and piers shall be deposited on both sides to approximately the same elevation at the same time.
- E. Care shall be taken to prevent any wedging action or backfill against the structure and the slopes bounding the excavation shall be stepped or serrated to prevent such wedge action.
- F. No backfilling shall be done except in the presence of the Engineer, or his authorized representative.

## **2.02 CONSTRUCTION METHODS**

- A. Excavation shall be done in accordance with the lines and grades indicated on the plans, or as established by the Engineer.
- B. The final elevation to which a foundation is to be constructed shall be as shown on the plans or as raised or lowered by written order of the Engineer when such alterations are judged proper to satisfactorily comply with the design requirements for the structure. Should it be found necessary, in the judgment of the Engineer to increase or decrease the depth of footings from that shown on the plans, the necessary alterations in the details of the structure shall be accomplished as directed by the Engineer. The City of Pine Bluff shall have the right to substitute revised details resulting from a consideration of the changes in the design condition.
- C. When a structure is to rest on an excavated surface, special care shall be taken not to disturb the bottom of the excavation, and the final removal of the foundation material to grade shall not be performed until just before the footing is to be placed.
- D. Protect excavations from rainfall and surface water. If the supporting soil is exposed to adverse wet or dry conditions, excavate deeper and/or wider to sound material at no additional cost to the City of Pine Bluff. Prior to such activity, the Contractor shall notify the Engineer.
- E. Excavated material required to be used for backfill may be deposited, by the Contractor, in storage piles at points convenient for rehandling of the material during the backfilling operations. The location of storage piles shall, however, be subject to the approval of the Engineer, who may require that the survey centerline of the structure and the transverse or hub line of any unit of the structure be kept free of any obstruction.
- F. Excavated material required to be wasted shall be disposed of as directed by the Engineer, and the disposal shall be in such manner as not to obstruct a stream or otherwise impair the efficiency or appearance of the structure or other parts of the work.

## **2.03 COFFERDAMS AND CAISSONS**

- A. The term cofferdam wherever used in this specification designates any temporary or removable structure which is constructed to hold the surrounding earth, water, or both out of the excavation, whether such structure is formed of earth, timber, steel, concrete, or a combination of these. It thus includes earthen dikes, timber cribs, any type of sheet piling, removable steel sheets and the like and all necessary bracing; and it shall also be understood to include the use of pumping wells or well points for the same purpose. The cost of cofferdams shall be included as an incidental cost to excavation.
- B. The term caisson, wherever used in this specification, designates a permanent part of the substructure, so constructed as to sink gradually into place as material is excavated within the area protected by its sidewalls. Such caisson may be of either the open-well or pneumatic type and quantities for same will always be included as bid items separate from excavation.

- C. In addition to interior dredging, the lowering of caissons may be facilitated by the following methods:
1. Addition of weight by increasing the thickness of caissons, where such increase is permitted by the type of design, shall be requested by the Contractor prior to beginning the work. Increased quantities due to this change shall be at the Contractor's expense.
  2. By the addition of removable loads to the caisson.
  3. The use of water or air jets placed around the caisson.
  4. Steel shell caissons may be driven with a drop or air hammer if the Contractor, at his own expense, provides a suitable driving ring. The driving ring shall be of sufficient strength and the manner of driving shall be regulated to preclude damage to the caisson.
- D. When no provisions for caissons is shown on the plans, it shall be the intent of this specification to require that a suitable cofferdam be provided for all excavations where such cofferdam may be necessary to control water conditions or to preclude sliding and caving of the walls of the excavation. Where no ground or surface water is encountered, the cofferdam needs to be sufficient only to protect the workmen and to avoid cave-ins or slides extending beyond the excavation limits.
- E. The Contractor shall submit, to the Engineer, upon request, drawings showing his proposed method of cofferdam construction and other details left open to this choice, or not fully shown on the plans. All shoring designs must meet the requirements of OSHA Standard 1926.650.
- F. The type and clearance of the cofferdam, insofar as such details affect the character of the finished work, will be subject to the approval of the Engineer, but other details of design will be left to the choice of the Contractor, who will be responsible for the successful completion of the work. The interior dimensions shall be such as to provide sufficient clearance for the construction and removal of any required forms and the inspection of their exteriors and to permit pumping outside of the forms.
- G. In general, sheet piling cofferdams shall extend well below the bottom of the footings and shall be well braced and as water-tight as practicable.
- H. When foundation pilings are to be driven inside a caisson or cofferdam and when it is judged impractical to dewater the caisson or cofferdam before placing a concrete seal, the excavation may be extended below the footing grade to a depth sufficient to allow for swell of the material during pile driving operations. After the pilings have been driven, all foundation material that has risen to a level above the footing grade shall be removed. It is the intention of this provision to establish a construction tolerance to be applied when a foundation is being constructed under water. Where it is possible to dewater the caisson or cofferdam before a seal is placed, it is considered practicable to remove the foundation material to the exact footing grades after foundation pilings are driven. Backfilling in a foundation to compensate for excavation which has been extended below grade, will not be permitted. Such areas below grade shall be filled with concrete at the time the seals or base courses are placed, and the concrete quantities involved shall be at the Contractor's expense. All caisson and cofferdam designs must meet the requirements of OSHA Standard 1926.650.
- I. Caissons or cofferdams which tilt or move laterally during the process of sinking shall be righted or enlarged, as necessary, at the sole expense of the Contractor.
- J. Unless otherwise provided, cofferdams shall be removed by the Contractor after the completion of the substructure. The removal shall be affected in such a manner as not to disturb or mar the structure. In lieu of the entire removal of the cofferdams, the Engineer may require the Contractor to remove any portion of them or to leave them entirely in place.

#### **2.04 PUMPING OR BAILING**

- A. Pumping or bailing from the interior of any foundation enclosure shall be done in such a

manner as to preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the time of the placing of concrete or for a period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water-tight wall. Pumping or bailing to dewater a sealed cofferdam or caisson shall not be started until the seal has set for at least 36 hours.

### **PART 3 EXECUTION**

#### **3.01 QUALITY ASSURANCE**

- A. The Testing Laboratory's representative will determine the moisture density relationship for each material proposed for use as backfill, in accordance with ASTM Method D689. In place density will be determined in accordance with ASTM Methods D2922 or D1556, and with each type of construction.
- B. For walls and trenches, determine the in place density for each 200-foot of wall or trench, for each lift of fill placed.
- C. For building pads and parking areas, determine the in place density for each 4,000 square feet (500 square yards) for each lift of fill placed.

#### **3.02 MEASUREMENT AND PAYMENT**

- A. Will not be paid for directly, but will be considered subsidiary to the bid for structures requiring excavation and/or backfilling.

**END OF SECTION**

## SECTION 31 23 33

### TRENCHING AND BACKFILLING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Work of this Section also includes:
  - 1. Replacing topsoil that contains regenerative material.
  - 2. Disposal of trees, stumps, brush, roots, limbs, and other waste materials from clearing operations.
  - 3. Imported topsoil.
  - 4. Crush rock backfill required by over-excavation.
  - 5. Imported pipe zone material.
  - 6. Trench settlement repair, including replacing roadway surfacing, sidewalk, or other structures.
  - 7. Replacing damaged culverts.
- B. Trench excavation is classified as common excavation and includes removal of material of whatever types encountered including rock to depths shown or as directed by Engineer.
- C. Pipe zone includes full width of excavated trench from bottom of pipe to a point 6 inches above top outside surface of pipe barrel.
- D. Conform to federal, state, and local codes governing safe loading of trenches with excavated material.
- E. The right is reserved to modify the use, location, and quantities of the various types of backfill during construction as Engineer considers to be in the best interest of Owner.
- F. There shall be no extra compensation for dewatering and rock excavation.
- G. Pipe shall be installed according to the latest version of AWWA C605.

##### 1.02 REFERENCES

- A. Arkansas Department of Transportation, P.O. Box 2261, Little Rock, Arkansas 72203, latest edition.
  - 1. ARDOT 303 - Aggregate Base Course.
- B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 (latest edition).
  - 1. ASTM D448 - Classifications for Standard Sizes of Aggregate and Bridge Construction.
  - 2. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. (2.49-kg.) Rammer and 12-inch (304.8-mm) Drop.
  - 3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10-lb. (4.54-kg.) Rammer and 18-inch (457-mm) Drop.
  - 4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes.
  - 5. ASTM D2922 - Test Methods for Density of Soils and Soil-Aggregates in Place by Nuclear Method.

- C. Occupational Safety and Health Administration (OSHA) Standard for Excavation and Trenches Safety System, 29 CFR 1926, Subpart P: Excavations.
- D. The Contractor shall be solely responsible for trench and excavation safety systems in accordance with Act 291 of 1993

## **PART 2 PRODUCTS**

### **2.01 FOUNDATION STABILIZATION**

- A. Crushed gravel or crushed rock, free from dirt, clay balls, or organic material, well graded from coarse to fine, containing sufficient finer material for proper compaction, and meeting ASTM D448 Size No. 67 (Concrete Aggregate).

### **2.02 PIPE ZONE MATERIAL**

- A. Select material shall consist of fine loose earth or sand free from clods or rocks larger than 3/4 inches in dimension and of proper moisture content for maximum consolidation.
- B. Crushed granular material conforming to ASTM D448, Size No. 67.
- C. For Polyvinyl Chloride (PVC) pipe, the maximum embedment particle size shall not exceed 3/4-inch (20 mm) for angular rock.
- D. Washed stone bedding size 1/4-inch to 3/4-inch.

### **2.03 COMMON FILL MATERIALS**

- A. Material shall not contain pieces larger than 3 inches, and shall be free of roots, debris, or organic matter.

### **2.04 SELECT FILL MATERIALS**

- A. Class 7, Class 3, and Class 4 as established by Section 303 of Arkansas Department of Transportation Standard Specifications for Highway Construction.
- B. ASTM Soil Classification GC as set forth in ASTM Designation D2487. On site material may be used, provided it is in accordance with ASTM D2487.

### **2.05 BEDDING MATERIAL**

- A. Pea gravel, sand, or other locally available bedding material, as approved.

### **2.06 TRENCH BACKFILL**

- A. Granular Backfill:
  - 1. Natural or artificial mixture of gravel and soil mortar uniformly well graded from coarse to fine.
  - 2. ARDOT Section 303 Class 3, Class 4, or Class 7 as specified in this Section.

### **2.07 PVC WATER AND SEWER PIPE TRENCH**

- A. See Drawings for trench details.

### **2.08 COMPACTION EQUIPMENT**

- A. Suitable type and adequate to obtain the amount of compaction specified.
- B. Operate in strict accordance with manufacturer's instructions and recommendations and maintain in such condition so that it will deliver manufacturer's rated compactive effort.

### **2.09 IMPORTED TOPSOIL**

- A. Suitable sandy loam from an approved source.



- B. Must possess friability and a high degree of fertility.
- C. Free of clods, roots, gravel, and other inert material.
- D. Free of quackgrass, horsetail, and other noxious vegetation and seed.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Where clearing or partial clearing of right-of-way is necessary, complete prior to start of trenching.
- B. Cut trees and brush as near to surface of ground as practicable, remove stumps, and pile for disposal.
- C. Do not permit excavated materials to cover brush or trees prior to disposal.

### **3.02 PREVENT TRENCH WATER AND ANIMALS FROM ENTERING PIPE**

- A. When pipe laying is not in progress, including noon hours, open ends of pipe shall be closed; and no trench water, animals, or foreign material shall be permitted to enter the pipe.

### **3.03 DISPOSAL OF CLEARED MATERIAL**

- A. Dispose of material in such a manner to meet requirements of state, county, and local regulations regarding health, safety, and public welfare.
- B. Dispose of nonflammable and flammable material off the construction site in an approved location.
- C. Do not leave material on the Project site, shove onto abutting private properties, or bury in embankments or trenches.

### **3.04 REMOVAL OF OBSTRUCTIONS**

- A. Remove obstructions within trench area or adjacent thereto such as tree roots, stumps, abandoned piling, logs, and debris.
- B. Engineer may, if requested, make changes in the trench alignment to avoid major obstructions, if such alignment changes can be made within the easement or right-of-way without adversely affecting the intended function of the facility.
- C. Dispose of obstructions in accordance with this Section.

### **3.05 REMOVAL AND REPLACEMENT OF TOPSOIL**

- A. Where trenches cross lawns, garden areas, pasturelands, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove topsoil for a depth of 6 inches for full width of trench to be excavated.
- B. Use equipment capable of removing a uniform depth of material.
- C. Stockpile removed topsoil at regular intervals, and do not mix with other excavated material.
- D. Locate stockpiles so that material of one ownership is not transported and stockpiled on property of another ownership.
- E. Minimum finished depth of topsoil over trenches: 5 inches.
- F. Imported topsoil may be substituted for stockpiling and replacing topsoil.
- G. Maintain finished grade of topsoil level with area adjacent to trench until final acceptance by Engineer.

- H. Repair damage to adjacent topsoil caused by work operations.
  - 1. Remove rock, gravel, clay, and other foreign materials from the surface.
  - 2. Regrade.
  - 3. Add topsoil as required.

### **3.06 TRENCH WIDTH**

- A. Minimum width of unsheeted trenches where pipe is to be laid shall be 18 inches greater than the outside diameter of the pipe, or as approved.
- B. Maximum width at top of trench will not be limited, except where excess width of excavation would cause damage to adjacent structures or property or cause undue stresses on the pipe.
- C. Confine trench widths to dedicated rights-of-way or construction easements, unless special written agreements have been made with affected property owner.

### **3.07 EXCAVATION**

- A. Excavate trench to lines and grades shown or as established by Engineer with proper allowance for pipe thickness and for pipe base or special bedding when required.
- B. If trench is excavated below required grade, correct with foundation stabilization material.
- C. Place material over full width of trench in compacted layers not exceeding 6 inches deep to established grade with allowance for pipe base or special bedding.

### **3.08 PREPARATION OF TRENCH - LINE AND GRADE**

- A. Do not deviate more than ½ inch from line or ½ inch from grade. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.
- B. Grade the bottom of the trench by hand to the line and grade where the pipe is to be laid, with proper allowance for pipe thickness and for pipe base when specified or indicated.
- C. Remove hard spots that would prevent a uniform thickness of bedding.
- D. Check the grade with a straightedge and correct irregularities found.
- E. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

### **3.09 SHORING, SHEETING, AND BRACING OF TRENCHES**

- A. Sheet and brace trench when necessary to prevent caving during excavation in unstable material or to protect adjacent structures, property, workers, and the public.
- B. Increase trench widths accordingly by the thickness of the sheeting.
- C. Maintain sheeting in place until pipe has been placed and backfilled at pipe zone.
- D. Remove shoring and sheeting as backfilling is done in a manner that will not damage pipe or permit voids in backfill.
- E. Conform to safety requirements of federal, state, or local public agency having jurisdiction for sheeting, shoring, and bracing of trenches; the most stringent of these requirements shall apply.

### **3.10 LOCATION OF EXCAVATED MATERIALS**

- A. Place excavated material only within construction easement, right-of-way, or approved working area.
- B. Do not obstruct private or public traveled roadways or streets.

### **3.11 REMOVAL OF WATER**

- A. Provide and maintain ample means and devices to promptly remove and dispose of water entering trench during time trench is being prepared for pipe laying, during laying of pipe, and until backfill at pipe zone is completed.
  - 1. These provisions apply during the noon hour as well as overnight.
  - 2. Provide necessary means and devices, as approved, to positively prevent under water from entering the construction area of another contractor.
- B. Dispose of water in a manner to prevent damage to adjacent property.
- C. Drainage of trench water through the pipeline under construction is prohibited.

### **3.12 FOUNDATION STABILIZATION**

- A. When existing material in bottom of trench is unsuitable for supporting pipe, excavate unsuitable material.
- B. Backfill trench to subgrade of pipe base with foundation stabilization material specified.
- C. Place foundation stabilization material over the full width of trench and compact in layers not exceeding 6 inches deep to required grade by making passes with a vibratory compactor (or equivalent).
- D. Material shall be considered unsuitable when it contains more than 5 percent organic material by volumetric sampling or when it will not support a reading of 1.5 on a hand penetrometer.

### **3.13 ROCK IN PIPE TRENCH**

- A. Where rock is encountered in bottom of trench, support pipe on bedding material.
- B. Minimum Bedding Thickness: Minimum of 4 inches or one eighth of the outside diameter of pipe, whichever is greater.
- C. Extend bedding up pipe sides one sixth of outside diameter of the pipe, minimum.
- D. Backfill over pipe according to pipe zone type.

### **3.14 PIPE ZONE BACKFILL**

- A. Depth of the pipe zone above pipe barrel varies with pipe material.
- B. Particular attention must be given to area of pipe zone from flow line to centerline of pipe to ensure firm support is obtained to prevent lateral movement of pipe during final backfilling of pipe zone.
- C. Backfill area of pipe zone from bottom of pipe to horizontal centerline of pipe by hand-placing material around pipe in 4-inch layers.
- D. Achieve continuous support beneath pipe haunches by "walking in" and slicing with shovel.
- E. Backfill area of pipe zone from horizontal centerline to top of pipe zone with pipe zone material as determined by class of backfill.
- F. In lieu of selected material for pipe zone in upper portion of pipe zone, imported pipe zone material approved by Engineer for trench backfill may be substituted.
- G. If the Engineer determines that the existing material is insufficient or unsuitable at trench side for selected material for pipe zone in upper portion of pipe zone, provide suitable material from other trench excavation along pipeline or imported pipe zone material.

### **3.15 TRENCH BACKFILL ABOVE PIPE ZONE**

- A. When backfill is placed mechanically, push backfill material onto slope of backfill previously placed and allow to slide down into trench.
- B. Do not push backfill into trench in such a way as to permit free fall of material until at least 2 feet of cover is provided over top of pipe.
- C. Under no circumstances allow sharp, heavy pieces of material to drop directly onto pipe or tamped material around pipe.
- D. Do not use backfill material of consolidated masses larger than ½ cubic foot.

### **3.16 EXCESS EXCAVATED MATERIAL**

- A. Dispose of excess excavated material off project site in an approved area.

### **3.17 DRAINAGE CULVERTS**

- A. Replace drainage culverts which are removed on near right angles to pipe centerline.
- B. If pipe cannot be reused or is damaged during removal, dispose of it and provide new pipe.
- C. Protect culverts from damage or restore to equivalent condition.
- D. Replace culverts to existing lines and grades.
- E. Do not replace culverts until proposed pipeline is installed and backfill of trench has been completed to subgrade of culvert.

### **3.18 PIPE COVER**

- A. Place select material from excavation over pipe to provide minimum coverage, as shown on Drawings or as directed by Engineer.

### **3.19 DRAINAGE DITCH RESTORATION**

- A. Undercrossings of minor drainage ditches not covered in another Specification Section shall be backfilled so that upper 1 foot of material in ditch between ditch banks is clay.
- B. Compact material for full ditch width by 6 passes of vibratory compactor (or equivalent).
- C. Where indicated on Drawings, provide concrete arch, and/or riprap on ditch banks.

### **3.20 SETTLEMENT**

- A. Correct settlement noted in backfill, fill, or in structures built over backfill or fill within warranty period.

### **3.21 IMPORTED TOPSOIL**

- A. Should regenerative material be present in soil, remove both surface and root which appears in within 1 year following acceptance of Project in a manner satisfactory to Owner.

**END OF SECTION**

## SECTION 31 25 00

### EROSION AND SEDIMENTATION CONTROL

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Install slope protection and erosion control.
- B. Complete Work to present a continuous appearance.

##### 1.02 RELATED SECTIONS

- A. Section 31 00 00 - Earthwork.
- B. Section 31 10 00 - Site Clearing.
- C. Section 31 23 33 - Trenching and Backfilling.

##### 1.03 SAFETY REQUIREMENTS

- A. Conform with OSHA requirements, federal, state, and local rules and regulations pertaining to safety and as specified elsewhere in these Specifications.

#### PART 2 PRODUCTS

##### 2.01 FILTER FABRIC FOR SILT FENCING

- A. Nonwoven polypropylene or polyester fabric.
- B. Manufacturer: Typar 3401, Trevira S1115, or equal.

##### 2.02 ACCESSORIES

- A. Wood or steel stakes. If using steel stakes (rebar), stakes shall have safety caps meet OSHA requirements.
- B. Rectangular hay bales secured with twine or nylon rope.
- C. Filter fabric shall be supported by steel or wooden post and backed with a woven wire fabric for support.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION

- A. Stake hay bales with wooden or steel stakes to prevent movement and to provide erosion control.
- B. Install silt fencing to control dust movement and to prevent erosion.
- C. Hay bales and silt fencing support shall be set in shallow trench and anchored a minimum of a 1-1/2 inch in ground surface.

**END OF SECTION**

## SECTION 31 31 10

### SOIL TREATMENT FOR TERMITE CONTROL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Soil treatment for termite control below grade, complete.

##### 1.02 REFERENCES

- A. EPA - Environmental Protection Agency - Federal Insecticide, Fungicide and Rodenticide Act.
- B. Arkansas State Plant Board Regulations.

##### 1.03 SUBMITTALS

- A. See Section 01 33 00 – Submittals and Substitutions, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Manufacturer's Application Instructions: Indicate caution requirements.
- D. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
- E. Warranty: Submit warranty and ensure that forms have been completed in Harding University's name.

##### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
  - 1. Having minimum of 2 years documented experience.
  - 2. Approved by manufacturer of treatment materials.
  - 3. Licensed in Searcy, Arkansas.

##### 1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for requirements for application, and comply with EPA regulations.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of toxicants.

##### 1.06 SEQUENCING

- A. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade.

##### 1.07 WARRANTY

- A. See Section 01 32 50 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year installer's warranty against damage to building caused by termites.
  - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and re-treat at no additional cost to Owner.
  - 2. Inspect annually and report in writing to Owner. Provide annual inspection service for 2 years from Date of Substantial Completion.
  - 3. Provide owner with the option of annual renewal after the initial two year warranty period.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Toxicant Chemical: EPA approved; synthetically color dyed to permit visual identification of treated soil.

- B. Diluent: Recommended by toxicant manufacturer.

## **2.02 MIXES**

- A. Mix toxicant to manufacturer's instructions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify site conditions prior to application.
- B. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- C. Verify final grading is complete.

### **3.02 APPLICATION**

- A. Treat entire area of drainage fill under slab-on-grade immediately prior to installation of vapor barrier.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
  - 1. Under Slabs-on-Grade.
  - 2. At Both Sides of Foundation Surface.
- D. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- E. Re-treat disturbed treated soil with same toxicant as original treatment.
- F. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

### **3.03 PROTECTION OF FINISHED WORK**

- A. Do not permit soil grading over treated work.
- B. Retreat areas disturbed by other contractors prior to pouring concrete.

**END OF SECTION**

**SECTION 32 11 23**

**AGGREGATE BASE COURSE**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This item shall consist of a foundation course for surface course, for other base courses, or for pavements.
- B. It shall be constructed on the prepared subgrade, subbase, or other completed base course according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and typical cross section shown on the plans.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Aggregate Base Course shall be either gravel and/or crushed stone so proportioned as to meet the requirements for a class of aggregate specified in the following table:

Sieve,mm	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	
				<b>PERCENT PASSING</b>					
75 (3")	100	100	100						
50 (2")	95-100	95-100	95-100						
37.5 (1-1/2")				85-100	100	100	100		
25.0 (1")								100	
19.0 (3/4")	60-100	60-100	60-100	60-100	60-100	50-90	50-90	65-100	
9.5 (3/8")	40-8-	40-80	40-80	40-80	40-80				
4.75 (#4)	30-60	30-60	20-60	30-60	30-60	25-55	25-55	25-55	
2.0 (#10)	20-50	20-50	20-45	20-45	20-45				
0.425 (#40)	10-35	10-35	10-35	10-35	10-35	10-30	10-30	10-30	
0.075 (#200)	3-15	3-15	3-12	3-12	3-12	3-10	3-10	3-10	
MAX. PLASTICITY									
INDEX (MINUS									
0.425 MATL.)	13	10	6	6	6	6	6	6	
(#40)									
MINIMUM PERCENT CRUSHED (RETAINED									
ON 4.75 mm [#4] SIEVE					15				
MINIMUM PERCENT									
CRUSHER-RUN MATERIAL						90	90	90	

- B. Class 7 and 8 shall be any mechanically crushed natural rock or stone of igneous, sedimentary, and/or metamorphic origin produced from a solid geological formation by quarrying method.
- C. The Contractor shall have the option of using any higher numbered class Aggregate Base Course than that specified, provided that payment will be for the class specified.



- D. Material furnished for Aggregate Base Course, Class 3 through Class 8, shall have a percent of wear by the Los Angeles Test not greater than 45 as determined by AASHTO T 96.
- E. When it is necessary to blend two or more materials, each material shall be proportioned separately through mechanical feeders to ensure uniform production. Premixing or blending to avoid separate feedings will not be permitted. Production of material by blending materials on the roadway to obtain a mixture that will comply with the requirements specified herein will not be permitted.
- F. For the purpose of this specification, shale and slate are not considered to be gravel or stone. The material furnished shall not obtain more than 5percent by weight of shale, slate, and other objectionable, deleterious, or injurious matter.
- G. For Class 1 and 2 materials, the fraction passing the 0.075 mm (#200) sieve shall not be greater than three-fourths of the fraction passing the 0.425 (#40) sieve. For Classes 3 through 8, the fraction passing the 0.075 mm (#200) sieve shall not be greater than two-thirds of the fraction passing the 0.425 mm (#40) sieve. For Classes 3 through 8 the fraction passing the 0.425 mm (#40) sieve shall have a liquid limit not greater than 25.
- H. To ensure that gravel is uniformly graded, the difference between the percent passing the various sieves shall be as follows for Classes 3, 4 and 5:

Sieve		Percent
19.0 mm - 9.5 mm	(3/4" - 3/8")	5 min.
9.5 mm - 4.75 mm	(3/8" - #4)	5 min.
4.75 mm - 2.00 mm	(#4 - #10)	5 min.
2.0 mm - 0.425 mm	(#10 - #40)	4 min.

- I. When the material contains aggregate larger than that specified above for the class called for in the Contract, the oversize aggregate shall be removed by screening or by screening and crushing. The removal of large size aggregate by hand methods will not be permitted.

**PART 3 EXECUTION**

**3.01 CONSTRUCTION REQUIREMENTS**

- A. The base course material shall be placed on a completed and approved subgrade or existing base that has been bladed to substantially conform to the grade and cross section shown on the plans.
- B. The subgrade shall be prepared as specified in Section 31 00 00 - Earthwork, and shall be free from an excess or deficiency of moisture at the time of placing base course material.
  - 1. The subgrade shall also comply, where applicable, with the requirements of other items that may be contained in the Contract that provide for the construction, reconstruction, or shaping of the subgrade or the reconstruction of the existing base course.
- C. Base course material shall not be placed on a frozen subgrade or subbase.
- D. The aggregate shall be placed on the subgrade or other base course material and spread uniformly to such depth and lines that when compacted it will have the thickness, width, and cross section shown on the Drawings.
- E. If the required compacted depth of the base course exceeds 150 mm (6 inches), the base shall be constructed in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 150 mm (6 inches) except when

vibrating or other approved types of special compacting equipment are used, the compacted depth of a single layer of base course may be increased to 200 mm (8 inches) upon approval of the Engineer.

- F. The material shall be spread the same day that it is hauled. Spreading shall be performed in such a manner that no segregation of course and fine particles nor nests or hard areas caused by dumping the aggregate on the subgrade will exist. Care shall be taken to prevent mixing of subgrade or unspecified material with the base course material during the blading and spreading operation.
- G. Aggregate shall not be dumped or mixed on an existing or newly constructed ACHM course or PCC Pavement that will not be overlaid under the same Contract nor on any open graded base course. Mechanical spreading equipment shall be used, if necessary, to place the base course on the subgrade.
- H. If sufficient working space is not available to allow proper aeration or addition of water to the base, the base material shall be mixed by any satisfactory method before placement.
- I. Each course shall be thoroughly mixed for the full depth of the course and shall be compacted by any satisfactory method that will produce the density thereafter specified.
  - 1. The aggregate shall be maintained substantially at optimum moisture during the mixing, spreading, and compacting operations, water being added or the material aerated as may be necessary.
  - 2. The specified grade and cross section shall be maintained by blading throughout the compaction operation.
  - 3. The material in each course shall be compacted to a density, as determined by AASHTO T 238, Method B, of not less than 98 percent of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D.
  - 4. The aggregate shall be compacted across the full width of application.
- J. The compacted base course shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and recompacting to the specified density, as directed.
- K. Where neither prime coat nor surfacing is provided in the same Contract with the base course, the material in the base course shall be uniformly compacted, stable, and free of segregated areas.
- L. The Contractor shall maintain the base course in a satisfactory condition until accepted.

### 3.02 QUALITY CONTROL

- A. To assure that the material used meets the requirements of the specifications, certain tests for quality control and acceptance will be performed as specified herein. The properties for which quality control and acceptance testing will be performed are gradation, density, moisture content, plasticity index, and thickness as specified in each Section.
- B. The maximum laboratory density shall be determined as follows:

% Retained - 4.75 mm (#4) Sieve	Test Method
10 Max.	AASHTO T 99, Method A
11 - 30	AASHTO T 99, Method C
31 Min.	AASHTO T 180, Method D

**Note:** In lieu of AASHTO T224, correction for coarse particles retained on the 3/4" (19.0

mm) sieve shall be determined by replacing with an equal mass of material passing the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

- C. The in-place density shall be determined by using AASHTO T 310, Direct Transmission. The moisture content shall be determined by AASHTO T 310 or ARDOT Test Method 347 or 348. A new maximum laboratory density and optimum moisture will be determined whenever the Engineer deems necessary or upon evidence provided by the Contractor.
- D. Tests for gradation, liquid limit, and plasticity index shall be performed by AASHTO T 11, T 27, T 89, and T 90.
- E. The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing.
- F. The Contractor shall provide the Engineer with the opportunity to observe all quality control sampling and testing.
- G. All quality control sampling and testing shall be performed by or under the direct supervision of a technician acceptable to the Owner and in accordance with ARDOT's Manual of Field Sampling and Testing Procedures. Test reports shall be signed and copies made available to the Engineer if requested.
- H. If the results of any test shows that the required minimum density has not been obtained, corrective action shall be taken, followed by a re-test at the same location. The original and re-test reports shall be cross referenced. All corrective actions shall be performed by the Contractor at no cost to the Owner.

### **3.03 ACCEPTANCE**

- A. Acceptance testing for thickness (when specified on the Drawings), gradation, plasticity index, density, and moisture content will be based on lots. The size of standard lots will be 100 cubic yards. Partial lots, of any size, may be established by the Engineer at any time.
- B. Test methods for acceptance shall be the same as specified for quality control testing.
- C. The item of work being tested shall not be considered complete or accepted until passing test reports are submitted to the Engineer.
- D. The Contractor shall take one test for all properties in each lot or partial lot at a location randomly selected by the Engineer.
- E. In addition to the required acceptance tests, the Engineer may require the Contractor to test any location that, by visual observation, appears to be defective.
- F. The Contractor's acceptance sampling and testing procedures and results will be subject to independent assurance sampling and testing conducted by the Owner. The Contractor shall be required to make changes to the equipment and/or procedures if the such tests are unable to verify the Contractor's test results.
- G. All acceptance testing performed by the Contractor is subject to observation by the Engineer. All test reports shall be signed and submitted to the Engineer the next business day after the tests are performed.
- H. If a lot or a partial lot fails to meet the specifications, the Contractor shall remove and replace that lot or partial lot with acceptable material at no cost to the Owner. Tests will be performed on the replacement material as required for the original material. Acceptance of the replacement material will be the same as for the original material.
- I. Payment for the quantity in the original lot will be withheld or recovered, and released after the removal and replacement has been acceptably performed.

**END OF SECTION**

## **SECTION 32 12 16**

### **ASPHALT PAVING**

#### **PART 1 GENERAL**

##### **1.01 SUMMARY**

- A. Prepare asphaltic concrete pavement in accordance with this Section and where indicated on the Drawings.
- B. Contractor will pay cost of testing.
- C. Construct Work of this Section that is adjacent to or connected to city streets in accordance with requirements of the City for city streets.
- D. Secure permits and inspections, post necessary bonds, and pay necessary fees.

##### **1.02 REFERENCES**

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, North West, Suite 225, Washington, DC 20001.
  - 1. AASHTO M14 - Anionic Emulsified Asphalt.
  - 2. AASHTO M81 - Cut-Back Asphalt Concrete (Rapid-Curing Type).
  - 3. AASHTO M82 - Cut-Back Asphalt Concrete (Medium-Curing Type).
  - 4. AASHTO M208 - Cationic Emulsified Asphalt.
- B. American Society of Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
  - 2. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.
  - 3. ASTM D946 - Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
  - 4. ASTM D977 - Specification for Emulsified Asphalt.
- C. Arkansas Department of Transportation, P.O. Box 2262, Little Rock, Arkansas 72203.
  - 1. ARDOT - Standard Specifications, Division 400, Latest Edition.

#### **PART 2 PRODUCTS**

##### **2.01 ASPHALTIC PAVING MATERIALS**

- A. Prime Coat: Medium curing cut-back asphalt; MC-30 or MC070; AASHTO M82; heated and applied within the temperature range 80 degrees F. - 150 degrees F.
- B. Tack Coat:
  - 1. Rapid curing cut-back asphalt:
    - a. AASHTO M81
    - b. SS-1
    - c. Application temperature 70 degrees F. - 160 degrees F.
    - d. Rapid curing emulsified asphalt to match aggregate type.

- e. Cationic: CRS-1; AASHTO M208
  - f. Application temperature 125 degrees F. - 185 degrees F.
- C. Hot-mix surfacing material shall meet the following requirements:
- 1. Asphaltic Cement: Mix Design in accordance with Arkansas Department of Transportation, latest edition.
  - 2. Testing: Tests of asphalt mixtures and materials will be made by commercial testing laboratory approved by Owner. Submit test reports to Engineer.
  - 3. Owner shall pay for all passing tests. Contractor shall be responsible for the cost of testing all material which fails to meet the requirements.

### **PART 3 EXECUTION**

#### **3.01 SUBGRADE PREPARATION**

- A. Subgrade for asphalt paving improvements shall have organic silty and clayey topsoils and other unsuitable material removed and replaced with approved material.
- B. Fill and tamp traces of utility trenches.
- C. Scarify and re-compact subgrade; proof roll with dump truck.
- D. Replace soft spots as needed.

#### **3.02 BASE COURSE FOR ASPHALTIC PAVING**

- A. Place material on prepared subgrade for a total compacted thickness, as required on plans.
  - 1. Spread course the same day the material is hauled. It shall be thoroughly mixed, either by repeated handling with a blade grader or by harrowing sufficiently to secure a uniform mixture of coarse and fine particles.
  - 2. Compact base course by systematically rolling and watering as required to obtain a firm, uniform, smooth surface as specified in Part 300 of ARDOT Standard Specifications for Highway Construction.
  - 3. Set blue tops prior to final finishing of base course.
- B. Minimum density shall be 100 Percent Modified Proctor (ASTM D-1557).
- C. Prime coat shall not be put down until base course is compacted.

#### **3.03 PRIME COAT**

- A. After acceptance of completed base course, a prime coat shall be uniformly distributed over the prepared base at the rate of 0.3 gallon per square yard.
- B. Remove surplus asphalt material.
- C. Construct and maintain barricades to keep traffic off the primed surface until it is thoroughly cured and ready for asphalt pavement (3 days minimum).

#### **3.04 TACK COAT**

- A. Apply tack coat when an asphalt course is to be laid on an asphalt or concrete surface.
- B. Clean surface to be treated with prime or tack.
  - 1. Sweep with mechanical broom immediately preceding the application of prime or tack.
  - 2. Remove patches of asphalt, dirt or other material which does not form an integral part of the surface.

3. When directed, sprinkle the surface with water and give an additional sweeping.

### **3.05 HOT-MIX SURFACING FOR ASPHALTIC PAVING**

- A. Plant Mixing and Transporting: Mixing, transportation, and temperature limitations for hot-mix surface course materials shall be in accordance with the requirements of Division 400, Asphalt Pavements of the ARDOT Standard Specifications for Highway Construction, latest Edition.
- B. Placing, compacting, and acceptance shall be in accordance with Division 400, Asphalt Pavements of the ARDOT Standard Specifications for Highway Construction, latest Edition.

**END OF SECTION**

**SECTION 32 12 16.01**  
**ASPHALTIC PAVEMENT REPAIR**

**PART1 GENERAL**

**1.01 SUMMARY**

- A. Repair asphaltic concrete pavement in accordance with this Section and where indicated on the Drawings.
- B. Construct Work of this Section that is adjacent to or connected to city streets in accordance with requirements of the City for city streets.
- C. Secure permits and inspections, post necessary bonds, and pay necessary fees.

**1.02 REFERENCES**

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, North West, Suite 249, Washington, DC 20001.
  - 1. AASHTO M14 - Anionic Emulsified Asphalt.
  - 2. AASHTO M81 - Cut-Back Asphalt Concrete (Rapid-Curing Type).
  - 3. AASHTO M82 - Cut-Back Asphalt Concrete (Medium-Curing Type).
  - 4. AASHTO M208 - Cationic Emulsified Asphalt.
- B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA Phone: (610) 832-9585 Fax: (610) 832-9555.
  - 1. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
  - 2. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. Rammer and 12-in. Drop.
  - 3. ASTM D946 - Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
  - 4. ASTM D977 - Specification for Emulsified Asphalt.
- C. Arkansas Department of Transportation, P.O. Box 2261, Little Rock, Arkansas 72203.
  - 1. ARDOT - Standard Specifications for Highway Construction, latest Edition.
  - 2. ARDOT 303 - Aggregate Base Course.
  - 3. ARDOT 304 - Aggregate Surface Course.
  - 4. ARDOT 305 - Asphaltic Concrete Hot Mix Stabilized Base Course.

**PART 2 PRODUCTS**

**2.01 ASPHALTIC PAVING MATERIALS**

- A. Base Course: Crushed stone conforming to ARDOT Standard Specifications for Highway Construction Section 303, Class 7.
- B. Prime Coat: Medium curing cut-back asphalt; MC-30 or MC070; AASHTO M82; heated and applied within the temperature range 80 degrees F. - 150 degrees F.
- C. Hot-mix surfacing material shall meet the following requirements: Asphaltic Cement, Type II in accordance with Arkansas Department of Transportation, Edition, latest edition.

## **PART 3 EXECUTION**

### **3.01 SUBGRADE PREPARATION**

- A. Subgrade for asphalt paving improvements shall have organic silty and clayey topsoils and other unsuitable material removed and replaced with approved material.
- B. Fill and tamp traces of utility trenches.
- C. Replace soft spots as needed.

### **3.02 BASE COURSE FOR ASPHALTIC PAVING**

- A. Place material on prepared subgrade in 2 courses for a total compacted thickness of 8 inches.
  - 1. Spread 1 course 4 inches thick (compacted) the same day the material is hauled. It shall be thoroughly mixed, either by repeated handling with a blade grader or by harrowing sufficiently to secure a uniform mixture of coarse and fine particles.
  - 2. Compact base course by systematically rolling and watering as required to obtain a firm, uniform, smooth surface as specified in Part 300 of ARDOT Standard Specifications for Highway Construction.
- B. Minimum density shall be 95 Percent Standard Proctor (ASTM D698).
- C. Prime coat shall not be put down until base course is compacted.

### **3.03 PRIME COAT**

- A. After acceptance of completed base course, a prime coat shall be uniformly distributed over the prepared base at the rate of 0.3 gallon per square yard.
- B. Remove surplus asphalt material.

### **3.04 HOT-MIX SURFACING FOR ASPHALTIC PAVING**

- A. Plant Mixing and Transporting: Mixing, transportation, and temperature limitations for hot-mix surface course materials shall be in accordance with the requirements of Division 400, Asphalt Pavements of the ARDOT Standard Specifications for Highway Construction, Edition, latest edition.
- B. Placing, compacting, and acceptance shall be in accordance with Division 400, Asphalt Pavements of the ARDOT Standard Specifications for Highway Construction, Edition, latest edition.

**END OF SECTION**



**SECTION 32 13 73**  
**CONCRETE PAVING**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Construction of concrete curbs, gutters, sidewalks, and streets.

**1.02 RELATED SECTIONS**

- A. Section 03 15 16 - Site Concrete Accessories.
- B. Section 03 20 01 - Concrete Reinforcing.
- C. Section 03 47 00 - Site Cast Concrete.
- D. Section 31 00 00 - Earthwork.
- E. Section 31 10 00 - Site Clearing.
- F. Section 31 23 33 - Trenching and Backfilling.

**1.03 REFERENCES**

- A. American Concrete Institute, 22400 W. Seven Mile Road, Detroit, Michigan 48219.
  - 1. ACI 614.
- B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM C94 - Specification for Ready-Mixed Concrete.
  - 2. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - 3. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
  - 4. ASTM D994 - Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

**1.04 SUBMITTALS**

- A. Submit complete information regarding concrete mix to Engineer for review in accordance with the requirements of ASTM C94, Alternate 2.

**PART 2 PRODUCTS**

**2.01 CURB FORMS**

- A. 2-inch dressed dimension lumber or metal of equal strength, free from defects that would impair appearance or structural quality of completed curb.
  - 1. Metal forms: Subject to approval of Engineer.
- B. Short-Radius Forms: 1-inch dressed lumber or plywood.
- C. Curb Face: No horizontal joints in form material closer than 7 inches from top of curb.
- D. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

**2.02 SIDEWALK FORMS**

- A. 2-inch dressed lumber, straight and free from defects, or standard metal forms.
- B. Short-Radius Forms: 1-inch dressed lumber or plywood.

- C. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

### **2.03 CRUSHED ROCK BASE**

- A. Clean gravel or crushed rock conforming to requirements for granular fill as specified in Section 31 23 33.

### **2.04 EXPANSION JOINT FILLER**

- A. 1/2-inch thick preformed asphalt-impregnated expansion joint material conforming to ASTM D994.

### **2.05 CONCRETE**

- A. Ready mixed conforming to ASTM C94, Alternate 2.
- B. Compressive Strength: 3,000 psi at 28 days.
- C. Maximum Strength of Aggregate: 1-1/2-inch.
- D. Slump: 2 to 4 inches.

### **2.06 CURING COMPOUND**

- A. Liquid membrane-forming, clear or translucent, suitable for spray application.
- B. Conform to ASTM C309, Type 1.

### **2.07 ACCEPTANCE OF MATERIALS**

- A. Materials shall be subject to inspection for suitability by the Engineer prior to or during incorporation into the work.

## **PART 3 EXECUTION**

### **3.01 EXCAVATION AND BACKFILL**

- A. Excavate and backfill in accordance with Section 31 23 33.

### **3.02 PREPARATION OF SUBGRADE**

- A. Bring the areas where curbs and sidewalks are to be constructed to required grade on undisturbed ground and compact by sprinkling and rolling or mechanical tamping.
- B. As depressions occur, refill with suitable material and recompact until the surface is at the proper grade.
- C. Compact subgrade on fill to 95 percent of maximum density at optimum moisture content as determined by ASTM D698.

### **3.03 PLACING CRUSHED ROCK BASE**

- A. After subgrade for sidewalks and curbs is compacted and at proper grade, spread at least 4 inches granular fill and compact to at least 95 percent of maximum density as determined by ASTM D698.
- B. Sprinkle with water and compact by rolling or other method.
- C. Top of compact granular fill shall be at proper level to receive concrete.

### **3.04 SETTING FORMS**

- A. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings.
- B. Stake wood or metal forms securely in place, true to line and grade.
- C. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.

- D. Construct short-radius curved forms to exact radius.
- E. Tops of forms shall not depart from grade line more than 1/8 inch when checked with a 10 foot straightedge.
- F. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.
- G. Forms shall be cleaned and oiled thoroughly after each use and before concrete is placed.

### **3.05 CURB CONSTRUCTION**

- A. Construct curbs to line and grade shown or established by the Engineer, and conform to the details shown on Drawings.
- B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Wherever requirements differ, the more stringent shall govern.
- C. Cast in uniform lengths of approximately 10 to 20 feet, except at closures where lengths may not be less than 6 feet.
- D. Placement of Preformed Asphalt-Impregnated Expansion Joints:
  - 1. At intervals not exceeding 40 feet.
  - 2. Beginning and end of curved portions of the curb.
  - 3. Connections to existing curbs.
- E. Contraction Joints:
  - 1. Place at intervals not exceeding 10 feet.
  - 2. Open type joint.
  - 3. Provide by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.
  - 4. Steel sheet shall be inserted the full depth of the curb.
  - 5. After initial set has occurred in the concrete and prior to removing the front curb form, steel sheet shall be removed with a sawing motion.
- F. As soon as concrete has set sufficiently to support its own weight, remove the front form and finish all exposed surfaces.
  - 1. Finish top of curb with a steel trowel.
  - 2. Finish edges with a steel edging tool.
  - 3. Rub formed faces with burlap sack or similar device to produce a uniformly textured surface, free from form marks, honeycomb, and other defects.
- G. Curing:
  - 1. Upon completion of finishing, apply approved curing compound to exposed surfaces of curb.
  - 2. Curing shall continue for a minimum of 5 days.
- H. Backfilling Curb: Upon completion of curing period, but not before 7 days has elapsed since pouring the concrete, backfill the curb as specified in Section 31 23 33.
- I. Adjusting:
  - 1. Finished curb shall present a uniform appearance for both grade and alignment

2. Remove curb sections showing abrupt changes in alignment or grade or that are more than 1/4 inch away from location as staked or that are defective for any reason.
3. Construct new curb at Contractor's expense.

### **3.06 SIDEWALK CONSTRUCTION**

- A. Thickness of sidewalks shall a minimum of 4 inches or as shown on the Drawings, with a turned down edge. Concrete shall be placed true to grade to insure that ponding of water will not occur.
- B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Where the requirements differ, the more stringent shall govern.
- C. Placement of Preformed Asphalt Expansion Joints:
  1. Where sidewalk ends.
  2. Around posts, poles, or other objects protruding through the sidewalk.
  3. At maximum intervals of 15 feet.
- D. Contraction Joints:
  1. Provide transversely to the walks.
  2. Saw cut weakened plane joints shall be straight and at right angles to the surface of the walk. Saw cuts shall be constructed midway between expansion joints to a depth of 25 percent of slab thickness. Saw cuts shall be performed within 24 hours of placement.
- E. Reinforcing: 6 by 6 inch, No. 10 mesh shall be installed.
- F. Finish:
  1. Broom surface with fine hair broom at right angles to length of walk and tool at edges, joints, and markings.
  2. Walks shall be scored at no less than 5-foot intervals and within 24 hours of concrete placement.
- G. Curing:
  1. Upon completion of finishing, apply an approved curing compound to exposed surfaces.
  2. Protect sidewalks from damage for period of 7 days.

### **3.07 CONCRETE STREET PAVING**

- A. In areas shown to receive concrete paving on the Drawings, concrete shall be placed in accordance with Division 3 (Site Concrete Work).

**END OF SECTION**

**SECTION 32 13 73**  
**PAVEMENT JOINT SEALANTS**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Expansion and contraction joints within portland cement concrete surfaces.
  - 2. Joints between cement concrete and asphalt pavement.

**1.03 SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

## **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## **1.06 PROJECT CONDITIONS**

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  - 2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
  - 3. When joint substrates are wet or covered with frost.
  - 4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

### **2.02 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range between the color black and dark grey.
- C. Finish of Joint: Sand joint filler.

### **2.03 COLD-APPLIED JOINT SEALANTS**

- A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
  - 1. Available products:
    - a. Crafcoc Inc.; RoadSaver Silicone.
    - b. Dow Corning Corporation; 888.

### **2.04 JOINT-SEALANT BACKER MATERIALS**

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

## **2.05 PRIMERS**

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### **3.03 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of backer materials.
  - 2. Do not stretch, twist, puncture, or tear backer materials.
  - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses provided for each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform

beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
  2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

### **3.04 CLEANING**

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

### **3.05 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

**END OF SECTION**



**SECTION 32 16 13**  
**CONCRETE CURBS AND SIDEWALKS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Construction of concrete curbs and sidewalks.

**1.02 RELATED SECTIONS**

- A. Section 31 23 33 - Trenching and Backfilling.

**1.03 REFERENCES**

- A. American Concrete Institute, 22400 W. Seven Mile Road, Detroit, Michigan 48219.
  - 1. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM C94 - Specification for Ready-Mixed Concrete.
  - 2. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - 3. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
  - 4. ASTM D994 - Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

**1.04 SUBMITTALS**

- A. Submit complete information regarding concrete mix to Engineer for review in accordance with the requirements of ASTM C94, Alternate 2.

**PART 2 PRODUCTS**

**2.01 CURB FORMS**

- A. 2-inch dressed dimension lumber or metal of equal strength, free from defects that would impair appearance or structural quality of completed curb.
  - 1. Metal forms: Subject to approval of Engineer.
- B. Short-Radius Forms: 1-inch dressed lumber, plywood, or metal.
- C. Curb Face: No horizontal joints in form material closer than 7 inches from top of curb.
- D. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

**2.02 SIDEWALK FORMS**

- A. 2-inch dressed lumber, straight and free from defects, or standard metal forms.
- B. Short-Radius Forms: 1-inch dressed lumber or plywood.
- C. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

**2.03 CRUSHED ROCK BASE**

- A. Clean gravel or crushed rock conforming to requirements for granular fill as specified in Section 31 23 33.

## **2.04 EXPANSION JOINT FILLER**

- A. 1/2-inch thick preformed asphalt-impregnated expansion joint material conforming to ASTM D994.

## **2.05 CONCRETE**

- A. Ready mixed conforming to ASTM C94, Alternate 2.
- B. Compressive Strength: 3,000 psi at 28 days.
- C. Maximum Size of Aggregate: 1-1/2-inch.
- D. Slump: 2 to 4 inches.

## **2.06 CURING COMPOUND**

- A. Liquid membrane-forming, clear or translucent, suitable for spray application.
- B. Conform to ASTM C309, Type 1.

## **2.07 ACCEPTANCE OF MATERIALS**

- A. All materials shall be subject to inspection for suitability, as the Engineer may elect, prior to or during incorporation into the work.

## **PART 3 EXECUTION**

### **3.01 EXCAVATION AND BACKFILL**

- A. Excavate and backfill in accordance with Section 31 23 33.

### **3.02 PREPARATION OF SUBGRADE**

- A. Bring the areas on which curbs and sidewalks are to be constructed to required grade on undisturbed ground and compact by sprinkling and rolling or mechanical tamping.
- B. As depressions occur, refill with suitable material and recompact until the surface is at the proper grade.
- C. Compact subgrade on fill to 95 percent of maximum density at optimum moisture content as determined by ASTM D698.

### **3.03 SETTING FORMS**

- A. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings.
- B. Stake wood or metal forms securely in place, true to line and grade.
- C. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.
- D. Construct short-radius curved forms to exact radius.
- E. Tops of forms shall not depart from grade line more than 1/8 inch when checked with a 10-foot straightedge.
- F. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.

### **3.04 CURB CONSTRUCTION**

- A. Construct curbs to line and grade shown or established by the Engineer, and conform to the details shown.
- B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Wherever requirements differ, the more stringent shall govern.

- C. Placement of Preformed Asphalt-Impregnated Expansion Joints (1/2 inch thick):
  - 1. Beginning and end of curved portions of the curb.
  - 2. Connections to existing curbs.
  - 3. At drainage structures.
- D. Contraction Joints: All contraction joints shall be formed by sawing unless otherwise specified, and filled with a commercially available silicone product approved by the Engineer.
  - 1. Contraction joints shall be constructed at 15 foot intervals.
  - 2. Contraction joints shall be 1/8 inch to 3/8 inch in width and 1-1/2 inch in depth.
  - 3. Contraction joints shall be constructed at right angles to the centerline and perpendicular to the surface of the curb and gutter.
  - 4. When curb and gutter is constructed adjacent to, or on rigid pavement, the same joint layout for pavement shall be used, where practicable.
- E. As soon as concrete has set sufficiently to support its own weight, remove the front form and finish all exposed surfaces.
  - 1. Finish top of curb with a steel trowel.
  - 2. Finish edges with a steel edging tool.
  - 3. Rub formed faces with burlap sack or similar device to produce a uniformly textured surface, free from form marks, honeycomb, and other defects.
- F. Fill contraction joints with a commercially available silicone product approved by the Engineer.
- G. Curing:
  - 1. Upon completion of finishing, apply approved curing compound to exposed surfaces of curb.
  - 2. Curing shall continue for a minimum of 5 days.
- H. Backfilling Curb: Upon completion of curing period, but not before 7 days has elapsed since pouring the concrete, backfill the curb as specified in Section 02315.
- I. Adjusting:
  - 1. Finished curb shall present a uniform appearance for both grade and alignment.
  - 2. Remove curb sections showing abrupt changes in alignment or grade or which are more than 1/4 inch away from location as staked or which are defective for any reason.
  - 3. Construct new curb at Contractor's expense.

### **3.05 SIDEWALK CONSTRUCTION**

- A. Thickness of sidewalks shall be as shown on the Drawings.
- B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Where the requirements differ, the more stringent shall govern.

- C. Placement of Preformed Asphalt Expansion Joints (1/2 inch thick):
  - 1. Where sidewalk ends.
  - 2. Around posts, poles, or other objects protruding through the sidewalk.
  - 3. Drainage structures.
  - 4. Adjacent to curb and gutter
- D. Transverse Joints:
  - 1. Joints shall be cut with a 1/4 inch joint at intervals not greater than the width of the walk being constructed, or as directed.
- E. Finish:
  - 1. Broom surface with fine hair broom at right angles to length of walk and tool at all edges, joints, and markings.
  - 2. Edges shall be rounded in a 1/4 inch radius, including edges at joints.
- F. Curing:
  - 1. Upon completion of finishing, apply an approved curing compound to exposed surfaces.
  - 2. Protection sidewalk from damage for period of 7 days.

**END OF SECTION**

**SECTION 32 17 23**  
**PAVEMENT MARKING**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Paint parking lot lines, letter, directional arrows, island curbs, and other areas as shown on the Drawings.

**1.02 SUBMITTALS**

- A. Provide the following:
  - 1. Paint System Data Sheet (PSDS) from paint manufacturer for each system used (sample form attached).
  - 2. Technical Data Sheets for each product used in the paint system.
  - 3. Copies of the paint system submittals to the coating applicator.

**1.03 QUALITY ASSURANCE**

- A. Inspection by Engineer, or waiver of inspection of any particular portion of the Work, shall not be construed to relieve Contractor of his responsibility to perform the Work in accordance with these specifications.

**1.04 WARRANTY**

- A. Contractor shall warrant to Owner and guarantee Work under this Section against defective workmanship and materials for a period of 1 year commencing on the date of final acceptance of the Work.

**PART 2 PRODUCTS**

**2.01 PAINT**

- A. Sherwin-Williams, Promar Traffic Marking.
  - 1. Yellow, Series No. B29Y2.
  - 2. White, Series No. B29W1.
  - 3. Medium blue, Series No. TM2133, Latex.
- B. Colors where shown on Drawings.

**PART3 EXECUTION**

**3.01 GENERAL**

- A. Paint shall be applied in 2 coats to a clean dry surface using template or a striping machine. Stripes shall be a uniform width of 4 inches wide. Other markings shall be as shown on Drawings.

**END OF SECTION**

## SECTION 32 31 26.12

### GUARD RAILS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide steel plate guard rail, including line posts, spacer blocks, terminal anchor posts, and guard rail anchor posts.

##### 1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 225, Washington, DC 20001.
  - 1. AASHTO M36 - Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
  - 2. AASHTO M180 - Corrugated Sheet Steel Beams for Highway Guardrail.
- B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM A36 - Specification for Structural Steel.
  - 2. ASTM A123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM A153 - Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware.
  - 4. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
  - 5. ASTM A325 - Specification for High-Strength Bolts for Structural Steel Joints.
  - 6. ASTM A769 - Specification for Electric Resistance Welded Steel Shapes.
  - 7. ASTM B695 - Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- C. American Wood Preservers Association, P.O. Box 849, Stevensville, MD 21666.
- D. Arkansas Department of Transportation, P.O. Box 2261, Little Rock, Arkansas 72203.
  - 1. ARDOT - Standard Specification for Highway Construction.

#### PART 2 PRODUCTS

##### 2.01 WOOD LINE POSTS

- A. Straight seasoned Southern Pine or Douglas Fir of the west coast region conforming to ARDOT Section 817.
- B. Dimensions as shown on Drawings.
- C. Pressure treated by a standard empty cell or full cell process in accordance with AWPA practice with creosote to retain a minimum of 12 pound per cubic foot of wood, or with pentachlorophenol or chromated copper arsenate to retain a minimum of 0.6 pounds of active chemical per cubic foot of wood.

##### 2.02 CONCRETE LINE POSTS

- A. Provide reinforced concrete conforming to the dimensions shown on Drawings.
- B. Material:
  - 1. Concrete conforming to ARDOT Section 802 Class A or S concrete, or mix specified for concrete pipe culverts in ARDOT Section 606.02.
  - 2. Reinforcing steel conforming to ARDOT Section 804.

3. Concrete for spacer blocks: Nonreinforced and conforming to ARDOT Section 802 Class A or S concrete or mix specified for pipe culverts in ARDOT Section 606.02.

## **2.03 STEEL POSTS**

- A. Steel line posts and spacer blocks shall consist of structural shapes of the section shown on Drawings.
- B. Fabricated of steel conforming to ASTM A36 by the electrical resistance process in accordance with ASTM A769.
- C. Galvanized in accordance with ASTM A123.
- D. Terminal Anchor Posts:
  1. Type and dimension as shown on Drawings.
  2. Concrete for anchors in conformance with ARDOT Section 802 Class A or S, or concrete for paving according to ARDOT Section 501.
  3. Steel anchor posts shall consist of structural shapes of the section shown on the Drawings, or as otherwise specified, and shall conform to the requirements of ASTM A36. The upper 15 inches of the anchor assembly shall be galvanized in accordance with the requirements of ASTM A123.
- E. Guard Rail Anchor Posts:
  1. Concrete for post shall conform to the requirements of ARDOT Section 802 for Class A or S, or for paving concrete as provided in ARDOT Section 501.
  2. Reinforcing steel shall conform to the requirements of ARDOT Section 804.
  3. Premolded joint filler shall conform to the requirements of ARDOT 501.03, Type 2.
- F. Guard Rail:
  1. Steel conforming to AASHTO M180, Class A, Type 1.
  2. Repair chipped or damaged galvanizing in accordance with AASHTO M36.
- G. Bolts, Nuts, and Washers:
  1. Steel conforming to ASTM A307 or ASTM A325.
  2. Galvanized in accordance with ASTM A153, or ASTM B695 Class 50 or Class 40 as an alternate.
  3. Threads on nuts and bolts shall conform to American Standard Course Series Class 3 fits, ASA B1.1.

## **PART 3 EXECUTION**

### **3.01 LINE POSTS**

- A. Space line posts as shown on Drawings and set plumb in hand or mechanically dug holes, or by driving.
- B. Drive in a manner to avoid battering or distorting posts.
- C. Backfill post holes with moist sand and thoroughly compact as placed.
- D. Field repair chipped or damaged galvanizing on steel posts in accordance with ARDOT Section 617.02.

### **3.02 TERMINAL ANCHOR POSTS**

- A. Construct in accordance with Drawings.
- B. Guard rail may be bolted to the angle at the terminal anchor and the two assemblies positioned to proper alignment prior to placing concrete, or it may be bolted to the terminal anchor angle after anchor posts have been placed and concrete sufficiently set.
- C. Weld in accordance with ARDOT Section 807.
- D. Place concrete directly against bottom and sides of anchor excavation, do not use side forms.
- E. Mix and place concrete in conformance with ARDOT Section 802.

### **3.03 GUARD RAIL ANCHOR POSTS**

- A. Excavation and Backfill:
  - 1. Excavate only to the extent necessary for construction.
  - 2. Remove all loose material from excavated hole prior to placing concrete for lower portion of post.
- B. Forms:
  - 1. Metal or wood, free from warp and of sufficient strength to resist springing during the process of depositing concrete.
  - 2. Securely stake, brace, set and hold firmly to the required line and grade.
  - 3. Clean and oil before concrete is placed.
- C. Place and finish in accordance with ARDOT Section 802.

### **3.04 GUARD RAIL**

- A. Construct in accordance with Drawings and in a manner resulting in a smooth, continuous installation.
- B. Secure fittings to posts and terminal anchors.
- C. Lap as shown on Drawings.

**END OF SECTION**



## SECTION 32 92 00

### SODDING

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Work included: Prepare the rough grade and furnish and place topsoil, fertilizer and sod in areas where shown and called for on the Drawings. Maintain growth of the turf during the contract period. The sod will be guaranteed during the contract period.
- B. REFERENCES
  - 1. TPI (Turfgrass Producers International) - Guideline Specifications to Sodding.
  - 2. FS O-F-241 - Fertilizers, Mixed, Commercial.

##### 1.02 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

##### 1.03 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum three years experience, and certified by the State of Arkansas.
- B. Sod: Minimum age of 8 months, with root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.
  - 1. Submit sod certification for grass species and location of sod source.

##### 1.04 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Comply with Arkansas Code 2-16-210 Plant Board Inspection and Certificate for Plant Materials and Products. Comply with all other applicable Arkansas Codes.

##### 1.05 TESTS

- A. Provide analysis of topsoil fill.
- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- C. Submit minimum two (10) oz. samples of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

## **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Protect materials from deterioration during delivery, and while stored at the site.

## **1.07 COORDINATION**

- A. Coordinate the work of this Section with installation of plant materials.

## **1.08 MAINTENANCE SERVICE**

- A. Maintain installed sod for minimum 30 days after substantial completion of the project.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS FOR SODDING**

- A. Commercial fertilizer shall be an organic fertilizer containing the following minimum percentages of available plant food by weight: 13-13-13 Nitrogen-Phosphorus-Potash.
- B. The sod shall contain a good cover of living or growing grass. The sod shall be obtained from areas having growing conditions similar to the sodded areas under this contract. Deliver sod on pallets. Protect root system from exposure to wind and sun. Do not deliver more sod than can be placed within 24 hours.
- C. Sod: TPI Certified, Field Grown; cultivated Common Bermuda grass sod; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq. ft.

### **2.02 HARVESTING SOD**

- A. Machine cut sod (and load on pallets) in accordance with TPI guidelines.
- B. Cut sod in area not exceeding one sq. yd., with minimum 1/2 inch and maximum 1 inch topsoil base.

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Verify that prepared soil base is ready to receive the work of this Section.
- B. Beginning of installation means acceptance of existing site conditions.

### **3.02 PREPARATION OF SUBSOIL**

- A. The site shall be brought to 4" below finished grade by the General Contractor. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded. Remove contaminated subsoil.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

### **3.03 PLACING TOPSOIL**

- A. Spread topsoil to a minimum depth of 3 inches over area to be sodded.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material while spreading.
- D. Grade to eliminate rough, low, or soft areas, and to ensure positive drainage.

### **3.04 FERTILIZING**

- A. Apply fertilizer in accordance with manufacturer's instructions at a rate and proportion necessary to eliminate any deficiencies of topsoil as indicated in analysis.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2" of topsoil.
- E. Lightly water to aid the dispersion of fertilizer.

### **3.05 LAYING SOD**

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod within 24 hours after harvesting to prevent deterioration.
- C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Place top elevation of sod 1/2" below adjoining edging, paving and curbs after settlement.
- E. Water sodded areas immediately after installation. Saturate sod.
- F. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Provide positive drainage in all sod areas.

### **3.06 MAINTENANCE**

- A. Mow grass at regular intervals to maintain at a maximum height of 2 1/2 inches. Do not cut more than 1/3 of grass blade length at any one mowing.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply chemical weed control measures in accordance with manufacturer's instructions or manually weed turf areas. Remedy damage resulting from improper use of chemicals.
- G. Immediately replace sod in areas which show deterioration or bare spots.
- H. Protect sodded areas with warning signs during maintenance period.

**END OF SECTION**

**SECTION 33 01 10.58**  
**DISINFECTION OF WATER UTILITY PIPING**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Disinfection of potable water distribution system.
- B. Test and report results.

**1.02 RELATED WORK**

- A. Section 33 05 31.15 - Polyvinyl Chloride Pressure Pipe and Fittings.

**1.03 REFERENCES**

- A. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
  - 1. AWWA C651-14- Standard for Disinfecting Water Mains (or latest edition).
- B. The Ten States Standards for Water, 2018 Edition or latest version, Minnesota's Bookstore Communications Media Division, 660 Olive Street, St. Paul, Minnesota 55155.

**1.04 QUALITY ASSURANCE**

- A. Testing Laboratory: Arkansas Department of Health.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to Arkansas Department of Health regulations for Work of this Section.

**1.06 PROJECT RECORD DOCUMENTS**

- A. Submit 3 copies of reports in accordance with Specifications.
- B. Disinfection report; accurately record:
  - 1. Type and quantity of disinfectant used.
  - 2. Date and time of start and completion of disinfectant injection.
  - 3. Test locations.
  - 4. Initial, 24-hour, and 48-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
  - 5. Date and time of start and completion of flushing.
  - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- C. Bacteriological report; accurately record:
  - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
  - 2. Time and date of water sample collection.
  - 3. Name of person collecting samples.
  - 4. Test locations.
  - 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.

6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of Arkansas Department of Health.
8. Bacteriologist's signature.
9. **Monticello's** PWS ID Number is 184.

### **1.07 STORAGE AND HANDLING**

- A. The Contractor is reminded that chlorine is a powerful oxidant and reacts readily with foreign substances.
- B. Chlorine compounds shall be handled and stored in accordance with manufacturer's recommendations.

## **PART 2 PRODUCTS**

### **2.01 CALCIUM HYPOCHLORITE**

- A. Granular form or tablets containing 65 percent available chlorine by weight.
- B. Calcium hypochlorite intended for swimming pool disinfection is **not allowed**.

### **2.02 SODIUM HYPOCHLORITE**

- A. Liquid form containing approximately 5 to 15 percent available chlorine.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Perform scheduling and disinfection activity with startup, testing, adjusting, and balancing, and demonstration procedures, including coordination with related systems.

### **3.02 EXECUTION**

- A. Provide and attach equipment required to execute Work of this Section.
- B. Utilize fire hydrants as blow-off points when possible.
- C. Fire hydrants shall not be used for sample points.
- D. Sample points constructed shall be a 3/4 inch or 1 inch copper riser pipe that shall extend adequately above the ground surface.
- E. During application of chlorine solution, prevent solution from flowing back into the distribution system.
- F. Disinfect piping system by one of the three following methods in accordance with ANSI/AWWA C651 (latest version):
  1. Tablet Method.
  2. Continuous Feed Method.
  3. Slug Method.
- G. Tablet Method:
  1. This method may only be used if pipes and appurtenances are kept clean and dry during construction.
  2. This procedure must not be used on solvent welded plastic or on screw joint steel pipe.

3. If using granules:
  - a. Placement of calcium hypochlorite granules during construction: Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft (150-m) intervals. The quantity of granules at each location shall be as shown in Table 1.

**Weight of calcium hypochlorite granules to be placed at beginning of main and at each 500-ft (150-m) interval**

Pipe Diameter ( <i>d</i> )			Calcium Hypochlorite Granules
	<i>in</i>	<i>(mm)</i>	<i>(g)</i>
4	(100)	1.7	(48)
6	(150)	3.8	(108)
8	(200)	6.7	(190)
10	(250)	10.5	(298)
12	(300)	15.1	(428)
14 and larger	(350 and larger)	$D^2 \times 15.1$	$D^2 \times 428$

Where D is the inside pipe diameter, in feet  $D = d/12$

4. If using tablets:
  - a. Placement of calcium hypochlorite tablets during construction: Calcium hypochlorite tablets (5-grams) shall be placed in the upstream end of each section of pipe to be disinfected, including branch lines. Also, at least one tablet shall be placed in each hydrant branch and in other appurtenances. The number of 5-g tablets required for each pipe section shall be  $0.0012 d^2L$  rounded to the next higher integer, where *d* is the inside pipe diameter, in inches, and *L* is the length of the pipe section, in feet. Table 2 shows the number of tablets required for commonly used sizes of pipe. Calcium hypochlorite tablets shall be attached by an adhesive meeting the requirements of NSF/ANSI 61. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach tablets inside and at the top of the main. If the tablets are attached before the pipe section is placed in the trench, their positions shall be marked on the pipe exterior to indicate that the pipe has been installed with the tablets at the top.

**Number of 5-g calcium hypochlorite tablets required for dose of 25 mg/L\***

Pipe Diameter		Length of Pipe Section, ft (m)				
		13 (4.0) or less	18 (5.5)	20 (6.1)	30 (9.1)	40 (12.2)
<i>in</i>	<i>(mm)</i>	Number of 5-g Calcium Hypochlorite Tablets				
4	(100)	1	1	1	1	1
6	(150)	1	1	1	2	2
8	(200)	1	2	2	3	4
10	(250)	2	3	3	4	5
12	(300)	3	4	4	6	7
16	(400)	4	6	7	10	13

\*Based on 3.25-g available chlorine per tablet

5. Filling and contact time: When installation has been completed, the main shall be filled with water such that the full pipe velocity is no greater than 1 ft/sec (0.3 m/sec). Fill rate must be carefully controlled to ensure tablets do not come loose from pipe. Precautions shall be taken to ensure that air pockets are eliminated. As an optional procedure, if required by the purchaser, water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system.

The chlorinated water shall remain in the pipe for at least 24 hr. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hr. A detectable free chlorine residual ( $\geq 0.2$  mg/L) shall be found at each sampling point after the 24- or 48-hr period.

6. Refer to ANSI/AWWA C651 (latest version) for additional detail.

H. Continuous Feed Method:

1. After installation flush water line to remove particulates. Velocity in the water line shall not be less than 3 ft./sec.
2. Fill water line with water dosed with chlorine. Chlorine concentration shall not be less than 25 mg/l free chlorine.
3. Retain chlorinated water in water line for 24 hours. Operate valves and hydrants during this time to disinfect.
4. Chlorine residual in water shall not be less than 10 mg/l at the end of the 24 hour period.
5. Refer to ANSI/AWWA C651 (latest version) for additional detail.

I. Slug Method:

1. After flushing water line to remove particulates, slowly fill water line with water dosed with a 100 mg/l concentration of chlorine.
2. Retain chlorinated water in water line for 3 hours.
3. Measure the free chlorine residual in the water line as it is filled. If dosage drops below 50 mg/l during this time, stop flow and relocate chlorination equipment to the reduced level of where chlorine was detected. As flow is resumed, apply chlorine to restore the free chlorine in the water to not less than 100 mg/l.
4. Operate valves and hydrants during this time to disinfect.
5. Refer to ANSI/AWWA C651 (latest version) for additional detail.

J. Final Flushing:

1. Flush water from water line until chlorine measurements are no higher than the chlorine residual that are found in the existing distribution system.
2. Inspect environment where the chlorinated water is to be discharged. Add a neutralizing chemical as the chlorinated water is being discharged if area is in threat of environmental damage from the chlorinated water.



K. Bacteriological Tests:

1. After final flushing and prior to the new water line being connected to the existing distribution system, two sets of acceptable water samples collected from the new water line and taken on consecutive days shall be submitted by the Contractor to the bacteriological laboratory at the Arkansas Department of Health in Little Rock, Arkansas.
2. Samples shall be tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater per the American Public Health Association, AWWA, and Water Environment Association (latest edition) and shall show the absence of coliform organisms.
3. If samples collected are positive, the disinfecting procedures and samples shall be repeated until two consecutive day samples are tested safe.

**END OF SECTION**

**SECTION 33 05 05.31**  
**HYDROSTATIC TESTING**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This Section covers test for water appurtenances and piping.

**1.02 RELATED SECTIONS**

- A. Section 33 05 31.15 - Polyvinyl Chloride Pressure Pipe and Fittings.

**1.03 SUBMITTALS**

- A. Submit testing procedures in accordance with Specifications.

**PART 2 MATERIALS**

**2.01 WATER FOR HYDROSTATIC TESTING OF PRESSURE LINES**

- A. Furnish water from the nearest hydrant or other suitable source for testing purposes.

**PART 3 EXECUTION**

**3.01 HYDROSTATIC AND LEAK TESTING OF PRESSURE LINES**

- A. Upon completion of installation, thoroughly clean new pipe:
1. Flush with water to remove dirt, stones, pieces of wood, or other obstructions that may have entered pipe during construction.
  2. Flush pipelines at a minimum rate of 2.5 feet per second for a duration suitable to Engineer.
- B. Upon completion of installation, pressure test water pipelines:
1. Conduct test in presence of Engineer and Owner.
  2. Minimum Pressure: 100 psig measured at the lowest elevation of the line.
  3. Duration: 2 hours.
  4. Repair visible leaks regardless of the amount of leakage.
- C. Provide water into pipeline for testing and flushing, including necessary:
1. Pumps, gages (increment at 10 psi or less), and meters.
  2. Plugs and caps.
  3. Temporary blowoff piping to discharge water.
  4. Reaction blocking to prevent pipe movement during testing.
- D. Water source for the pump suction shall be potable water from the Owner's distribution system; vessel used shall be approved by the Engineer.
- E. Prevent contamination of the Owner's water distribution system.
- F. After pipelines or isolated sections of pipelines have been filled with water, increase the pressure to test pressure by means of a pump.
- G. Test pressure shall be 100 psi or 50 percent above normal operating pressure, whichever is greater for two (2) hours, except at the lowest elevation of the line, where the test pressure shall be 125 psig or 50 percent above normal operating pressure, whichever is greater.
- H. Duration of hydrostatic leakage test shall be 2 hours, or as specified by Engineer.

- I. Open interior valves, including fire hydrants and other appurtenances, open during tests.
- J. After the specified test pressure has been applied, the entire pipeline shall be checked in the presence of the Engineer giving particular attention to parts of the pipeline and the appurtenances that are exposed.
- K. If leaks are apparent, perform corrective work and replace material that is required to remedy the defect and stop the leaks at no extra cost to the Owner.
- L. If no leaks were apparent or after corrective work has been completed, the pipelines shall be subjected to a leakage test at the pressure specified with a meter inserted in the test pump discharge line.
- M. AWWA C600-17 leak test for Ductile Iron.
  - 1. Hydrostatic Testing shall comply with Section 5.2 of AWWA C600-17.
  - 2. Leakage Criteria to follow AWWA C600-17 Section 5.5.1.4 "Test Allowance."

$$L = \frac{S \times D \times (P^{0.5})}{148,000}$$

L = Quantity of makeup water in gallons per hour

S = Length of pipe section being tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

- N. AWWA C605-13 leak test for PVC.
  - 1. Hydrostatic Testing shall comply with Section 10.3 of AWWA C605-13.
  - 2. Leakage Criteria to follow allowable criteria found in AWWA C605-13 Section 10.3.6 "Test Allowance."

$$Q = \frac{L \times D \times (P^{0.5})}{148,000}$$

Q = Quantity of makeup water in gallons per hour

L = Length of pipe section being tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

This formula is based on a testing allowance of 10.5 GPD/mile/inch of nominal pipe diameter at a test pressure of 150 psi.

- O. If test of pipe laid discloses leakage greater than the allowable leakage as calculated from the above formula, locate the leak or leaks and perform corrective work and replace material that is required in order to remedy the defect and stop the leak.
- P. Corrective work shall be approved by Engineer.

**END OF SECTION**

## SECTION 33 05 19

### DUCTILE IRON UTILITY WATER PIPE

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide cement-lined ductile iron pipe and gray cast iron or ductile iron fittings specified.
- B. Pipe and fittings shall be manufactured in the United States. Foreign made products shall be unacceptable.
- C. Service shall include potable waterline.

##### 1.02 RELATED SECTIONS

- A. Section 31 23 33 - Trenching and Backfilling.

##### 1.03 REFERENCES

- A. American National Standards Institute, 25 West 43rd Street, 4 floor, New York, NY, 10036.
  - 1. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  - 2. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in, for Water and other Liquids.
  - 3. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Fittings Pressure Pipe and Fittings.
  - 4. ANSI/AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges.
  - 5. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
  - 6. NSF/ANSI 61 - Drinking Water System Components - Health Effects.
- B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
  - 1. ASTM A307 - Specifications for Carbon Steel Externally Threaded Standard Fasteners.
  - 2. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
  - 3. ASTM D1248 - Specification for Polyethylene Plastic Molding and Extrusion Materials.
- C. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
  - 1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.
  - 2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
  - 3. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
  - 4. AWWA C207 - Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. Through 144 in.

#### PART 2 PRODUCTS

##### 2.01 PIPE

- A. Buried Pipe: Pressure Class 250 or 300, as shown on Drawings and in compliance with applicable requirements of ANSI A21.50. Flanged pipe shall meet or exceed ANSI/AWWA C115/A21.15.

- B. Pipe shall be jointed with push-on, mechanical, flanged, restrained, or flexible joints meeting applicable requirements of ANSI A21.11-72 and ANSI 21.15-75.
- C. Ductile iron pipe shall receive standard thickness cement lining and bituminous seal coat in conformance with ANSI/AWWA C104/A21.4.
- D. Ductile iron pipe shall be coated on the exterior with either coal tar or asphalt base material approximately 1 mil thick.
- E. Flexible Joint (Ball and Socket) Pipe: Class 58.

## **2.02 FITTINGS**

- A. Ductile iron, Pressure Class 250 or 300 Class as shown on Drawings, cement-lined and seal-coated. Where taps are shown on fittings, tapping bosses shall be provided.
  - 1. Flanged Joint: ANSI/AWWA C115/A21.15, faced and drilled. 125-pound ANSI standard.
  - 2. Mechanical Joint: ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
  - 3. Flexible Joint: American Flex-Lox pipe or equal.
- B. Cement Linings:
  - 1. In accordance with ANSI/AWWA C104/A21.4
  - 2. Certified to be in compliance with NSF/ANSI 61.
- C. Fittings shall receive an exterior coating of 1 mil thick bituminous material in accordance with ANSI/AWWA C104/A21.4.
- D. Fittings shall have distinctly cast on them the manufacturer's identification, pressure rating, nominal diameter of openings, and the number of degrees or fraction of the circle on bends.

## **2.03 FLANGES**

- A. ANSI/AWWA C115/A21.15, threaded, 250 psi working pressure, ANSI 125-pound drilling.

## **2.04 BOLTS**

- A. For Class 125 FF flanges use carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.
- B. For Class 250 RF flanges use carbon steel, ASTM A307, Grade B hex head bolts and ASTM A563, Grade A heavy hex head nuts.
- C. For mechanical joint use manufacturer's standard.

## **2.05 GASKETS**

- A. Gaskets for mechanical joints shall be rubber, conforming to ANSI/AWWA C111/A21.11.
- B. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber conforming to applicable parts of ANSI/AWWA C115/A21.15 and AWWA C207.
- C. Gasket Material: Free from corrosive alkali or acid ingredients and suitable for use in potable waterlines.
- D. Gaskets shall be full-face type for 125-pound FF flanges.

## **2.06 LUBRICANT**

- A. Lubricant for push-on or mechanical joint end piping shall be manufacturer's standard.

## **PART 3 EXECUTION**

### **3.01 HANDLING PIPE**

- A. Do not damage the cement lining when handling the pipe.

### **3.02 RELATION TO SEWER LINE**

- A. Laying water main, follow Health Department requirements. Maintain 10-foot horizontal separation and 18-inch vertical separation in crossing.

### **3.03 CUTTING PIPE**

- A. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.

### **3.04 DRESSING CUT ENDS**

- A. Dress cut ends of pipe in accordance with the type of joint to be made.
- B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket.
- C. Dress cut ends of pipe for flexible couplings and flanged coupling adapters as recommended by the coupling or adapter manufacturer.

### **3.05 MECHANICAL JOINT**

- A. Join pipe with mechanical joints in accordance with the manufacturer's recommendations. Provide special tools and devices, special jacks, chokers, and similar items required for proper installation. Pipe manufacturer shall provide lubricant for the pipe gaskets, no substitutes shall be permitted.

### **3.06 FABRICATION OF FLANGED PIPE AND FITTINGS**

- A. Flanged pipe and fittings shall be fabricated in the shop, not in the field, and delivered to the job site with flanges in place and properly faced.
- B. Threaded flanges shall be individually fitted and machine tightened on the threaded pipe by the manufacturer.
- C. Flanges shall be faced after fabrication in accordance with ANSI/AWWA C115/A21.15.

### **3.07 JOINTING FLANGED PIPE**

- A. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of oil, grease, and foreign material.
- B. The rubber gaskets shall be checked for proper fit and thoroughly cleaned.
- C. Care shall be taken to assure proper seating of the flanged gasket.
- D. Bolts shall be tightened so that the pressure on the gasket is uniform.
- E. Torque-limiting wrenches shall be used to ensure uniform bearing insofar.
- F. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.

### **3.08 THRUST BLOCKS**

- A. Install 2,500 psi concrete thrust blocks at bends, wyes, or other thrust points on pressure piping.
- B. Block to bear against undisturbed soil and shall be of size and with bearing area as shown on Drawings.

### 3.09 TESTING

- A. Lines shall be hydrostatically or pneumatically tested. Test procedures shall be as specified in Section 33 05 05.31.

### 3.10 POLYETHYLENE MATERIAL FOR DUCTILE IRON PIPE PROTECTION

- A. Polyethylene material, either in tubing form or flat sheets or rolls, as specified herein, shall be placed around all Ductile Iron pipe and fitting joints and all valves and fire hydrants with mechanical joint ends, and all saddles, sleeves, couplings, tapping saddles and any other appurtenances with exposed bolts, as directed by the Owner. Ductile iron pipe and appurtenances shall be completely encased in polyethylene tubing material.

Specific requirements for the polyethylene material are:

The material shall conform to ANSI A21.5 (AWWA C-105). The tubing material shall be made from virgin polyethylene extended in the form of a tube and shall have the following characteristics:

Minimum thickness	8 mils
ASTM D1248, Type I, Class C (black)	Grade E-1
Maximum flow index	0.4
Minimum tensile strength	1,200 p.s.i.
Minimum elongation	300%
Dielectric strength (raw material)	Volume resistivity minimum
Dielectric strength (sheet material)	800 V/mil

Tape for field application shall be Polyken #900 or Scotchwrap #50 or equal, at least two (2) inches wide.

**END OF SECTION**

## SECTION 33 05 31.15

### POLYVINYL CHLORIDE PRESSURE PIPE AND FITTINGS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide polyvinyl chloride (PVC) pipe and fittings.

##### 1.02 RELATED SECTIONS

- A. Section 31 23 33 - Trenching and Backfilling.
- B. Section 33 05 05.31 - Hydrostatic Testing.

##### 1.03 REFERENCES

- A. Arkansas Department of Health.
  - 1. ADH: *"Rules and Regulations Pertaining to Public Water Systems, latest Edition."*
- B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
  - 1. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 2. ASTM D2241 - Specifications for Poly (Vinyl Chloride) (PVC) Pressure - Rated Pipe (SDR Series).
  - 3. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
  - 4. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- C. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
  - 1. AWWA C110/A21.10-03 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. For Water and Other Liquids.
  - 2. AWWA C605-13 - Underground installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
  - 3. AWWA: *"The Ten States Standards for Water, 2007 Edition or latest version."*

#### PART 2 PRODUCTS

##### 2.01 PIPE

- A. PVC pressure pipe, Class 200, SDR-21 in compliance with ASTM D1784 and manufactured from virgin PVC compound with a cell classification of 12454-B with gasket joints and integral bell for buried water piping.
- B. Pipe and fittings shall be manufactured in the United States. Foreign made products shall be unacceptable.
- C. Pipe shall be permanently marked at 5-foot intervals with the following information:
  - 1. Nominal size.
  - 2. Material code designation.
  - 3. Manufacturer's name or trademark and production record code.
  - 4. ASTM or AWWA certification.
  - 5. SDR designation.



- D. Warranty:
  - 1. Manufacturer of the pipe shall warrant product for a period of not less than one (1) year.
  - 2. Forward copies of warranty to the Owner.
  - 3. Replace defective materials at no extra cost to the Owner.

## **2.02 JOINTS**

- A. Buried Pipe: Gasketed slip joint.
- B. Comply with ASTM D3139.

## **2.03 FITTINGS**

- A. Fittings 4 Inches and Larger: Ductile iron, 350 psi pressure class, cement-lined and seal-coated. Where taps are shown on fittings, tapping bosses shall be provided.
  - 1. Flanged Joint: ANSI/AWWA C110/A21.10-03 and ANSI B16.1, faced and drilled 125-pound ANSI standard.
  - 2. Mechanical Joint: ANSI/AWWA C110/A21.10-03 and ANSI/AWWA C110/A21.11-07.
  - 3. Flexible Joint: American Flex-Lox pipe or equal.
- B. Cement Linings: In accordance with ANSI A21.4.
- C. Fittings shall receive an exterior coating of 1 mil thick bituminous material in accordance with ANSI A21.4.
- D. Fittings shall have distinctly cast on them the manufacturer's identification, pressure rating, nominal diameter of openings, and the number of degrees or fraction of the circle on bends.
- E. Fittings Smaller Than 4 Inches: PVC.

## **2.04 GASKETS**

- A. As recommended by pipe manufacturer to conform to pipe.
- B. Comply with ASTM F477.

## **2.05 MARKING TAPE**

- A. Install on pressure systems.
- B. Terra Tape "Extra Stretch."
- C. Or equal.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Any connection to water main for the purpose of connecting any water line to the water main, shall use a minimum of Schedule 40, Polyvinyl chloride (PVC) pipe.
- B. Rigid PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations.
- C. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of installation and final use.

### **3.02 TRACE WIRE**

- A. Furnish and install a 12-gage insulated copper trace wire with PVC pressure pipe.
- B. Run wire continuous from valve box to valve box, meter box, air release vault, cleanout, or other access points.
- C. Bring wire up inside boxes and vaults in an accessible method.
- D. Bring wire around or tape wire to each pipe section.
- E. Pipe testing shall include following trace wire.
- F. Wire breaks shall be repaired at no additional expense to the Owner.

### **3.03 MARKING TAPE**

- A. On pressure installations of non-metallic pipe, metallic marking tape, Terra Tape Extra Stretch or equal shall be installed 6 to 12 inches above the top of pipe or service line.
- B. The tape shall be in addition to the trace wire specified.

### **3.04 THRUST BLOCKS**

- A. Install 2,500 psi concrete thrust blocks at bends, wyes, or other thrust points on pressure piping.
- B. Block to bear against undisturbed soil and shall be of size and with bearing area as shown on Drawings.

### **3.05 TESTING**

- A. Pressure lines shall be hydrostatically tested at the pressures listed in Section 33 05 05.31.
- B. Use pipe-locating equipment to test continuity of trace wire.
- C. Engineer shall observe and document trace wire test.

**END OF SECTION**

## SECTION 33 05 31.20

### POLYETHYLENE STORM SEWER PIPE AND FITTINGS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide high density polyethylene corrugated storm sewer pipe and fittings with integrally formed smooth interior.

##### 1.02 RELATED SECTIONS

- A. Section 31 23 33 - Trenching and Backfilling.
- B. Section 33 42 11 - Storm Water Pipe and Fittings.

##### 1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 225, Washington, DC 20001.
  - 1. AASHTO M252 - Standard Specification for Polyethylene Corrugated Drainage Pipe.
  - 2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12-inch to 24-inch diameter.
- B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
  - 2. ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
  - 3. ASTM D2412 - Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
  - 4. ASTM D3350 - Standard Specification for Polyethylene Pipe and Fittings Materials.
  - 5. ASTM F405 - Standard Specification for Corrugated Polyethylene Pipe and Fittings.
  - 6. ASTM F667 - Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.

##### 1.04 SUBMITTALS

- A. Submit in accordance with Specifications.
- B. Submit manufacturers certificate of compliance.

#### PART 2 PRODUCTS

##### 2.01 PIPE

- A. Provide pipe and fittings manufactured of polyethylene compounds which meet or exceed the requirements of Type II, Category 4 or 5, Grade P33 or P34, Class C per ASTM D1248. Clean reworked material may be used.
- B. Pipe and fittings shall be free of foreign inclusions and visible defects.
- C. Cut pipe ends squarely and cleanly so as not to adversely affect jointing.
- D. Minimum parallel plate pipe stiffness values at 5 percent deflection (per ASTM D2412) shall be as follows:
  - 1. 12-inch: 45 psi.

2. 15-inch: 42 psi.
3. 18-inch: 40 psi.
4. 24-inch: 34 psi.
5. 30-inch: 28 psi.
6. 36-inch: 22 psi.

E. Manufactured in accordance with ASTM F405, ASTM F667, AASHTO M252, and AASHTO M294.

## **2.02 FITTINGS**

- A. Provide molded or fabricated fittings manufactured by pipe supplier. Fittings produced by manufacturer other than pipe supplier shall not be allowed.
- B. Provide Split Couplings:
  1. Corrugated to match pipe corrugations.
  2. Engage a minimum of 6 corrugations for 12-inch through 24-inch diameter and 4 corrugations for 30-inch and 36-inch diameter pipe.
- C. Gaskets: Neoprene, where required by Engineer.
- D. Manufactured in accordance with ASTM F405, ASTM F667, AASHTO M252, and AASHTO M294.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with ASTM D2321 and manufacturer's instructions.

**END OF SECTION**

## SECTION 33 05 33.13

### CORRUGATED-WALL, SMOOTH INTERIOR HDPE PIPE

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide smooth interior Corrugated High Density Polyethylene (HDPE) Pipe with silt tight and leak resistant joint.

##### 1.02 RELATED SECTIONS

- A. Section 31 23 33 - Trenching and Backfilling.
- B. Section 33 42 11 - Storm Water Pipe and Fittings.

##### 1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 225, Washington, DC 20001.
  - 1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Pipe, 4-inch to 10" diameter.
  - 2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12-inch to 48-inch diameter.
  - 3. AASHTO MP7-97 - Standard Specification for Corrugated Polyethylene Pipe, 54-inch to 60-inch diameter.
- B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM D2321 - Recommended Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
  - 2. ASTM D3350 - Standard Specification for Polyethylene Pipe and Fittings Materials.
  - 3. ASTM F477 - Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

##### 1.04 SUBMITTALS

- A. Submit in accordance with Specifications.
- B. Submit manufacturers certificate of compliance.

#### PART 2 PRODUCTS

##### 2.01 PIPE MATERIAL

- A. Pipe and fitting material shall be high-density polyethylene meeting ASTM D3350 minimum cell classification 324420C for 4-inch to 10-inch diameters, or 335420C for 12-inch through 60-inch diameters.

##### 2.02 PIPE REQUIREMENTS

- A. Pipe manufactured for this specification shall comply with the requirements for test methods, dimension, and markings found in AASHTO M252, AASHTO M294 and/or AASHTO MP7-97. The prescribed sizes of pipe are nominal inside diameters. Pipe sizes shall be no less than 99% of nominal inside diameter and have a nominal length of 20.0 feet.
- B. For 4-inch to 10-inch diameters, the pipe supplied shall be smooth Interior and Annular Exterior Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO M252, Type S.

- C. For 12-inch to 42-inch diameters, the pipe supplied shall be smooth Interior and Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO M294, Type S or D.
- D. For 48-inch to 60-inch diameters, the pipe supplied shall be smooth Interior and Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO MP7-97, Type S or D.
- E. Manning's "n" value for use in design shall not be less than 0.012.

### **2.03 FITTINGS**

- A. Fittings shall conform to AASHTO M252, M294 or MP7-97. Fabricated fittings shall be welded on the interior and exterior at all junctions.

### **2.04 JOINT PERFORMANCE**

- A. Pipe shall be joined with bell-and-spigot joints meeting ASHTO M252, M294 or MP7-97. Joints shall provide a silt-tight and leak resistant joint.
- B. Pipe joints shall incorporate a gasket meeting the requirements of ASTM F477 to form a silt tight and leak resistant connection. Joints shall exceed the soil tight joint performance criteria of AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.
- C. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris.
- D. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

### **2.05 ACCEPTABLE MANUFACTURERS**

- A. Smooth Interior and Corrugated HDPE Pipe shall be as manufactured by:
  - 1. Hancor, Inc.
  - 2. Advanced Drainage Systems, Inc.
  - 3. Engineer approved equal.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Installation shall be in accordance with ASTM D2321 with the exception that minimum cover in trafficked areas shall be one foot for 4-inch to 48-inch pipe and 24-inches for 54-inch and 60-inch pipe.
- B. Backfill the pipe with material meeting the requirements of ASTM D2321 Class I, II or III subject to approval of the Engineer. Backfill shall be placed in six to 12 inch lifts compacted to a minimum 90% standard proctor or as designated by the Engineer.
- C. Trench width should be wide enough to place and compact backfill around the entire pipe. The trench width shall be outside diameter +24-inches for pipe sizes 12-inch to 30-inch, and outside diameter +36-inches for pipe sizes 36-inches to 60-inches.

**END OF SECTION**

## SECTION 33 31 26

### SANITARY PRESSURE SEWER PIPING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Furnish and install pressure pipe and fittings for sewage force main.

##### 1.02 RELATED SECTIONS

- A. Section 31 23 33- Trenching and Backfilling.

##### 1.03 REFERENCES

- A. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
  - 1. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly (Vinyl Chloride)(CPVC) Compounds.
  - 2. ASTM D2241 - Specification for Rigid Poly (Vinyl Chloride)(PVC) Pressure Rated Pipe (SDR-Series).
  - 3. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
  - 4. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- B. American National Standards Institute, 25 West 43rd Street, 4 floor, New York, NY, 10036.
  - 1. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  - 2. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in, for Water and other Liquids.
  - 3. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Fittings Pressure Pipe and Fittings.
  - 4. ANSI/AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges.
  - 5. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
- C. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
  - 1. ASTM A307 - Specifications for Carbon Steel Externally Threaded Standard Fasteners.
  - 2. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
  - 3. ASTM D1248 - Specification for Polyethylene Plastic Molding and Extrusion Materials.

##### 1.04 SUBMITTALS

- A. Make submittals in accordance with Specifications.
- B. Product Data:
  - 1. Pipe materials and manufacturers.
  - 2. Manufacturer's standard installation instructions.
- C. Certificate of Compliance: Submit attesting that materials provided are in compliance with referenced standards.

- D. Test Records:
  - 1. Date of test.
  - 2. Description and identification of piping tested.
  - 3. Test fluid.
  - 4. Test pressure.
  - 5. Remarks to include such items as:
    - a. Leaks (type, location).
    - b. Repairs made on leaks.
  - 6. Certification by Contractor and written approval by Engineer.

## **1.05 QUALITY CONTROL**

- A. Polyvinyl Chloride (PVC)
  - 1. PVC pipe manufactured from Type 1, Grade 1 PVC, conforming to ASTM D1784.
  - 2. Pipe shall be tested in accordance with ASTM D2241 and product standard PS 22-70.

## **PART 2 MATERIALS**

### **2.01 PVC PIPE, FITTINGS, AND JOINTS**

- A. Pipe: Conform to the following requirements:
  - 1. ASTM D2774 Pressure PVC Pipe rated at 200 psi, SDR 21.
  - 2. ASTM D1784 Class 200, Type I, Grade 1.
- B. Permanently mark at 5-foot intervals with the following information:
  - 1. Nominal size.
  - 2. Material code designation.
  - 3. Manufacturer's name or trademark and production record code.
  - 4. ASTM or AWWA certification.
  - 5. SDR designation.
- C. Joints:
  - 1. Buried Pipe: Gasketed slip joint with integral bell for buried sewer piping.
  - 2. Comply with ASTM D3139.
- D. Fittings:
  - 1. Fittings 4 Inches and Larger: Cast iron or ductile iron mechanical joint.
  - 2. Fittings Smaller Than 4 Inches: PVC.
- E. Gaskets:
  - 1. As recommended by pipe manufacturer for outside diameter of pipe.
  - 2. Comply with ASTM F477.
- F. Marking Tape:
  - 1. Install on pressure systems.



2. Terra Tape "Extra Stretch."
  3. Or equal.
- G. Trace Wire: All tracer wire shall be 12 gage minimum, insulated copper.
- H. Tee Fittings:
1. Furnish caps or plugs with each tee outlet or stub.
  2. Band or otherwise secure plug or cap to withstand test pressures involved without leakage.
  3. Furnish tee outlets with gasketed type joint or approved adapter to join service connection pipe used.

## **2.02 DUCTILE IRON PIPE, FITTINGS, AND JOINTS**

- A. Pipe:
1. Buried Pipe: Pressure Class 250 or 300, as shown on Drawings and in compliance with applicable requirements of ANSI A21.50. Flanged pipe shall meet or exceed ANSI/AWWA C115 /A21.15.
  2. Pipe shall be jointed with push-on, mechanical, flanged, restrained, or flexible joints meeting applicable requirements of ANSI A21.11-72 and ANSI 21.15-75.
  3. Ductile iron pipe shall receive standard thickness cement lining and bituminous seal coat in conformance with ANSI/AWWA C104 /A21.4.
  4. Ductile iron pipe shall be coated on the exterior with either coal tar or asphalt base material approximately 1 mil thick.
  5. Flexible Joint (Ball and Socket) Pipe: Class 58.
- B. Fittings:
1. Ductile iron, Pressure Class 250 or 300 Class as shown on Drawings, cement-lined and seal-coated. Where taps are shown on fittings, tapping bosses shall be provided.
    - a. Flanged Joint: ANSI/AWWA C115/A21.15, faced and drilled. 125-pound ANSI standard.
    - b. Mechanical Joint: ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
    - c. Flexible Joint: American Flex-Lox pipe or equal.
  2. Cement Linings: In accordance with ANSI/AWWA C104/A21.4
  3. Fittings shall receive an exterior coating of 1 mil thick bituminous material in accordance with ANSI/AWWA C104/A21.4.
  4. Fittings shall have distinctly cast on them the manufacturer's identification, pressure rating, nominal diameter of openings, and the number of degrees or fraction of the circle on bends.
- C. Flanges:
1. ANSI/AWWA C115/A21.15, threaded, 250 psi working pressure, ANSI.
- D. Bolts:
1. For Class 125 FF flanges use carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

2. For Class 250 RF flanges use carbon steel, ASTM A307, Grade B hex head bolts and ASTM A563, Grade A heavy hex head nuts. For mechanical joint use manufacturer's standard.

E. Gaskets:

1. Gaskets for mechanical joints shall be rubber, conforming to ANSI/AWWA C111/A21.11.
2. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber conforming to applicable parts of ANSI/AWWA C115/A21.15 and AWWA C207.
3. Gasket Material: Free from corrosive alkali or acid ingredients and suitable for use in potable waterlines
4. Gaskets shall be full-face type for 125-pound FF flanges.

F. Lubricant:

1. Lubricant for push-on or mechanical joint end piping shall be manufacturer's standard.

G. Marking Tape:

1. Install on pressure systems.
2. Terra Tape "Extra Stretch."
3. Or equal.

H. Trace Wire:

1. All tracer wire shall be 12 gage minimum, insulated copper.

## **2.03 CONCRETE FOR THRUST BLOCKING AND ENCASEMENT**

- A. Compressive Strength: Minimum 2,500 psi at 28 days.

## **PART 3 EXECUTION**

### **3.01 PREPARATION OF TRENCH**

A. Bell Holes:

1. Excavate bell holes at each joint to permit proper assembly and inspection of entire joint.
2. Bell holes shall be of sufficient depth to preclude direct bearing of bell on bottom of trench.

### **3.02 RELATION TO WATER LINE**

- A. Laying sewer line follow Health Department requirements. Maintain 10-foot horizontal separation and 18-inch vertical separation in crossings.

### **3.03 THRUST BLOCKING**

- A. Do not over excavate in areas where thrust blocks are to be poured.
- B. Construct suitable forms to obtain shapes that will provide full bearing surfaces against undisturbed earth, as indicated.
- C. Pour thrust blocking against undisturbed earth.
- D. Cure thrust blocks a minimum of 5 days before conducting hydrostatic and air tests.

### **3.04 LAYING AND JOINTING PIPE AND FITTINGS**

- A. Install in accordance with manufacturer's written instructions.

### **3.05 HYDROSTATIC TESTING OF PRESSURE LINES**

- A. Conduct test in presence of Engineer or Engineer's representative.

- B. Provide water into pipeline for testing and flushing, including necessary:
  - 1. Pumps, gages (increment at 10 psi or less), and meters.
  - 2. Plugs and caps.
  - 3. Temporary blowoff piping to discharge water.
  - 4. Reaction blocking to prevent pipe movement during testing.

### **3.06 HYDROSTATIC AND LEAK TESTING OF PRESSURE LINES**

- A. Upon completion of installation, thoroughly clean new pipe.
  - 1. Flush with water to remove dirt, stones, pieces of wood, etc., which may have entered pipe during construction.
  - 2. Flush pipelines at a minimum rate of 2.5 feet per second for a duration suitable to Engineer.
- B. Upon completion of installation, pressure test pipelines:
  - 1. Minimum Pressure: 100 psig or 50 percent greater than operating pressure, whichever is greater; as measured at the lowest elevation of the line.
  - 2. Duration: 2 hours.
  - 3. Repair visible leaks that exceed the leakage rate as determined in paragraph 3.6 L
- C. Water source for the pump suction shall be potable water from the Owner's distribution system; vessel used must be approved by the Engineer.
- D. Adequate steps shall be taken to prevent contamination of the Owner's system by the Contractor's actions.
- E. After pipelines or isolated sections of pipelines have been filled with water, increase the pressure to test pressure by means of a pump.
- F. Test pressure shall be 100 psi or 50 percent above normal operating pressure, whichever is greater.
- G. Duration of hydrostatic leakage test shall be 2 hours, or as specified by Engineer.
- H. Open interior valves, including fire hydrants and other appurtenances, open during tests.
- I. After the specified test pressure has been applied, the entire pipeline shall be checked in the presence of the Engineer giving particular attention to that part of the pipeline and those appurtenances that are exposed.
- J. If leaks are apparent, the Contractor shall, at his expense, perform whatever work and/or replace whatever material is required to remedy the defect and stop the leaks.
- K. If no leaks were apparent or after corrective work has been completed, the pipelines shall be subjected to a leakage test at the pressure specified with a meter inserted in the test pump discharge line.

- L. The maximum leakage per hour for ductile iron, PVC, and concrete pipe shall be as calculated from the following formula from Section 10.3.6 (Test Allowance) of AWWA C605-13.

All rubber gasket or O-ring joints (iron, PVC, and concrete)

$$Q = \frac{L \times D \times (P^{0.5})}{148,000}$$

Q = Quantity of makeup water (gallons per hour)

L = Length of pipe sections being tested

D = Nominal diameter (inches)

P = Average test pressure during the hydraulic test (psig)

This Formula is based on a Testing Allowance of 10.5 GPD/Mile/inch of nominal pipe diameter at a test pressure of 150 PSI.

- M. If any test of pipe laid discloses leakage greater than the allowable leakage as calculated from the above formula, locate the leak or leaks and perform whatever work and/or replace whatever material is required in order to remedy the defect and stop the leak.
- N. Corrective work must be approved by Engineer.

**3.07 EXTERIOR PROTECTION FOR BURIED OR SUBMERGED PIPING ACCESSORIES**

- A. Wrap mechanical joints and valves with 8 mil polywrap.

**3.08 POLYETHYLENE MATERIAL FOR DUCTILE IRON PIPE PROTECTION**

- A. Polyethylene material, either in tubing form or flat sheets or rolls, as specified herein, shall be placed around all Ductile Iron pipe and fitting joints and all valves and fire hydrants with mechanical joint ends, and all saddles, sleeves, couplings, tapping saddles and any other appurtenances with exposed bolts, as directed by the Owner. Ductile iron pipe and appurtenances shall be completely encased in polyethylene tubing material.

Specific requirements for the polyethylene material are:

The material shall conform to ANSI A21.5 (AWWA C-105). The tubing material shall be made from virgin polyethylene extended in the form of a tube and shall have the following characteristics:

Minimum thickness	8 mils
ASTM D1248, Type I, Class C (black)	Grade E-1
Maximum flow index	0.4
Minimum tensile strength	1,200 p.s.i.
Minimum elongation	300%
Dielectric strength (raw material)	Volume resistivity minimum
Dielectric strength (sheet material)	800 V/mil

Tape for field application shall be Polyken #900 or Scotchwrap #50 or equal, at least two (2) inches wide.

**END OF SECTION**

**SECTION 33 42 10**  
**STORM UTILITY DRAINAGE PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe and Culverts.
- B. Pipe Joint Material.
- C. Inlets and Junction Boxes.
- D. Foundation Drain Pipe.

**1.02 RELATED SECTIONS**

- A. Section 03 01 30 - Site Concrete Work.
- B. Section 31 23 33 - Trenching and Backfilling.

**1.03 REFERENCES**

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 249, Washington, DC 20001.
  - 1. AASHTO M36 - Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
  - 2. AASHTO M176 - Porous Concrete Pipe.
  - 3. AASHTO M218 - Sheet Steel, Zinc-Coated (Galvanized) for Corrugated Steel Pipe.
  - 4. AASHTO M245 - Polymer Precoated Corrugated Steel Pipe.
  - 5. AASHTO M246 - Steel Sheet, Polymer Precoated for Corrugated Steel Pipe.
- B. American Concrete Institute, P. O. Box 9094, Farmington Hills, MI 48333-9094 38800, Country Club Drive, Farmington Hills, MI 48331 Phone 248/484-3700, Fax 248/848-3701
  - 1. ACI 301 - Specification for Structural Concrete for Buildings.
- C. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA Phone: (610) 832-9585 Fax: (610) 832-9555.
  - 1. ASTM C14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
  - 2. ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  - 3. ASTM C412 - Specification for Concrete Drain Tile.
  - 4. ASTM C443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - 5. ASTM C444 - Specification for Preformed Concrete Pipe.
  - 6. ASTM C478 - Specification for Precast Reinforced and Nonreinforced Masonry.
  - 7. ASTM C700 - Specification for Vitriified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
  - 8. ASTM D1785 - PVC Plastic Pipe, Schedules 40, 80, and 120.
  - 9. ASTM D3034 - Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

## **PART 2 PRODUCTS**

### **2.01 PIPE JOINT MATERIAL**

- A. Band Couplers:
  - 1. Manufacturers:
    - a. LUV band, with 2 annular corrugations, by Caldwell Culvert; or equal.
    - b. Smooth Cor band, with 2 annular corrugations by Caldwell Culvert; or equal.
  - 2. Minimum gage in accordance with AASHTO M36.
  - 3. Gaskets: Ramneck.
- B. Reinforcing End Collars:
  - 1. 12-gage.
  - 2. 6 inches wide.
  - 3. Annular corrugations same as pipe.

### **2.02 COATINGS FOR PIPE AND CULVERTS**

- A. Polymer:
  - 1. AASHTO M218, M245, and M246.
  - 2. Thickness: 10 mils, both sides.
  - 3. Equal to Dow Chemical Trenchcoat protective film as furnished by Caldwell Culvert Company, North Little Rock, Arkansas.
- B. Design mix to attain minimum 4,000 psi compressive strength at 28 days.

### **2.03 PRE-CAST CONCRETE STRUCTURES**

- A. Conform to local standards.
- B. Conform to ASTM C478.

### **2.04 FOUNDATION DRAIN PIPE**

- A. Open-joint Pipe: Extra-quality or heavy-duty extra quality concrete drain tile conforming to ASTM C412, or extra-strength vitrified clay pipe conforming to ASTM C700.
- B. Perforated Pipe: Type 1 or Type 2 perforated concrete pipe conforming to ASTM C444 and applicable requirements of ASTM C14, Class 2 or Class 3, or extras-strength, perforated, vitrified clay pipe conforming to ASTM D1785, or perforated SDR Standard PVC pipe conforming to ASTM D3034. Do not use bituminized fiber pipe or PE plastic pipe for perforated drain piping.
- C. Porous Wall Pipe: Standard-strength "Poroswall" concrete pipe by the Walker Poroswall Pipe Co., or equal. Straight, free from cracks and defects, meeting AASHTO Designation M176-631, Class II, and having infiltration rate of not less than 1 gallon per minute per inch of internal diameter per foot of pipe. Provide wye, tee, and related fittings required.

### **2.05 METAL GRATES, COVERS, AND FRAMES (CAST IRON GRATES, COVERS, AND FRAMES SUBJECT TO VEHICLE TRAFFIC)**

- A. All frame, covers, grates, and other castings shall be heavy-duty cast iron and shall be non-rocking, machine surfaces bearing surfaces.
- B. Furnish frames with anchors for attachment to concrete work.

- C. Furnish covers with pry holes or flush type drop handles and non-slip surfaces.
- D. Cast iron castings to be size and type shown on Drawings.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION OF PIPE AND CULVERTS**

- A. Lay sections on properly compacted granular bedding (4-inch minimum) to lines and grades shown on Drawings.
- B. Backfill with approved imported granular materials as specified in Section 31 23 33.
- C. Band Couplers:
  - 1. Install band couplers in accordance with manufacturer's recommendations and AASHTO guidelines.
  - 2. Use Ram Neck gasket material in end corrugation of each pipe end.
- D. Reinforcing End Collars:
  - 1. Install reinforcing end collar where pipe terminates without protective end treatment, such as headwall, inlet box, or grouted rip rap.
- E. Storm drains shall have a minimum cover of 24 inches.
- F. Pipes (storm, sanitary, water) that cross each other with less than 1-1/2-foot clearance must have a concrete encased intersection.

#### **3.02 INSTALLATION OF INLETS AND JUNCTION BOXES**

- A. Conform to city standard construction details.
- B. Construction methods to conform to Section 03 01 30.
- C. Construct concrete drainage structures with exposed concrete surfaces rubbed to smooth finish and with metal frames for grates and covers securely anchored in place.
- D. Structures may be cast-in-place or pre-cast.
- E. Frame castings to be securely held in place to proper line and grade to make an integral part of the complete structure.
- F. Construct catch basin, weirs, headwalls and similar structures of reinforced concrete unless otherwise indicated; pre-cast concrete units as approved.
  - 1. Provide concrete foundations for manholes and other structures.
  - 2. Concrete structures shall be reinforced.
  - 3. All concrete construction shall receive a smooth finish in accordance with ACI 301 on all surfaces exposed to exterior or interior of structure; rough formed for all unexposed construction.
  - 4. Moist cure concrete for a minimum of seven days after placing.
- G. Where manholes occur in pavement, set tops of frames and covers flush with finish surface. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- H. Backfill at structures and compact in accordance with Section 31 23 33.

### **3.03 INSTALLATION OF FOUNDATION DRAINS**

#### **A. Open-joint:**

1. Lay with joints opened 1/10-inch and with top half of joints covered with strips of roofing felt.
2. Grade pipe lines to drain.
3. Place drainage fill in accordance with Section 31 00 00.

#### **B. Laying Pipe:**

1. Carefully prepare bedding so pipe after installation will be true to line and grade.
2. Surface grade drainage fill material beneath pipe to provide uniform and continuous support beneath pipe at all points. Densify fill material beneath pipe.
3. After each pipe has been brought to grade, aligned, and placed in final position, deposit and densify sufficient bedding material under pipe haunches and on each side of pipe to hold pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations. Deposit bedding material uniformly and simultaneously on each side of pipe to prevent lateral displacement.

**END OF SECTION**



**SECTION 33 42 11**  
**STORM WATER PIPE AND FITTINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe and culverts and other miscellaneous drain lines around site as shown on Drawings.
- B. Pipe Joint Material.

**1.02 RELATED SECTIONS**

- A. Section 03 47 00 - Site Cast Concrete.
- B. Section 31 23 33 - Trenching and Backfilling.

**1.03 REFERENCES**

- A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 249, Washington, DC 20001.
  - 1. AASHTO M36 - Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
  - 2. AASHTO M176 - Porous Concrete Pipe.
  - 3. AASHTO M218 - Sheet Steel, Zinc-Coated (Galvanized) for Corrugated Steel Pipe.
  - 4. AASHTO M245 - Polymer Precoated Corrugated Steel Pipe.
  - 5. AASHTO M246 - Steel Sheet, Polymer Precoated for Corrugated Steel Pipe.
- B. American Concrete Institute, P. O. Box 9094, Farmington Hills, MI 48333-9094, 38800 Country Club Drive, Farmington Hills, MI 48331 Phone 248/484-3700, Fax 248/848-3701
  - 1. ACI 301 - Specification for Structural Concrete for Buildings.
- C. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA Phone: (610) 832-9585 Fax: (610) 832-9555.
  - 1. ASTM C14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
  - 2. ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
  - 3. ASTM C412 - Specification for Concrete Drain Tile.
  - 4. ASTM C443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - 5. ASTM C444 - Specification for Preformed Concrete Pipe.
  - 6. ASTM C478 - Specification for Precast Reinforced and Nonreinforced Masonry.
  - 7. ASTM C700 - Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
  - 8. ASTM D1785 - PVC Plastic Pipe, Schedules 40, 80, and 120.
  - 9. ASTM D3034 - Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

**PART 2 PRODUCTS**

**2.01 PIPE AND CULVERTS**

- A. Corrugated Steel Pipe and Culverts:
  - 1. In compliance with latest AASHTO specifications.

2. Galvanized to AASHTO standards.
  3. Install as per AASHTO and manufacturer's recommendation.
- B. HDPE Pipe:
1. Conform to AASHTO M252 and AASHTO M294.
  2. Joints shall provide a silt tight and leak resistant joint with a gasket meeting ASTM F-477.
  3. Acceptable Manufacturers:
    - a. ADS.
    - b. Hancor.
    - c. Or equal.
- C. Reinforced Concrete Pipe:
1. Class III or as shown on Drawings.
  2. Conform to ASTM C76.
  3. Joints shall conform to ASTM C443.

## **2.02 PIPE JOINT MATERIAL**

- A. Band Couplers:
1. Manufacturers:
    - a. LUV band, with 2 annular corrugations, by Caldwell Culvert; or equal.
    - b. Smooth Cor band, with 2 annular corrugations by Caldwell Culvert; or equal.
  2. Minimum gage in accordance with AASHTO M36.
  3. Gaskets: Ram Neck.
- B. Reinforcing End Collars:
1. 12-gage.
  2. 6 inches wide.
  3. Annular corrugations same as pipe.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF PIPE AND CULVERTS**

- A. Lay sections on properly compacted granular bedding (4-inch minimum) to lines and grades shown on Drawings.
- B. Backfill with approved imported granular materials as specified in Section 31 23 33.
- C. Band Couplers:
  1. Install band couplers in accordance with manufacturer's recommendations and AASHTO guidelines.
  2. Use Ram Neck gasket material in end corrugation of each pipe end.
- D. Reinforcing End Collars: Install reinforcing end collar where pipe terminates without protective end treatment such as headwall, inlet box, or grouted rip rap.

- E. Install HDPE sewer and drainage pipe in accordance with ASTM D-2321 - Recommended Practice for Installation of Thermoplastic Sewer Pipe.

**END OF SECTION**