

STAGE RIGGING AND DRAPERIES

SECTION 11 61 33

PART 1 GENERAL

- 1.1 SCOPE This package of equipment and the related drawings, (TR-1, TR-2, TR-3, TR-4 and TR 5), describe complete theatrical rigging systems and draperies for the main auditorium and the Black Box Theatre.

NOTE: Furnish and install curtain track and draperies in the TV Studio and Band Practice Room. (See Drawings A 2.02F and A 2.01L and Part 7.00 Rigging Schedule, below.)

1.2 OVERVIEW

- A. Complete System: The Contractor shall provide all items necessary for a complete, safe, fully functional system as described herein, including all tools, scaffolding, labor, and supervision, even though they may not be specifically enumerated. Any errors, omissions or ambiguities do not relieve the Contractor of this responsibility, but shall be brought to the attention of the Architect for clarification.
- B. Work Included: The work of this section shall include, but not necessarily be limited to the following:
1. Furnish and install stage rigging and draperies in auditorium.
 2. Furnish and install lighting grid, curtain track and draperies in the Black Box Theatre.
- C. Related Work: Related work which is not included in this section but with which the work in this section shall be coordinated:
1. Structural steel and miscellaneous metals not specifically called out as part of this section.
 2. Galleries, ladders and catwalks.
 3. Stage flooring.
 4. Stage lighting.
 5. Electrical work related to rigging system installation.
- D. The Theatrical Contractor, as part of the work of this section, shall provide, install and test a complete motorized rigging control system as specified herein for areas indicated on the drawings and circuit schedules. The Theatrical Contractor shall be responsible for all low-voltage device termination that is related to the rigging control system. The Electrical Contractor shall be responsible for all required conduit, wire and line voltage (120v. and greater) terminations.
- E. All theatrical rigging and drapery equipment furnished under this section (other than required conduit, wire and back boxes) shall be installed after the work of all other trades has been substantially completed and cleaned up. Final project completion times, however, shall be met.

- F. Field Conditions: All bidders shall fully inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or item the bidder could have been fully informed of prior to the bid date
- G. Safety: The systems shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the users to arrange and operate a safe assembly and working environment for audience and user personnel.
- H. Insurance: In the absence of more stringent requirements, the Rigging Contractor shall maintain injury and property liability insurance coverage throughout the project's scheduled timetable, including workmen's compensation coverage for Contractor's employees.

1.3 CONTRACTOR QUALIFICATIONS

- A. Requirements: The Rigging Contractor shall be an approved rigging manufacturer or shall be an authorized representative or dealer of an approved manufacturer. The contractor shall have been installing stage-rigging systems for a period of five years or more, and shall have completed at least ten installations of this type and scope. The architect shall be the final judge of the suitability of experience.
- B. Approved Rigging Contractors: The Theatrical Rigging Contractor shall be one of the following accepted firms:

SECOA, Inc.
8650 109th Avenue North
Champlin, MN 55316
800 328 5519
Contact: Jeff Jones

Gopher Stage Lighting, Inc.
4141 Cedar Avenue South
Minneapolis, MN 55407
877 871 0138
Contact: John Becker

Texas Scenic Company
P.O. Box 680008
San Antonio, TX 78268
800 292 7490
Contact: John Owens

Main Stage Theatrical Supply, Inc..
8761 A Ely Rd.
Pensacola, FL 32514
800 851 3618
Contact: Dean Sternke

- C. Requirements for Approval:
Other contractors seeking acceptance must submit the following information at least 2 weeks prior to the bid opening date. Approval of contractors will be by addenda. Failure to submit any of the required information noted below will automatically be disqualify the contractor from consideration of approval.
- D. Provide a listing of 10 equivalent installations including:
1. Name, address and telephone number of Owner;
 2. Name, address and telephone number of architect;
 3. Scope of work.
 4. A brief written description of the contractor's operation including facilities, financial capabilities, and experience of key personnel.
 5. A statement from a bonding company agreeing to provide the required bonds in the amount required for the project.

1.4 SUBMISSIONS

- A. Bill of Materials: Bidders shall supply a complete bill of materials with their bids, identifying equipment and quantities being offered.
- B. Line item pricing for items indicated as "Future" shall be included in addition to the base bid.
- C. Drawings: Submit component and installation drawings and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation.
1. They shall be approved by the Architect before beginning any fabrication, installation or erection. Such approval does not relieve the Rigging Contractor of the responsibility of providing equipment in accordance with the specifications.
 2. Submittal drawings shall be presented at a scale not less than 1/4" for equipment layouts and 1/2" = 1'-0" for equipment details, mounting and other details. Each sheet shall allow space for approval stamps and have the name of the project, the contractors and/or the supplier's name, address telephone number, and the date submitted. Submit the following items for Architect's approval, prior to fabrication:
 - a. Stage plan view
 - b. Stage side section view
 - c. Gridiron layout indicating all stage equipment
 - d. Electrical riser diagrams indicating the necessary power and control wiring for all rigging equipment and systems
 - e. Plan and elevation views indicating all power, motor and control hardware locations and layout
 - f. Provide full dimensions for panel layouts with finishes and materials for all custom panels.
 - g. Details of installation and erection, including adjoining conditions and necessary clearances

- h. Indication by arrow and boxed caption of each variation from contract drawing and specifications, except those indicated as acceptable in specifications or on drawings.
- D. Catalog Cuts: In lieu of drawings, the Contractor may submit catalog cuts for standard equipment items. These must contain full information on dimensions, construction, applications, etc. to permit proper evaluation. In addition, they must be properly identified as to their intended use. Any options or variations must be clearly noted. Specific items from multiple lists, intended for use on this project, shall be highlighted.
- E. Schedule: Prior to the commencement of the installation work, the Rigging Contractor shall submit an outline of the proposed schedule and requirements for approval.

1.6 INSTRUCTION:

- A. Upon completion of the work, the Rigging Contractor shall submit (3) bound copies of a detailed Operating and Maintenance Manual including as-built shop drawings, equipment descriptions, and parts lists. The Rigging Contractor shall go through the manual with personnel designated by the owner and demonstrate and explain the maintenance and operation of the systems. A minimum of four hours of “hands-on” instruction shall be provided at a time mutually acceptable to owner and contractor.
- B. Signage with basic operating instructions and warnings shall be posted in the areas where the equipment will be operated. Signage shall be in conformance with ANSI-Z535.

1.7 WARRANTY

- A. The Rigging Contractor shall provide a three year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner’s representative. The guarantee shall not cover damage due to normal wear and tear, acts of God, neglect, or improper use of equipment. The Rigging Contractor shall provide any required maintenance or replacement within thirty days of notification by the Owner except for safety related items, which shall be corrected within 48 hours of notification. Subsequent to the expiration of the guarantee period the Rigging Contractor agrees to furnish repair and maintenance service, at the Owner’s expense, within thirty days of request for such service.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Theatrical rigging systems are specialized overhead lifting systems. Due to the highly specialized nature of these overhead lifting systems, and the safety requirements of the equipment, the rigging products provided for this work shall be the products of a single rigging manufacturer for consistency and ease of integration. Accessory items such as wire rope, fittings, curtain tracks, and the like may be from other specialty manufacturers.

- B. The rigging manufacturer must have the following programs in place. Approval to bid does not release the manufacturer from meeting these requirements:
1. The manufacturer must have a product testing program, including determination of recommended working loads for products based on destructive testing by an independent laboratory and review by an independent licensed engineer.
 2. The manufacturer of the stage equipment must have a documented quality management system that is audited annually by an independent third party registrar. The manufacturer's QMS shall be registered to the ISO 9001:2000 standard or equal.
 3. The manufacturer must carry primary product and general liability insurance of \$2,000,000 each, with excess liability coverage of \$10,000,000 and a Contractors Professional Liability policy with \$2,000,000 coverage.
- C. Approved Motorized Hoist Controls/ Motorized Hoist rigging systems are manufactured by:

J.R. Clancy, Inc
7041 Interstate Island Road
Syracuse, New York 13209
800-836-1885

ETC, Inc
3031 Pleasant View Rd.
P.O. Box 620979
Middleton, Wisconsin 53562
800-831-4116

Vortek, Inc.
7200 Rawson Rd.
Victor, NY 14564
585-924-5000

2.2 GENERAL STANDARDS

- A. Each hoist shall be fully tested under full rated load throughout its full travel distance with all its lift lines terminated to the hoist before the hoist is shipped from the manufacturer. Testing shall include:
1. Hoist operation
 2. Hoist/motor speed
 3. Lift line terminations under load
 4. Braking and stopping under load
 5. Load cell functions
 6. Slack line detection
 7. Position sensing
 8. Hoist noise

- B. A copy of all testing results must be furnished by the installing contractor to the architect, theatre consultant or owner's representative at the time of system commissioning. Manufacturers who cannot provide testing results shall not be acceptable.
- C. Only hoists that successfully pass pre-shipment testing shall be sent to any job site. A record of testing and its results shall be available for review at the manufacturer's facility for at least one year after testing.
- D. Paint as required under this section shall be the manufacturer's standard finish and color except as noted.
- E. All equipment items shall be new and conform to applicable provisions of Underwriters' Laboratories (UL), American Standards Association (ASA), American National Standards Institute (ANSI), National Fire Protection Association (NFPA) Life Safety Code 01, National Electric Code (NEC) and PLASA.
- F. Where acceptable equipment items are specified by catalog number only, device shall meet all published manufacturer's specifications. Where quantities or sizes are not given, refer to drawings. Where two or more products are listed, contractor may use either, at his discretion. Equipment shall not be substituted without specific written approval by the Architect under the substitution paragraphs of these specifications.
- G. All pipe battens shall be fabricated from 1.5" Schedule 40 pipe.
- H. All turnbuckles and cable clips shall be drop forged.
- J. All turnbuckles and clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.
- K. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
- L. In order to establish minimum standards of safety, a minimum factor of 8 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:

Cables and fittings	10 Design Factor
Cable bending ratio	26 times diameter
Max. fleet angle	2 degrees
Steel	1/5 of yield
Bearings	Two times required load at full for 2000 hours

2.3 HOISTS

- A. System Summary:
 - 1. Provide (4) Single speed, 2000 pound capacity hoists: Stage electrics.

2. Provide (2) Single speed, 1200 pound capacity hoists: Side tab curtains.
 3. Provide (17) Variable speed (0 – 120 fps) 1200 pound capacity hoists: Scenery and drapes.
 4. Provide (3) Single speed, 3300 pound capacity hoists: Orchestra shell ceiling units (FUTURE)
 5. Provide “Foundation” controller, E-stops and all related mounting and interconnection hardware to facilitate a complete installation.
- B. Hoists shall be purpose-designed and fabricated for overhead lifting of theatre lights, equipment, curtains and scenic elements, whether used on stage, in the auditorium or other places of public assembly where people shall move beneath the suspended or moving load. The systems shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment; they shall provide an engineered, efficient device for overhead lifting. The mechanical, electrical and safety features of this hoisting and control system shall establish the standard of quality, performance and safety by which hoisting systems of other manufacture shall be evaluated. (NOTE: The ETC, Inc. “Prodigy” Hoist system is referenced herein as a standard of quality and safety. Alternate products must meet or exceed these standards.)
- C. Each wire rope lift line shall adhere to a design factor of 10:1 with an ultimate strength of 7000 pounds. All load path components between the building structure and the batten shall exceed the breaking strength of the wire rope. The motor brake shall be rated at least at 125% of the motor torque.
- D. Standard configured hoists shall be capable of supporting a live load as follows:
1. General purpose Variable Speed 0-180 fpm, 1200 pound capacity in standard configuration. Powerhead shall measure no more than 24” high x 12” w x 96” long and weigh 700 pounds.
 2. General purpose 20 fpm 2,000 or greater pound capacity in standard configuration. Powerhead shall measure 24” high x 12” w x 96” long and weigh 700 pounds.
 3. Stage Electric 20 fpm 2,000-pound capacity in stage electric configuration. Powerhead shall measure 24” high x 12” w x 96” long and weigh 700 pounds.
- E. The standard general purpose hoist shall consist of the following major components: 1) Powerhead, 2) Powerhead support framework, compression tube with beam clamps (if required), loft blocks, lift line and lift line terminations, Rotational Cable Adjuster (ROCA) and 3) pipe batten. Hoist mechanism side covers shall be provided to protect machinery from dust and debris.
- F. The standard stage electric hoist shall consist of the following major components: 1) Powerhead, 2) Compression Tube with beam clamps, cable management system, loft blocks, lift line and lift line terminations Rotational Cable Adjuster (ROCA), 3) pipe batten and power/control distribution strip (if not provided in “dimming and distribution” package). Hoist mechanism side covers shall be provided to protect machinery from dust and debris.
- G. The hoist shall include the following features:
1. A Power head containing the following elements: the gear motor, motor brake, load brake, limit switches operating electronics, load sensor, slack line detector, absolute position sensors, cable drum assembly, and wire rope.

2. Optional Compression Tube (if required) that prevents hoist system lateral forces from transferring to the building. Hoists or hoisting systems that impose a lateral load on the building shall not be acceptable.
 3. The hoist shall incorporate a built-in load cell.
 4. The hoist shall incorporate a built-in slack line sensor.
 5. The hoist shall include the emergency contactor built into the hoist.
- H. The hoist shall be manufactured from UL Listed components and shall be UL Listed and tested as a complete system (not just UL listed parts).

2.4 POWERHEAD

- A. The Powerhead shall be a fully enclosed housing that shall prevent contact with moving and electrical parts and shall provide protection against dirt, dust and debris.
- B. For setup and maintenance, the following functions shall be available from the Powerhead: power and operating switches, address setting knobs, limit switch setting knobs, limit switch override button, indicators for power, status and communication. Each of these functions shall be clearly labeled.

2.5 GEARMOTOR AND MOTOR BRAKE

- A. The gear motor and motor brake shall be an integral unit from a single manufacturer. It shall operate on 208 Volt or 480 Volt 60 Hz, 3 phase current for fixed speed units and 480 Volt, 60 Hz, 3 phase current for variable speed hoists.
- B. The motor brake shall be integral to the gear motor and shall be capable of holding 125% of the motor full load torque.
- C. The motor brake shall be electrically actuated to apply and hold braking force.
- D. The motor brake shall be magnetically released and held open upon actuation.

2.6 LOAD BRAKE

- A. Fixed Speed Hoists
 1. The rotary disk load brake shall bring the moving load to a complete stop and shall hold the load in position in the event of a mechanical failure of the motor, motor brake or gearbox.
 2. Noise from the load brake shall be minimally audible at any time in the operational cycle.
 3. Normal hoist operation shall not be limited by heat or noise caused by the load brake.
 4. The load brake shall be electrically mechanically released when the load is moving in the up direction. The load brake shall be closed when the hoist has stopped. The load brake shall always be engaged when the load has stopped moving either up or down. When lowering the load the load brake shall partially disengage to allow and control descent of the batten. The load brake shall remain closed in the absence of rotational torque on the gearbox.

B. Variable Speed Hoists

1. The rotary disk load brake shall open upon activation of hoist movement and shall close after the load has come to a stop; it shall hold the load in position.
2. Noise from the load brake shall be minimally audible at any time in the operational cycle.
3. Normal hoist operation shall not be limited by heat or noise caused by the load brake.
4. The load brake shall be electrically mechanically released when the load is moving either up or down.

2.7 WIRE ROPE DRUM

- A. Shall wrap up to eight 1/4" diameter 7 x 19 galvanized aircraft (utility) wire rope lift lines up to 75' long in a compact manner on the cable drum. They shall be managed by a wire rope (cable) keeper integral to the Powerhead. The drum design shall prevent wire rope from tangling or crossing over itself.

2.8 LIMIT SWITCH

- A. A limit switch assembly shall be mounted within the Powerhead for hard "normal" and "ultimate" end of travel limits. Hard end of travel limits shall be set/adjusted at the time of installation aided by an indicator light visible on the bottom panel of the Powerhead cover. Any system that indicates that the limit has been set by audible or tactile means only shall not be acceptable.

2.9 LOAD SENSOR/LOAD PROFILING.

- A. A load sensor shall be built into the Powerhead to create a profile of the actual load on the hoist as it travels through its normal cycle. The profile may be changed by "re-training" the profiling system whenever the suspended load is changed on the batten by activating a key-switch operated training cycle on the motor controller. The load sensor shall continuously monitor the load when load sensing is turned on.

2.10 POSITION SENSOR

- A. A position sensing system shall be built into the Powerhead to provide accurate position information. The system shall consist of two absolute sensor types that provide accurate position information for each batten at power-up of the system. Hoisting systems that require re-homing shall not be acceptable.

2.11 SLACK LINE DETECTOR

- A. The slack line detector shall be built into the Powerhead. When a slack line condition in excess of 15" develops in a lift line, the slack line detector shall remove power from the hoist. The batten shall be allowed to move only in the upward direction to allow removal of the cause of the slack line fault.

2.12 LOCAL USER INTERFACE AT POWERHEAD

- A. User interface at the Powerhead control panel at the rear of the hoist shall include:
 - 1. Hoist Up/Down Control
 - 2. Limit Switch override buttons (tool accessible)
 - 3. Address switches
 - 4. Status LED's

2.13 INFORMATION STORAGE WITHIN POWERHEAD

- A. Record of severe fault conditions with date and time stamp
- B. Record of E-stops, overloads, moves and power cycles
- C. Record of travel distance and peak loads since installation/inspection

2.14 BEAM CLAMPS

- A. Beam clamps shall be capable of attaching to horizontal beams, joists, truss flanges or flat steel plates measuring from 3/8" thick up to 1" thick and from 4" wide up to 14" wide placed no more than 14'-0" apart. P75, P1200VS, P2000G, P2000E and P3300G Powerheads may be mounted on 3/8" thick x 4" wide or larger steel structures if deemed sufficient by a structural engineer. Support structures must be deemed sufficient by a structural engineer to support any forces imposed by the hoisting systems. Beam clamps shall accommodate up to 1/2" vertical misalignment.
- B. Hoist systems that do not neutralize hoist generated lateral forces on the building shall not be accepted for this project.

2.15 LOFT BLOCKS

- A. Each loft block shall be an assembly of steel side plates, a wire rope idler, sheave, bearings, shaft locked against rotation and support hardware. Each loft block shall be inserted into the slot on the bottom of the Compression Tube. The blocks shall be positioned no closer than 4'-0" from each other, unless mulled.
- B. Loft block sheaves shall a D:d ratio of 26:1 minimum and contain a pair of press fit sealed ball bearings. Lift lines shall travel in a groove shaped and sized for 1/4" diameter wire rope per the latest edition of the Wire Rope Users' Manual as published by the Wire Rope Technical Board. The loft block sheave shall be concentric about the hub and shall be evenly balanced for ease of rotation.
- C. An idler shall be incorporated into the top assembly of the loft block to guide and support lift lines as they pass the block.

- D. Hoisting systems requiring the loft blocks to be mounted directly to the facility structure shall not be accepted for this project.

2.16 LIFTLINE TERMINATIONS

- A. Each lift line shall be terminated in the Powerhead via a standard copper oval compression sleeve installed/crimped at the factory.
- B. Lift lines shall be terminated at the load hanger with a low profile Rotational Cable Adjuster (ROCA) TM, thimble and copper oval compression sleeve. The ROCA and cable terminations at the batten shall be installed at the time of hoist installation.
- C. Batten trim shall be adjustable up to 6" via the ROCA.
- D. Systems utilizing turnbuckles or chain to trim the batten shall not be accepted for this installation.

2.17 HANGERS

- A. Raceway hangers (as coordinated with the distribution equipment specified under Division 116700), shall be specially shaped flat bar that shall support the wire rope termination hardware and secure the raceway and the pipe batten.

2.18 CABLE MANAGEMENT FOR ELECTRICS

- A. Provide industry standard SO cable support, strain relief, cable cradles and required lift lines in coordination with the dimming, control and distribution equipment as specified under Division 16700.

2.19 PIPE BATTEN

- A. The pipe batten shall be 1½" schedule 40 grade A, seamless pipe fabricated in the largest possible lengths without splices. Battens of greater length shall be spliced by means of .120 x 1 9/16 dia. DOM tube 18" long with 9" of tube inserted into each half of the splice. The tight fitting splice tube shall be held in place by a pair of 3/8 x 2 ½" grade 5 hex bolts on each side of the joint. The bolts shall pass through the pipe at an angle of 90° to each other. There shall be two bolts on each side of the joint spaced 1" and 8" from the joint. Alternatively, one pair of bolts on one side of the joint may be replaced with either plug welds or tight fitting steel rivets. Pipes shall be straight and painted flat black.
- B. A safety-yellow batten cap shall be installed at each end of each pipe batten.
- C. The manufacturer shall provide up to four self-adhesive labels for each batten on which the rated batten load shall be written by the installer.

2.20 POWER AND CONTROL DISTRIBUTION RACEWAYS (PCD-R)

- A. Each hoist shall receive power and control via a pair of 8'-0" long jumper cables extending from the Powerhead to the source outlets. Receptacles shall be installed in a sheet metal junction box or trough with outlets. Each outlet shall be located no more than 6'-0" away from the rear face of each hoist.
- B. Each Power head shall include a power cord hardwired to the hoist with an appropriately sized twist lock connector at the PCD end and a removable control cable with a circular 9-pin connector at each end. Inclusion of a 20 amp 3-phase breaker in the PCD is optional. The wiring and connectors shall be barriered between high and low voltage.
- C. Provide PCD raceway as shown on drawings.
- D. The power/distribution channel shall be UL LISTED for this application.

2.21 FOUNDATION VARIABLE SPEED CONTROL SYSTEM

A. GENERAL

- 1. The entire motor system shall be operated by an Electronic Theatre Controls (ETC) Foundation rigging control system. It shall be purpose-designed and fabricated to manage and operate motors specifically designed for overhead lifting. The System shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment and shall provide an engineered, efficient device to control the equipment. The mechanical, electrical and safety features of this control system shall establish the standard of quality, performance and safety by which motor systems of other manufacture shall be evaluated. The controller shall be capable to control up to 48 motors. The controller shall provide two connections for motor communication, supplying up to 24 motors per connection.
- 2. The Foundation control system shall consist of a surface or panel mounted primary controller and up to six optional external E-stop stations.
- 3. The controller shall be UL Listed and shall be fabricated from UL Listed components.
- 4. The Emergency Stop and Hold-To-Run (Dead-man) signals between the control station and the motor starters or drives in the motors shall be hard wired 24 Volt signals.
- 5. Systems that rely on software and bus communications to transmit Emergency Stop or Hold-to-Run signals shall not be acceptable.
- 6. The communication protocol shall be RS-485. Systems that use TCP/IP as a communication protocol shall not be acceptable.
- 7. Only physical, industrial heavy-duty pushbuttons shall create a "dead-man" signal. The "dead-man" operation is required, so that the operator must be at the console and pressing a button to initiate and continue motion.
- 8. For safety, no movement shall be permitted to be initiated from the touch screen. Systems that allow movement to be initiated from the touchscreen shall not be permitted.
- 9. Systems that allow motors to run without an operator actively present at the console shall not be permitted.

10. The system shall not contain any permanently moving components (like hard drives or fans) and shall be maintenance free and completely quiet during operation. Systems that contain permanently moving components shall not be acceptable.
11. The control system shall only employ the FOUNDATION controller, a power and control distribution infrastructure and the motors. A System that requires separate drive cabinets or motor-starters shall not be acceptable.

B. ENCLOSURE

1. The side panels of the control system shall be machined out of solid Aluminum. The thickness shall be no less than 1/4".
2. The wall mount bracket and face panel shall be fabricated from 16ga powder coated sheet steel specially formed to provide support for the installation.
3. The control section of the system shall be lockable by rotation of the entire surface. The system shall provide a physical lock, once it is in the closed position
4. Controllers that do not have a physical cover and lock for the operating controls shall not be acceptable.
5. An optional rack mount bracket shall be available.
6. An optional lockable touchscreen cover shall be available.
7. The Foundation face panel shall be printed with complete labeling information to identify the function of each of the buttons in the control station.
8. The face panel shall identify the system as a Foundation controller for stage rigging.
9. The wall mount bracket shall be mountable independently from the control station. It shall be possible to run in and terminate all wires on connectors just with the installed wall bracket.
10. The entire control panel shall be easy to connect to the wall bracket. All electrical connections shall be made via touch safe connectors. The system shall be closed up by concealed screws.
11. A system that relies on directly terminated / non-connectorized building wires to the control system shall not be acceptable.
12. The Foundation controller shall run on 100V to 240V AC 50/60Hz, 2A max Power

C. BUTTONS AND JOYSTICK

1. The control system shall include one power button with a power indication LED.
2. The control system shall include one readily accessible USB port for the connection of a USB memory stick for the use with show file transfer, inspection reports, log files and software updates.
3. The control system shall include two illuminated and dimmable "GO" buttons.
4. The control system shall include one proportional joystick
 - a) The position sensing shall be done by an absolute hall effect encoder
 - b) Joysticks that rely on analog pots or incremental encoders shall not be acceptable
 - c) The joystick shall incorporate one dead man button
 - d) The joystick shall incorporate 2 RGB LED illuminated and dimmable indication areas that allow indication of the direction, function or status of the Joystick.

D. E-STOP

1. The E-stop button on the FOUNDATION controller shall be an NFPA-79 compliant mushroom head button with an illuminated ring surrounding the button.
2. During normal operation the E-stop button shall be in the out position. An E-stop can be activated via this button by firmly pressing the button in. The button shall latch and immediately cause all motors in the system to stop motion.
3. To continue system operation the E-stop button must be cleared at the station where it was pressed by twisting the button to release the latch. The E-stop must be acknowledged at the control station where it was activated before any new movement can occur.
4. The operator shall acknowledge the end of an E-stop condition. At that time the control system shall initiate an automatic self-test of the system safety functions including safe opening of all E-stop contactors.
5. The illuminated ring around the E-stop button shall change intensity depending on whether the system is moving or not. The transition between low and high intensity shall be a smooth fade. The intensity levels shall be adjustable at the time of installation or service.
6. The illuminated ring around the E-stop button shall blink in case of an E-stop condition.
7. In addition to the E-stop station at the main control panel, up to six external E-stop stations may be connected to the system. Each external E-stop station shall operate in the same way as the primary E-stop at the FOUNDATION control panel.
8. The LCD screen shall report the E-stop as an E-stop condition.
9. The report shall indicate if the activated E-stop was the internal one, the one on the remote control or one of the external stations.
10. The E-stop system shall be completely hard-wired. A system that relies on software or bus system to transmit E-stop signals shall not be acceptable for this installation.
11. The E-stop signal shall be provided in parallel to all E-stop contactors in the motors. A single E-stop contactor failure shall only affect a single motor.
12. Serial wiring of the E-Stop signal from motor to motor shall not be acceptable.

E. LCD SCREEN

1. The graphic LCD screen shall be a 15'' full industrial grade graphics type to communicate all information in symbols, colors and easily readable text
2. The display shall be illuminated.
3. The FOUNDATION control system shall employ an ambient light sensor and proximity sensor. Controllers without ambient light and proximity sensors shall not be acceptable.
4. All intensities of all indicator lights and LCD intensity shall be dimmable and shall automatically adjust based on ambient light conditions.
5. If the control system is not used for a pre-determined time, the intensities shall dim. When the proximity sensor is actuated, the intensities shall dim up again.
6. The screen shall employ a multi-touch sensor that allows for gesture control like zooming and scrolling. Controllers without multi-touch touchscreens shall not be acceptable.
7. Readout language may be selected to be English, Spanish, French or German.
8. It shall be possible to look at all motors or only a sub set, based on a flexi-channel filter.

F. USER ACCESS LEVELS

1. Upon completion of the startup sequence the display shall indicate that the system is “OK” or shall provide specific information should a fault in the self-test occur.
2. Fault conditions shall be reported in easily readable text. Any system that reports fault conditions in a pattern of illuminated lights or a series of blinking lights shall not be acceptable for this installation.
3. The FOUNDATION system shall provide at least the following access levels
 - a) Emergency User
 - b) User
 - c) Power User
 - d) Administrator
 - e) Commissioning
 - f) Inspection
4. These levels shall be unlocked either by a user name and pin code or via a USB dongle
5. It shall be possible to call the manufacturer to retrieve a 3-day temporary access code for any access level for the specific control system.

G. OPERATION

1. The LCD screen shall provide a display of the motor name and number, its current position above the floor, the amount of weight suspended from the batten, preset position recorded, as well as a bar graph scale that shows the current position of the motor and the current weight suspended by the motor.
2. Fault conditions shall be displayed in red or orange, depending on the severity of the condition
3. Position readout and position entry shall be in feet and inches, in decimal feet or in metric dimensions.
4. The weight readout shall be in pounds or kilograms.

H. MANUAL OPERATION

1. In manual operation, it shall be possible to select one or multiple motors and then directly move the selected motors by the means of the joystick
2. The user shall have the ability to change the name of a motor
3. The user shall have the ability to add a comment for each motor
4. The user shall have the ability to store the following trims
 - a) High trim (soft upper limit)
 - b) Low trim (soft lower limit)
 - c) 8 intermediate trims
 - d) 2 system wide trims
5. These trims shall be usable as references in presets and cues

6. The user shall have the ability to directly enter a numeric target position

I. PRESET OPERATION

1. The system shall provide the capability to store presets with numbers ranging from 1 to 999.
2. The user shall be able to add individual motors with specific positions to presets
3. The user shall be able to name each preset
4. The user shall be able to add a comment to each preset

J. CUE STACK OPERATION

1. The system shall provide the capability to store cues with numbers ranging from 1.00 to 999.99.
2. The user shall be able to add individual motors with specific positions to cues
3. The system shall be able to display multiple cues with their stored motors and positions at the same time in spreadsheet type view.
4. For each cue, it shall be possible to assign:
5. One total move speed for all motors
6. Different move speeds and wait times for all up- and downwards moving motors.
7. Individual move speeds and wait times for each motor in the cue
8. One total move time for all motors
9. Different move and wait times for all up- and downwards moving motors.
10. Individual move and wait times for each motor in the cue
11. It shall be possible to enter a cue playback rate that re-calculates the times or speeds of the cue.
12. In playback, it shall be possible to start a selected cue with either one of the two "GO" buttons
13. During playback, it shall be possible to override the playback speed with the joystick. The joystick shall indicate this function via a specific color code.
14. On completion of a cue, the next cue shall automatically be loaded
15. It shall be possible to start the next cue(s) while the current cue is still running.
16. The control system shall display the current cue and additionally several cues and the respective motors, targets, speeds and speeds in a spreadsheet pattern
17. The control system shall display the remaining time of a running cue

K. FILE OPERATION

1. The control system shall provide the means of storing at least 10,000 different show-files on the internal hard-drive.
2. The control system shall provide a means to store and read show-files to/from a USB thumb drive.

L. HELP SYSTEM

1. The control system shall provide an online help system embedded in the console software, accessible to all user levels.

M. REMOTE CONTROL PENDANT

1. An optional remote control pendant with a 50'-0" long attached cable and plug shall be provided for the system. The remote control shall connect to the FOUNDATION control system via a connector on a 2-gang wall plate.
2. The remote control pendant shall provide an up, down and E-Stop button.
3. The remote control shall provide up/down control for those motors that have been selected at the FOUNDATION controller.
4. When the remote control is plugged in the E-stop on the remote control shall be activated.
5. When the remote control is unplugged, the E-Stop system shall seamlessly and automatically bypass the connector. This bypass system shall be achieved by a redundant means and shall be monitored and frequently tested for proper functionality.
6. A "shunt-plug" to achieve this function shall not be acceptable

N. REMOTE ENABLE / GO PENDANT

1. An optional remote enable pendant with a 50'-0" long attached cable and plug shall be provided for the system. The remote control shall connect to the FOUNDATION control system via a connector on a 2-gang wall plate.
2. The remote enable pendant shall provide an Enable / Go button and an E-Stop button.
3. The connector shall be the same as for the remote control and the same E-Stop bypass principles shall apply.

O. SYSTEM DIAGNOSTICS

1. Upon energization of the control system shall automatically perform a series of diagnostic tests that assures the proper functionality of all system safety functions. Should an error in the safety functions be determined, the controller shall report back a fault condition on the LCD display and shall identify the nature of the fault in easily readable text form.
2. Should the controller be continuously energized, the system shall automatically perform a series of diagnostic tests every 30 days to determine if there are any problems with any portion of the motor control system safety features. In the event of a problem, the controller shall report back a fault condition on the LCD display and shall identify the nature of the fault in readable text form.
3. The automatic self-tests shall include a complete test of all Emergency Stop contactors for their respective ability to shut down all hoists.
4. All faults and failures shall be displayed on the control station as a color indication of the respective motor and additionally as easily readable text.
5. The system inspection reminder shall show the number of days remaining until the system inspection, or the number of days the inspection is overdue.
6. A failure of the Load Cell, Encoders or a wiring issue shall be automatically detected during machine standstill and motion.

7. Motor, brake resistor or drive over-temperature shall be detected and shall stop the motor.
8. The motor direction shall be detected and the system shall automatically be stopped if the command direction differs from the actual movement direction.
9. A failure of the chain between the drum and the limits shall create a fault condition and stop the motor.
10. The number of simultaneous moving motors shall be limited in the control system in order to reduce the maximum dynamic load to the building structure.
 - a) The system shall trip out the control system if more than the allowed amount of motors are about to start to move
 - b) This system shall react before the motors start to move to avoid even the initial startup load impact
 - c) The setting for this limit shall allow a granularity of 1 motor increment.
 - d) This system shall be executed in pure hardware.
 - e) This system shall have redundant software back up.
 - f) Systems that solely rely on software to achieve this function shall not be acceptable.
11. Eleven months after a system inspection has been performed, the system shall remind the user to schedule a full system maintenance/inspection. The reminder shall remain visible in the system until it is turned off by the factory authorized and trained inspector.

P. MONITORING AND MOTOR HISTORY

1. The system shall automatically keep track of system and motor history.
2. Each fault condition shall be logged with a time and date stamp. Logging of the motor events shall continue to function while the main control station is turned off or while the motor is not connected to the rest of the system.
3. The control system shall keep a log of the distance traveled and peak load for each motor. There shall be separate entries of this data for “Since the last inspection” and “Since time of manufacture.”
4. The data shall be accessible during inspection. It shall be downloadable in an Excel compatible file format.
5. A control system that does not provide logging shall not be acceptable.

Q. CONFIGURATION

1. The control system shall provide all configuration software “on-board”.
2. It shall be possible to configure all motor functions through the control system at the control panel. A system that requires an additional computer or laptop connected to the motor or the system shall not be acceptable for this installation.
3. The configuration software shall allow easy and simple configuration of the system by factory trained and authorized installers.

R. INSPECTION

1. On-Board software shall allow easy and quick annual inspection of the control system functions by a factory trained and authorized inspector.

- a) The inspection software shall automatically provide inspection relevant data to the inspector, such as peak load and travel distance.
 - b) The software shall guide the inspector through a number of inspection tasks.
 - c) The software shall automatically recognize safety relevant signals (E-stop, Limit Switches).
- 2. The inspection software shall automatically fill in an inspection report and generate a PDF file that can be stored on a USB thumb-drive.
 - 3. The inspection report shall include a 2D barcode that encodes a copy of the inspection data and a checksum that can be utilized to validate the inspection report.

PART 3 PIPE GRID (BLACK BOX THEATRE)

- A. Pipe grid shall be constructed from lengths of 1-1/2" nominal I.D. schedule 40 steel pipe. All joints shall be sleeve spliced with 18" long sleeves with 9" extending into each pipe and held by two 3/8" hex bolts and lock nuts on each side of the joint. Grids shall be installed as indicated on the drawings with pipes intersecting on five-foot by five-foot centers.
- B. Intersecting pipes shall be joined with a Clancy #015-100 Cross Grid Connector or by an approved equal. The cross grid connector shall have a recommended working load of at least 2,500 lbs.
- C. Each pipe shall terminate just off the wall except as noted. Internally sleeved wall plates shall securely brace the grid against the wall once it is in place. Supply sufficient braces to prevent lateral movement of the pipe grid.
- D. The grid shall be hung from the overhead steel structures on centers not exceeding 8 feet in either direction using 1/4" 7x19 galvanized aircraft cable (or equivalent capacity welded, proof coil chain or threaded rod) ending in 6" x 3/8" forged turnbuckles attached to appropriately rated pipe clamps. At each hanging point the cable shall attach to the overhead structure with an appropriately rated fitting. Cables shall be formed over thimbles of correct size and fastened with two forged cable clips or Nicopress sleeves crimped three times. Turnbuckles shall be moussed after final trim.
- E. All pipe, fittings and related hardware shall be painted black.

PART 4 EXECUTION

4.1 INSTALLATION

- A. The Rigging Contractor shall be responsible for storage of stage equipment, tools, and equipment during the period of the installation.
- B. Extent: All specified equipment shall be installed by fully trained superintendents and workmen. Equipment shall be installed in a workman like manner, per plans and specifications. Equipment shall be aligned, adjusted, and trimmed for the most efficient operation, the greatest safety and for the best visual appearance.

- C. Standards: Installation practices shall be in accordance with OSHA Safety and Health Standards and all local codes. All welding must be performed in full compliance with the latest edition of the Structural Welding Code (ANSI/AWS D1.1).
- D. Alignment: Mule blocks, cable rollers and guides shall be installed, as required, to provide proper alignment, to maintain specified fleet angles, and to prevent contact with other surfaces.
- E. Attachments: All equipment shall be securely attached to the building structure. Under hung blocks and mule blocks shall be welded in place unless otherwise directed.
- F. Finishes:
 - 1. All welds must be touched up to match disturbed finishes.
 - 2. All finishes which are disturbed during shipping and installation shall be touched up to match the original.

4.2 CLEAN UP

- A. The Contractor shall be responsible for clean-up, including removal of packing materials etc. and the protection of surfaces or equipment provided by other contractors.

4.3 INSPECTION AND TESTING

- A. Inspection: During the installation of equipment the Rigging Contractor shall arrange for access as necessary for inspection of equipment by the Owner's representatives.
- B. System Pre-Testing By Rigging Contractor: On completion of installation and testing the Rigging Contractor shall conduct a complete pre-test of the system to ensure it is working properly and in conformance with this specification. This shall include a complete test of all electrical systems and components. All tests shall be conducted as if the Architect or Consultant were present and appropriate corrections made before the final inspection.
- C. Special Testing: If specifications, the Architect's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Rigging Contractor shall give the Architect timely notice of its readiness for inspection, and of dates of inspections to be made by other authorities.
- D. Completion Testing: Upon completing the installation of all equipment specified under this section, the Contractor shall notify the Architect, who will schedule an inspection. At the time of inspection, the Rigging Contractor shall furnish sufficient workers to operate all equipment and to perform such adjustments and tests as may be required by the Owner's representative. Any equipment, which fails to meet with approval, shall be repaired or replaced with suitable equipment and the inspection shall be re-scheduled under the same conditions as previously specified. At the time of these inspections, no other work shall be performed in the auditorium and stage areas. All temporary bracing, scaffolding, etc. shall be removed to permit full operation of, and access to, all equipment. Final approval will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every particular.

4.4 FOLLOW-UP INSPECTION

- A. One year after the completion of installation, the Rigging Contactor shall return to the site and provide the following services:
 - 1. Complete inspection of the rigging system,
 - 2. Make all required adjustments,
 - 3. Correct all warranty items,
 - 4. Written recommendations for necessary repairs or changes not included in the warranty,
 - 5. 1-hour rigging operation and safety class, and written proposal for the next year's maintenance visit.

PART 5 STAGE CURTAIN SPECIFICATIONS:

- A. Description: Curtains shall be manufactured in accordance with the following: (SEE RIGGING and DRAPERY SCHEDULE BELOW)
- B. Fabric types:
 - 1. KM Fabrics Encore Velour. Inherently flame resistant 22-ounce polyester. Color: Black.
 - 2. KM Fabrics Prestige Velour. Inherently flame retardant 26-ounce polyester. Standard color as selected by owner's representative.
 - 3. KM Fabrics Princess Velour. Inherently flame retardant 16-ounce polyester. Color: Black
- C. Flame Retardancy: Cotton fabrics and other flammable fabrics must be chemically mill treated for flame retardancy according to the requirements of the National Fire Protection Association's NFPA #701.
- D. Fullness: See above for fullness of each curtain.
0% = flat, no extra material.
50% - 100% = additional fabric to be included, exclusive of turn backs and hems.
- E. Seams: Seams between strips shall be single stitched without puckers using thread of matching color. All fabrics with a grain or pile shall have all strips running in the same direction.
- F. Pleats: Pleats shall be box type on 12" centers. Valances and borders are to have their pleats arranged to conceal the seams.
- G. Top Finish: 3-1/2" jute webbing shall be double stitched to the top of the curtain with 1" of face fabric turned under the webbing.
 - 1. Brass rustproof grommets shall be inserted in pleat centers (12" centers on flat curtains). Grommets shall be used as follows:
 - #2 grommets - muslin, lightweight fabrics.
 - #3 grommets - unlined velour, medium weight fabrics.
 - #4 grommets - lined velour, heavy weight fabrics.

2. Track-mounted curtains shall be supplied with plated wire S-hooks or CCF-2 curtain to carrier snap hooks. Batten-mounted curtains are to be supplied with 36" braided #4 cotton tie lines. Tie lines shall be black or white to best match the curtains with the centerline in alternate color to aid in hanging curtains.

H. Bottom Hems:

1. Valances and borders shall have 4" bottom hems.
2. All full height curtains shall have 6" bottom hems complete with separate interior chain pockets filled with #8 plated jack chain. Chain pockets shall be stitched so that the chain will ride 2" above the finished bottom edge of the curtain.
3. Scrims, drops and cycloramas shall have an additional pipe pocket sewn to the back of the hem and shall be furnished with a 3/4" pipe batten, threaded and coupled every 10 feet.

I. Side Hems:

1. House (Main) Curtain shall have 1/2 width of face fabric turned back at the leading edge.
2. All lined traveler curtains shall have 1/2 width of face fabric turned back at the leading edge.
3. All other side hems shall be 2".

J. Lining: Lining, as required, shall conform to the following requirements:

1. Lining shall be in the same fullness as face fabric.
2. Lining shall finish 2" shorter than face fabric.
3. Lining shall be attached to the face fabric along the bottom hem at seams by 4" long heavy woven cotton tape.

PART 6 TRACKS

A. Traveler Curtain Track:

1. Track shall be of 14 gauge, galvanized construction, entirely enclosed except for the slot in the bottom. Each section of track less than 20 feet shall be in one continuous piece. Splice clamps shall be permitted for section lengths over 20 feet.
2. Carriers shall be constructed of nylon, supported from two heavy-duty polyethylene wheels held in the ball bearing by a nickel-plated steel rivet. Each carrier shall be equipped with a free-moving swivel and sufficient trim chain to accommodate a curtain S-hook. Each carrier shall have a back-pack. Rubber washers shall be provided between each back-pack and carrier to reduce noise.
3. The Master Carrier block shall be constructed of plated steel having two cable clips to clamp the cord to the carrier. Four wheels in pairs identical to the single carrier above shall support the block.
4. Live and dead end pulleys shall be adjustable, equipped with oil-impregnated sleeve bearing wheels on adequately guarded plated steel housings. End stops at each track end and one adjustable, demountable floor pulley shall be furnished. Stretch-resistant, fiberglass center operating cord shall be 3/8" in diameter.

11 61 33-22

5. Track shall be rigged for bi-parting operation with a 36" center overlap. Hanging clamps will be provided for suspension at six-foot maximum intervals.
6. ADC # 282 track assembly, _____ ft. long. (SEE SCHEDULE below and related drawings.)

B. Side Tab Track

1. Track shall be galvanized steel construction.
2. Each curtain carrier shall be spaced on 12" centers and shall be of steel construction to include two, nylon-tired ball bearing wheels rolling on two separate parallel treads.
3. Each carrier shall contain a free moving plated swivel to accommodate curtain snap hook.
4. Two rubber bumpers shall be attached to each carrier to function as noise reducers.
5. Track shall be rigidly supported from ceiling clamps or hanging clamps on four-foot maximum centers.
6. ADC # 173 walk-along track assembly, _____ ft. long. (SEE SCHEDULE and related drawings.)
7. All walk-along track used in this project shall be coated in a chip-resistant black finish.

PART 7 RIGGING AND DRAPERY SCHEDULE (See Drawing TR 2)

NOTE: The line-sets marked "future" as indicated below shall not be included in the base bid. However, space to accommodate them shall be allowed in the system layout. Provide winch power and control capability in the base bid.

Line #	Purpose	Dist. from Prosc	Capacity	Winch/ Batten type	Drapery Fabric	W x H	Fullness	Color
1.	Valance	+ 0-10	1200#	VS/A	I	56 x 8	0%	TBD
2.	Front Curtain	+ 1-10	1200#	VS/B	I	(2)@28x25 (add lining per specs)	75%	TBD
3.	Scenery	+ 2-10	1200#	VS/A				
4.	# 1 Electric	+ 4-10	2000#	SS/C				
5.	Border #1	+ 5-10	1200#	VS/A	II	56 x 8	0%	Black
6.	Legs # 1	+ 6-10	1200#	VS/A	II	12 x 25	0%	Black
7.	Shell # 1 (future)	+ 8-4	2000#	SS/B				
8.	Scenery	+ 9-10	1200#	VS/A				
9.	Border # 2	+10-10	1200#	VS/A	II	56 x 8	0%	Black
10.	Legs # 2	+11-10	1200#	VS/A	II	(2)@12x25	0%	Black
11.	# 2 Electric	+13-4	2000#	SS/C				
12.	Scenery	+14-10	1200#	VS/A				
13.	Border # 3	+15-10	1200#	VS/A	II	56 x 8	0%	Black
14.	Mid-stage Traveler	+16-10	1200#	VS/B	II	(2)@ 28x25	50%	Black
15.	Shell # 2 (future)	+18-10	2000#	SS/B				

11 61 33-23

16. Scenery	+19-10	1200#	VS/A					
17. # 3 Electric	+21-4	2000#	SS/C					
18. Shell # 3 (future)	+23-4	2000#	SS/B					
19. Border # 4	+24-10	1200#	VS/A	II	56 x 8	0%	Black	
20. Up-stage Traveler	+25-10	1200#	VS/B	II	(2)@ 28x25	50%	Black	
21. Scenery (Scrim)	+26-10	1200#	VS/A	III	56 x 25	0%		
22. # 4 Electric	+28-4	2000#	SS/C					
23. Scenery	+31-4	1200#	VS/A					
24. Cyclorama	+32-4	1200#	VS/A	IV	56 x 28	0%	CBS Gray	
25. SL Tab	32' SL of Center	1200#	SS/D	II	10 x 25	0%	Black	
26. SR Tab	32' SR of Center	1200#	SS/D	II	10 x 25	0%	Black	

Black Box Theatre	V	(17)@12x16-0	0%	Black
TV Studio	V	(6) @ 8x10-0	0%	Black
Band Practice Room	V	(2) @30w x 10	50%	TBD

NOTE: Theatrical contractor shall furnish and install 1-1/2" Schedule 40 Black steel pipe in TV Studio as indicated in plans. See sheet TR-5, A2.02F and E2.02F

Winch types: Packaged Hoist: ETC, Inc. "Prodigy Series" or equal by J.R. Clancy or Vortek, Inc. Speed and capacity as noted.

SS: Single speed: 20 FPM

VS: Variable speed: 0 – 120 FPM.

Batten types:

A. Standard batten. 58'-0" length, 1-1/2" Schedule 40.

B. Truss batten (2 pipes with 1' - 0" spacers) for shell ceiling. 58'-0" length (Coordinate with shell contractor.)

C. Stage electric, double-hung (truss, 2 pipes with 2' - 4" spacing), 58'- 0" length

D. Tab batten, 24'-0" length, perpendicular to proscenium.

Fabric Types:

I. 26 oz. IFP Velour

II. 22 oz. IFP Velour

III. Seamless Sharks-tooth Scrim

IV. Seamless Muslin; CBS Gray

V. 16oz. IFR Velour

Track types:

Line sets # 1, 14 and 21: ADC Type 282

Line sets # 27 and 28: ADC Type 173.

TV Studio: ADC Type 173. Room F213 (See Sheet TR-5 and A2.02F)

Black Box Theatre: ADC type 173.

Band Practice Room: ADC type 282. (Center parting; draw from south end) (See sheet A2.01L)

END OF SECTION

11 61 33-24