

116010 – STAGE RIGGING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All work of this section shall comply with the requirements of any documentation issued by Owner, related to the Project, and with all Drawings and all other Contract Documents, including all Addenda.

1.2 MODIFICATIONS TO GENERAL CONDITIONS

- A. Where any requirements of this section modify, change or add to any part of the Project Specifications, the remaining, unaltered provisions of that part of that section shall remain in effect. Where any requirement of this section and any requirement of Project Specification conflict, the most rigorous provision shall apply.

1.3 DEFINITIONS

- A. "Owner" as used in this section means the representative of the Town of Westport
- B. "Contractor" as used in this section refers to that subcontractor directly responsible for supply of the Stage Rigging.
- C. "Electrical Contractor" or "EC" as used in this section refers to the contractor responsible for supply and installation of all electrical wiring, conduit, fasteners, terminations and labor for the Project.
- D. "Project" as used in this section refers to the renovation of the stage rigging system, at Staples High School, including, but not limited to the work described in this section.
- E. "Consultant" as used in this section refers to THEATER DESIGN INC.
- F. "Electrical/Mechanical Engineer" as used in this section refers to CES.
- G. "Structural Engineer" as used in this section refers to MG McLaren
- H. "Sound/AV consultant" as used in this section refers to D'Agostino & Associates
- I. "General Contractor" as used in this section refers to the contractor with overall responsibility for the completion of the work of this specification.
- J. "Contractor" as used in this section shall refer to the contractor responsible for the provision and installation of the rigging system.
- K. "Theater Equipment" as used in this section refers to the work described in paragraphs 1.5 through 1.10.
- L. "Supply" as used in this section means, "to supply, complete with instruction for installation (installation by others)".
- M. "Provide" as used in this section means "supply, install and make operable".
- N. "NIC" as used in this section and on the contract drawings means "not included in this subcontract, not to be supplied".

- O. "By Others" as used in this section and on the contract drawings means "not included in this subcontract, supplied as part of another subcontract".
- P. "Or As Approved" as used in this section and on the contract drawings means "substitution only after written approval by Consultant.

1.4 RELATED DOCUMENTS

- A. 260953 Stage Lighting
- B. 274100 AV
- C. Structural Drawings S000 – S002
- D. Electrical Drawings E100 – E106

1.5 SCOPE OF WORK

- A. The Scope of Work includes:
 - 1. The removal of the existing counterweight stage rigging system and installation of a new counterweight stage rigging system
- B. All equipment shall perform as specified when installed on site. Failure to meet any requirement of this section on site shall be deemed sufficient cause for rejection of equipment.
- C. Examine all portions of this specification and the contract drawings to determine their interrelationships and necessary coordination. Provide all products, and execute all work, of this section in accordance all codes and customary practice.

1.6 WORK INCLUDED IN THIS SECTION

- A. Demolition
 - 1. Remove all stage draperies, wrap them in protective plastic and store for reinstallation after completion of the stage rigging work. Each drapery to have identification tag. Prepare reinstallation drawing referencing location of drapes. Submit this drawing as part of shop drawing submittal
 - 2. Remove and dispose of existing counterweight rigging system, per Owner direction except for counterweights, which are to be stored per Owner's direction for reinstalled on new counterweight sets and new loading gallery (by others).
 - 3. Remove and dispose of existing truss hoists and dispose of per Owner direction
 - 4. Remove and dispose of all legacy or unused rigging equipment
 - 5. Remove and dispose of any impediments to the installation of the new rigging
 - 6. Remove and dispose of any non-rigging items, trash, debris, etc. from the existing fly floor

7. Remove Sure-Guard II fire curtain release
8. Remove and dispose of existing projection screen and housing per Owner direction.
- B. Provide all rigging system components identified on the TE-series drawings and as specified herein.
- C. Coordination with structural contractor and other trades as may be required.
- D. Provide labor and an experienced supervisor to:
 1. Install and make operable the counterweight and motorized stage rigging
 2. Program control of motorized hoists
 3. Test and commission the system
- E. Provide site inspection reports and installation instructions as specified.
- F. Factory testing, engineering checkout, field-testing, and completion checkout as specified.
- G. Provide "as built" drawings, guarantee and warranty, operations manuals, instruction, and software updates as specified.

1.7 RELATED WORK BY OTHERS

- A. Relocation of pipes, ductwork and any other mechanical devices that conflict with installation of the new loading gallery
- B. Installation of new loading gallery

1.8 RESPONSIBILITIES

- A. All work of this Specification shall be furnished by a single contractor who will bear overall responsibility for the successful execution and completion of the Project.
- B. Make any and all alterations to standard design and construction of any equipment necessary to meet any and all requirements of this Section.
- C. The Contract Documents describe performance attributes of systems to be provided, including means of operation and control, dimensions and profiles, and visual appearances. Assume all responsibility for engineering of systems described, including modification of and addition to any details as required fulfilling the design intent of this specification.
- D. Omissions and/or errors within this specification shall not relieve the Contractor or their sub-contractors of the responsibility for providing a properly functioning installation of theater systems as described herein
- E. Correct or replace, at no cost to Owner, any system or part of system found not meeting specifications at time of Completion Checkout, or any time during warranty period.

1.9 QUANTITIES

- A. In case of a discrepancy in the quantities between this specification and contract drawings, the larger number shall prevail
- B. Should any quantities identified in this specification be insufficient to meet the design intent of the specification, the Contractor shall provide the required quantities

1.10 QUALIFICATIONS

- A. The Contractor shall be the exclusive systems designer and engineer of the stage rigging system. The Contractor shall provide the following information as part of their bid package:
 - 1. List of representative current projects and approximate contract value. Include list of names, phone numbers and addresses of owner, owner's representatives and architect.
 - 2. For projects described above, list of names of persons who supervised preparation of shop drawings, manufacture of components, and installation of equipment.
 - 3. List of names, phone numbers, and addresses of persons who would do project management, product engineering, supervision of shop drawing, supervision of testing and user training for Stage Lighting System should this contract be awarded.
 - 4. The Contractor shall maintain a full-time field engineering staff.
- B. Listed stage rigging contractors are:
 - 1. Interamerica Stage www.iastage.com
 - 2. iWeiss www.iweiss.com
 - 3. Texas Scenic www.texasscenic.com
- C. BASIS OF BID
 - 1. Stage counterweight rigging – Wenger/Clancy
 - 2. Motorized hoists - ETC
 - 3. Listing of equipment and components manufactured by Basis of Bid manufacturers is not an endorsement of those items, but a point of reference and a basis for the respective system designs.
- D. Proposed substitutions for any work of this section to be submitted to Theater Consultant for approval two (2) weeks prior to bid due date. Identify the specific component/system with an explanation for the substitution and a demonstration of its equivalency to the Basis of Bid.
- E. Approval of any proposed substitution to be at the sole discretion of the Theater Consultant.

1.11 CODES AND STANDARDS

- A. Provide materials, components and assemblies that are UL, CE listed and meet all applicable codes, standards, and specifications applying to the work of this section.

1.12 OWNER'S TESTING AGENCY

- A. If any work is required to be specially tested or approved, whether by the Owner's instructions or by any laws, ordinances or any public authority, the Contractor shall give Owner's representative timely notice of its readiness for inspection, and of dates of inspections to be made by other authorities, through General Contractor. Contractor is responsible for time, labor, materials and fees associated with such.

1.13 SHOP DRAWINGS

- A. Provide a PDF file of all shop drawing for submittal to Consultant. Include cut sheets and equipment manuals, as may be appropriate.
- B. Prepare all shop drawings under supervision of a qualified project engineer. Include names and contact telephone numbers of project manager and project engineer with shop drawing package.
- C. Engineer, design and draft all shop drawings to represent actual fabrication and installation drawings and details. Copies or tracings of contract drawings will not be acceptable as shop drawings and shall be rejected.
- D. Submit shop drawings as a package containing all drawings, details, layouts, schedules and schematics necessary to fully explain design features, appearance, fabrication, installation, function and operation of each system completely. Provide a fully referenced index of drawings.
- E. Shop drawing packages that are incomplete will not be reviewed until such time as complete set of relevant drawings, cut sheets and other information is submitted.
- F. Review of shop drawings by Consultant is for conformance with design concept and for conformance with information given in the contract documents. Nonconformities and errors detected during review shall be noted on shop drawings and returned to Contractor on completion of review. Consultant is not responsible for completeness or accuracy of the Contractor shop drawings. Acceptance of shop drawings including deviations and inconsistencies not detected during review shall not relieve the Contractor from sole responsibility to provide materials and work conforming to the letter and spirit of the Stage Lighting contract documents.
- G. No equipment shall be manufactured, fabricated, shipped or installed prior to shop drawings being reviewed by Consultant. Only shop drawings returned marked "Reviewed" or "Make Corrections as Noted" may be used by contractor in the work. Correct and resubmit any shop drawings marked "Revise and Resubmit" or "Rejected."
- H. If field dimensions obtained after approval of shop drawings require changes in size, detail or similar considerations, revised shop drawings shall be submitted for review.
- I. All shop drawings shall identify THEATER DESIGN INC, as the theater consultant, along with its website: www.theaterdesigninc.com.

1.14 SAMPLES

- A. Submit all samples as requested by Consultant.

1.15 MOCK UPS

- A. Provide mock-ups as requested by Consultant.

1.16 INSTALLATION INSTRUCTIONS

- A. Provide installation instructions for all items supplied in this section, as reviewed and approved with the shop drawings. Such instructions shall be fully coordinated with trades doing adjoining work and with site conditions. Instructions shall include inter-equipment connection diagrams with terminal designations.

1.17 INSPECTION REPORTS

- A. If conditions exist that are contrary to proper installation of Stage Rigging System, directly inform General Contractor and Consultant of the discrepancies. Failure to inform General Contractor shall constitute acceptance of installation and place responsibility for any revisions or additions necessary to properly install work of this section with Contractor.

1.18 OPERATIONS MANUALS

- A. Provide two (2) copies of an Operations Manual, in approximately 8-1/2" x 11" 3-ring binders. Where page is larger than 8-1/2" x 11", said page shall be folded to fit within the binder. Each Manual shall contain; a complete description of the system operation, all equipment operating instructions, all equipment schematics, all equipment service manuals, recommended maintenance procedures, all equipment data sheets, all system test data, all warranty information, and all as built drawings. The manuals shall be fully indexed for ease of use.
- B. Provide copy of operations manual as a PDF file.
- C. Submit a draft to Consultant for approval at least 4 weeks prior to completion checkout. If manual is rejected, revise as needed and resubmit prior to delivering to Owner.
- D. Certain payments to Contractor may be retained until Owner receives Operations Manual in good order as specified.

1.19 RECORD DRAWINGS

- A. The Contractor shall provide "as built" record shop drawings including any late changes or adjustments which occur as corrections to punch list items or as change orders after Substantial Completion of Contract. As-Builts shall be in the form of a PDF file designed to print to 24x36. At Substantial Completion of Contract, the Contractor shall prepare a complete set of their shop drawings for incorporation into the Operations Manual.
- B. Certain payments to the Contractor may be retained until Owner receives the Record Drawings in good order as specified.

1.20 GUARANTEE AND WARRANTY

- A. Provide a one (1) year written guarantee covering all labor, materials and workmanship incorporated into the work. Warranty shall commence from date of Owner acceptance. Indicate date of expiration on warranty.

- B. Carry out all warranty work with no additional cost to Owner for any parts, labor, or transportation. Provide warranty replacement equipment within 24 hours of notice by Owner. Provide on-site warranty repair within 2 days of notice.
- C. If a particular component, part or piece of equipment fails more than three times during the warranty period, the failure shall be deemed due to an error in product engineering. In that case, within 24 hours of notice by Owner, take whatever action is necessary to modify or correct the defect by design change. Provide temporary backup or replacement equipment within 24 hours of notice. Provide permanent, redesigned, replacement equipment on a work schedule that does not conflict with rehearsals or performances.
- D. Warranty on components and equipment modified or replaced due to error in product engineering shall be same as for original components and equipment and shall commence from date of installation of modified or replaced component or equipment.
- E. At a period six months after Owner acceptance, provide labor to inspect the Stage Rigging systems and make any necessary adjustment/repairs. Submit a written report describing the general condition of the rigging system and any required adjustment/repairs.

1.21 SERVICE AGREEMENT

- A. As part of the bid, provide a service agreement for a 3-year and 5-year term, including: costs, all included services and a copy of the Contractor's standard service agreement for Owner review.
- B. The proposed service agreements shall be separate from the lump sum bid and identified as Alternates.
- C. Upon project completion, the Owner may decide to enter into one of the service agreements.
- D. Contractor shall hold the Service Agreement price for the duration of the Project.

1.22 TRAINING

- A. Provide training to Owner's operating personnel on operation and care of system for not less than two (2) four (4) hour sessions. Instruction shall include, but not be limited to: operation of the systems and equipment, proper maintenance of all systems, troubleshooting, replacement procedures for user replaceable parts, and operating procedures to obtain maximum usage of systems.
- B. Deliver all copies of approved Operations Manual to Owner prior to first instruction session and review it as part of that session. Owner shall schedule training session at their convenience.

- C. Instruction must be by qualified expert operators who have actual experience with systems in performance conditions. Submit instructor's qualifications to Consultant for approval at least 2 weeks prior to Completion Checkout.

PART 2 – PRODUCTS – STAGE RIGGING

2.2 GENERAL

- D. All systems, equipment and components in this specification shall meet the requirements of NFPA 701 and all other codes and ASTM standards.
- E. All material to be new, unused and of the latest design. Refurbished materials are not acceptable.
- F. Mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall not be any burrs or sharp edges that may cause a hazard. No sharp corners shall be accessible to users
- G. Shop and field welding (if required) shall meet the requirements of the AISC manual and shall be without spatter or other evidence of poor practice.
- H. Paint and finish all assemblies with manufacturers' standard finish and color, except as noted.
- I. All turnbuckles, clips, tracks, chains and other hardware shall be furnished plated or painted.
- J. All components and assemblies shall be rated to operate under the indicated loads with a safety factor of no less than six (6).

2.2 MANUAL COUNTERWEIGHT RIGGING

- A. Provide twelve (12) new double purchase counterweight sets spaced 10" OC including: T-bar battery, locking rail, head blocks, loft blocks, wire rope, pipe batten, hardware and necessary components.
- B. Material used in the fabrication of components shall comply with the appropriate standards.
- C. All rigging components and assemblies shall be rated to operate under the indicated loads with a safety rating of no less than six (6).
- D. Each set shall be operated by means of a 3/4" polyester hand line. This hand line shall operate the counterweight arbor in a vertical motion. When not in use it shall be locked in position by means of a rope lock.
- E. Properly align and counterweight each rigging set to minimize the amount of force required to move the pipe battens.
- F. Each set shall be installed to allow for the travel noted on the TE Series drawings.

2.3 SHEAVES

A. Headblock

1. Each headblock shall consist of one (1) 7-line 12" diameter cast iron sheave. The sheave is to be machine grooved with proper diameters to eliminate differential motion and slip between operating line and hoisting cables. There is to be one (1) groove for the operating hand line.
2. Each headblock for the lighting battens shall be one (1) 8-line 12" diameter cast iron sheave. The sheave is to be machine grooved with proper diameters to eliminate differential motion and slip between operating line and hoisting cables. There is to be one (1) groove for the operating hand line. Provide five (5).
3. The sheave is to be mounted on two (2) sealed roller bearings (Timken or as approved) and supported by a solid steel shaft. It shall be mounted into a rigid steel housing. The housing shall consist of two (2) steel side plates connected with spacers to prevent the cables and hand line from leaving their appropriate grooves.
4. The headblock shall be connected to the headblock rigging steel by steel angles and clips.
5. Provide one (1) headblock assembly per set. Each assembly shall be designed to operate with a load of 1,100 pounds plus a safety factor of no less than six (6).

B. Single Loftblocks

1. Each rigging set single loftblock shall consist of one (1) 8" diameter machined cast iron sheave mounted on two (2) sealed roller bearings (Timken or as approved) and supported by a solid steel shaft mounted into a rigid steel housing. The housing shall consist of two (2) steel side plates connected with spacers to prevent the cable from leaving the grooves in the sheave.
2. The side plates shall be slotted for attachment to the rigging steel.
3. Provide one (1) single loftblock assembly for each rigging set. Each assembly shall be designed to operate with a safety factor of no less than six (6).

C. Multiple Loftblocks

1. Each multiple loftblock shall consist of one (1) 8" diameter machined cast iron sheave mounted on two (2) sealed roller bearings (Timken or as approved) and supported by a solid steel shaft mounted into a rigid steel housing. The housing shall consist of two (2) steel side plates connected with spacers to prevent the cable from leaving the grooves in the sheave.
2. The side plates shall be slotted for attachment to the rigging steel.
3. Provide six (6) multiple loftblock assemblies ranging from two (2) to seven (7) lines for each rigging set. Each assembly shall be designed to operate with a safety factor of no less than six (6).

2.4 COUNTERWEIGHT ARBOR

- A. The counterweight arbor shall be as noted on the TE series drawings and shall consist of a structural steel frame with provision for securing seven (7) 1/4" diameter cables and the 3/4" polyester hand line at the top essentially as noted on the TE-Series drawings.
- B. The bottom of the arbor shall have provisions for attaching the hand line.

- C. Two (2) tie rods shall be used to reinforce the connection between the top and bottom of the counterweight arbor and shall be spaced to allow the use of standard cast iron weights.
- D. A steel tie plate and top plate shall be provided to secure the counterweights.
- E. Attached to the arbor wall shall be two (2) fiber guides secured with machine bolts. The guides shall be machined to engage the counterweight guide track ("T" track) and provide smooth operation of the arbors.
- F. Provide one (1) arbor for each rigging set.

2.5 FLOOR BLOCK

- A. Each floor block assembly shall consist of one (1) single groove cast iron 11' diameter machined rope sheave. It shall be mounted on two (2) sealed ball bearings and supported by a solid steel shaft.
- B. The assembly shall be mounted in a housing consisting of two (2) steel side plates, one (1) cast iron guide and necessary pipe spacers for stiffness and to prevent the rope from leaving the groove.
- C. The floor block shall engage the T-bar guide track with fiber guides bolted to the housing. In this manner the floor block may be moved up or down to maintain proper tension on the hand line.
- D. Provide one (1) floor block assembly for each rigging set..

2.6 COUNTERWEIGHTS

- A. Existing counterweights are to be reused.

2.7 LOCKING RAIL

- A. Provide one (1) locking rail to run the length of the rigging.
- B. The locking rail shall be constructed of 4" structural angles, 4"x3" support posts (space 4'-0" on center) and 6"x4" clip angles for mounting. They shall be securely mounted to the stage floor.
- C. The locking rail shall contain accommodation for one (1) cam activated rope lock for each rigging set. The locking rail shall be 2'-3" from the stage floor to the rope lock mounting shelf.

2.8 ROPE LOCKS

- A. Provide one (1) cam-activated rope lock for each rigging set.

- B. Rope lock housing is to be made of a one-piece iron casting. A one-piece cast iron eccentric lever shall be used to activate two (2) malleable iron cams, to grip the rope.
- C. The range of the rope lock shall be adjustable from 5/8" to 7/8" diameter by means of a 1/4" diameter thumb screw locked in place with a hex nut.
- D. Rope lock shelf shall have a neoprene pad to prevent noise when the locking handle is opened.

2.9 PIPE BATTEN

- A. The pipe batten is to be fabricated from 1-1/2" diameter seamless steel schedule 40 pipe, 51'-0" long. Joints are to be sleeved and plug-welded at installation. Joint detail to be submitted with shop drawings (for approval).
- B. Provide one (1) pipe batten assembly for each rigging set.

2.10 GUIDE SYSTEM

- A. The counterweight guide system shall consist of two (2) 1-1/2" x 1-1/2" x 3/16" steel T-bar tracks extending from the counterweight pit to the underside of the headblock beams.
- B. The "T" bar tracks shall be attached to 1-3/4" x 1-3/4" x 3/16" steel angle battens with bent steel "U" clips.
- C. The steel angle battens should not be placed more than 4'-5" apart and attached to the wall with sufficient angle brackets to maintain a secure and plumb system at times.
- D. At the upper and lower extremities of arbor travel shall be a stop angle. Securely mounted to the top of the stop angle shall be a 2"x4" hardwood strip.
- E. Guide tracks shall be installed plumb within 1/8" over total length with a variation of no more than 1/16" over 20'-0" section.
- F. Coordinate guide system T-bar track to align with structure within the wall.

2.11 BATTEN SUPPORT CABLE

- A. Each set is to be provided with 7x19 pre-formed galvanized aircraft cable, impregnated with dry lubricant. Minimum breaking strength shall be not less than 7,000 pounds. These cables shall be attached to a P8 9/32" chain with an appropriate Nicopress sleeve or two (2) cable clips. This chain will be wrapped around the pipe, twice, and secured with a 5/16" Grade 5 bolt and Nylock washer. All components, above, to be rated for a minimum safety factor of (6).
- B. From the pipe, the cables will run vertically upward, pass over the loftblocks and headblock and terminate at the top of the counterweight arbor. The cable will then be attached to the arbor with 3/8" shackle assemblies.

- C. All cable ends are to be properly fastened and loose ends taped.

2.12 HANDLINE

- A. Each set shall be operated by means of a 3/4" polyester rope. The rope shall be attached to the top of the counterweight arbor, run vertically upward around the headblock, down through the rope lock and around the floor block and terminate at the eye provided on the bottom of the counterweight arbor.
- B. The hand line shall be a three (3) strand twisted polyester composite rope, 3/4" in diameter with a tensile strength of 10,540 pounds and a working load of 2,620 pounds. Rope to be Multiline II 3 STML-689 by New England Ropes, Inc. or equal.
- C. All ends of rope to be properly fastened and ends taped (after final adjustment).

2.13 INDEX STRIPLIGHT

- A. Provide one (1) electrical illuminating index strip fixture with LED lamps, (included in this contract).
- B. The index strip light shall be mounted to an outrigger assembly so that the index strip hangs approximately 8'-0" above the stage floor. It shall run the full length of the locking rail.
- C. Index strip light to be controlled by local switch located at the downstage end of the locking rail.
- D. Provide one (1) index strip assembly

2.14 DEAD HUNG RIGGING

- A. Provide two (2) dead hung rigging sets with pipe battens.
- B. Pipe batten to be fabricated from 1-1/2" diameter seamless steel schedule 40 pipe, 51'-0" long. Joints are to be sleeved and plug welded at installation. Joint detail to be submitted with shop drawings.

2.15 MISCELLANEOUS

- A. Bearings on sheaves to be greased at assembly and sealed with proper grease retaining seals after assembly.
- B. Provide additional idlers and sheaves as required to prevent cables from rubbing and/or interfering with structural steel.
- C. Cable and rope connections that terminate around a sharp edge should pass around proper thimbles. This shall avoid stress concentrations which might reduce the life of the cable or rope.

- D. Sheaves and headblock shall be aligned after assembly to minimize friction caused by cable rubbing against the sides of the grooves.
- E. Secure turnbuckles after assembly by “mousing” with wire or set screws.
- F. Provide protective structural steel expanded metal enclosures around components immediately adjacent to areas populated by technical staff.

2.16 MOTORIZED STAGE RIGGING

- A. Provide seven (7) fixed speed motorized rigging sets as noted on the TE-series drawings.
- B. Each assembly shall be capable of supporting live load of 1,500 pounds with a safety factor of 6.
- C. Hoists shall be purpose-designed for overhead lifting and shall incorporate mechanical, electrical and other safety features
- D. All hoist assemblies to be tested under full rated load throughout their travel distance prior to shipping to site. Testing to include:
 - 1. Operation
 - 2. 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. Noise
- E. Paint per manufacturer’s standard.
- F. All equipment shall be new and conform to applicable provision 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.
- G. 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.
- H. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
- I. In order to establish minimum standards of safety, a minimum factor of 10 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:

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

J. DESIGN FACTORS

1. Each wire rope Hoist line shall adhere to a design factor of 10:1 with an ultimate strength of 4200 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.
2. The standard hoist shall consist of the following major components: 1) Powerhead, 2) compression tube with beam clamps, loft blocks, lift line and lift line terminations, Right Angle Cable Adjuster (RACA) (2) connector strip) and (4) pipe batten.
3. 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 Right Angle Cable Adjuster (RACA), 3) pipe batten and power/control distribution strip
4. The hoist shall include the following features:
 - a. A Powerhead containing the following elements: the gear motor, motor brake, load brake, limit switches operating electronics, load cell, slack line detector, absolute position sensors, cable drum assembly, and wire rope.
 - b. A Compression Tube 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.
 - c. The hoist shall incorporate a built-in load cell.
 - d. The hoist shall incorporate a built-in slack line sensor.
 - e. The hoist shall include the emergency contactor built into the hoist.
 - f. Hoists that do not include built-in load cell, built-in slack line detection, and an emergency contactor shall not be acceptable.
 - g. Hoists that do not use absolute position encoders shall not be acceptable.

K. GEAR MOTOR AND MOTOR BRAKE

1. 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.
2. The motor brake shall be integral to the gear motor and shall be capable of holding 125% of the motor full load torque.
3. The motor brake shall be spring actuated to apply and hold braking force.
4. The motor brake shall be magnetically released and held open upon actuation.

L. LOAD BRAKE

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 mechanically released when the load is moving in the up direction. The load brake shall close 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.

M. WIRE ROPE DRUM

1. The drum shall be capable of wrapping up to eight 3/16" diameter 7 x 19 galvanized aircraft (utility) wire rope lift lines up to 50' long in a compact manner. 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.

N. LIMIT SWITCH

1. 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.

O. LOAD SENSOR

1. 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.

P. POSITION SENSOR

1. 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. Incremental encoders shall not be acceptable for position readout purposes.

Q. SLACK LINE DETECTOR

1. 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.

R. POWERHEAD INTERFACE

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

S. INFORMATION STORAGE WITHIN POWERHEAD

1. Record of severe fault conditions with date and time stamp
2. Record of E-stops, overloads, moves and power cycles
3. Record of travel distance and peak loads since installation/inspection
4. Hoist systems that do not record the above data shall not be acceptable.

T. CABLE MANAGEMENT

1. Cable Management by means of a pantagraph.
2. At high trim, the entire system shall be stored as noted on the TE-Series drawings.
3. The cable management system shall be integral to the hoist system.
4. The connector strip shall be built to the length specified with outlets or pigtails located as specified or as shown on the construction drawings. Outlets or plugs shall be as noted on TE-series drawings. The distribution shall also contain connectors for Ethernet and/or DMX connections.
5. Cable management systems that utilize cable cradles, cable reels or locate feeder or data cables outside the off-stage edges of the batten shall not be acceptable for this project.
6. Hoisting systems utilizing cable management systems from third-party vendors shall be fully integrated into the hoisting system without additional structural changes or changes to the controller.

U. SUPPORT STEEL

1. Provide additional support steel, as required, to support the drum assemblies, winch units, and electrical controls. Any additional support steel shall be submitted for review prior to fabrication.

V. ELECTRICAL CONTROLS

1. The motorized rigging shall be controlled by means of a touch screen pendant. Pendant shall require password protection or key switch for operation and an oversized E-stop button.
2. The controls (reversing starter, relays, terminals) for each rigging set shall be housed in independent cabinets and mounted adjacent to the winch units.
3. Motor voltage to be 208 volt, 3 phase, 60 cycle, AC. and all control wiring to be low voltage.

W. MISCELLANEOUS

1. All bearings to be greased at assembly and sealed with proper grease retaining seals after assembly.
2. All cable connections that terminate around a sharp edge should pass around proper thimbles to avoid any stress concentrations which might reduce the life of the cable and rope.
3. All limit switches shall be adjusted, after installation of rigging sets to conform to requirements of the client and the architect.
4. Secure all turnbuckles after assembly by mousing with wire or by use of set screws.

X. All materials and components to be new and unused

Y. In addition to items identified on the S-series drawings, provide any other materials and/or assemblies required

2.3 PRODUCTS – ELECTRICAL

A. All materials to be new and unused

B. In addition to items identified in the TE-series drawings, provide any other materials/assemblies, etc. required.

PART 3 - EXECUTION

3.2 STAGE RIGGING

A. Assume responsibility to provide equipment and instruction for complete and working installation of all equipment and systems specified in this section, coordinated with work of all other subcontractors.

3.3 COORDINATION WITH OWNER AND CONSULTANT

A. CONTRACTOR shall submit all drawings, schedules, and other communications relating to work of this section as directed.

3.4 ENVIRONMENTAL CONDITIONS

- A. Ship Theater Equipment to site only after notification by GC that storage facilities are available to protect equipment prior to installation, as described below. Equipment to be installed only when site conditions provide mechanical, electrical, and weather protection for each class of equipment, as described below.

- B. Pack all equipment in sturdy containers to provide mechanical protection during shipping and storage. Provide padding as necessary to protect equipment from vibration and shock. Provide inner plastic sheeting to protect equipment from moisture and dust. Keep plastic covers on equipment until such time as installation areas have been completed and conditions exist as indicated below.

3.5 REVIEW OF FIELD CONDITIONS

- A. Confirm by site visit and by report from GC all field conditions that may affect manufacture and installation of the equipment prior to fabrication. Provide any additional hardware, panels and back boxes to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.

3.6 INSTALLATION INSTRUCTION

- A. Provide specific, detailed direction to GC as required for proper installation of all Theater Equipment, coordinated with actual site conditions, as per Part 1 of this section.

- B. ITEMS PLACED AND ATTACHED TO EXISTING WORK
 - 1. Provide all items required to properly install and secure Theater Equipment in place.

3.7 ALTERATION OF EQUIPMENT DETAILS

- A. If any Theater Equipment or other related device requires relocation or change of mounting detail, and this fact is not known until after shipment due to sequence of work, modify equipment or provide new equipment to fit revised location or mounting detail. Notify Consultant of any such changes, and submit all changes to Consultant for review prior to fabrication.

3.8 WIRING

- A. CONTRACTOR shall describe to the EC appropriate length cable loops, terminations, etc.; or any other wiring procedure (beyond customary trade practice) required for successful operation.

3.9 MARKING

- A. All equipment shall be permanently and logically marked for ease of installation.

3.10 PAINTING AND TOUCH UP

- A. Provide paint and supplies to correct minor cosmetic damage to Theater Equipment. Ensure that all equipment is clean and in perfect condition at time of Completion Checkout.

- B. Repair or replace any equipment that has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.

3.11 CLEAN UP

- A. Clean all Theater Equipment of trash, dust and debris.

3.12 PROTECTION OF CONTROL EQUIPMENT

- A. Do use any Theater Equipment control devices intended for installation for the purpose of checking out wiring or circuitry prior to proper conditions existing on site, as specified above. Equipment may be used for such testing only in specific areas where such proper conditions exist.

3.13 ENGINEERING CHECKOUT

- A. Prior to energizing relevant Theater Equipment, perform complete system checkout to verify that all items are correctly installed and shall safely operate as specified herein.

B. FIELD TESTING AND ADJUSTMENT

- C. Perform all tests and adjustments specified below upon completion of installation of Theater Equipment but no later than six weeks prior to Beneficial Occupation of facility by Owner.

3.14 TEST PROCEDURES

- A. Prior to Consultant's inspection perform all following tests:

1. Inspect all device labels to ensure that devices are correctly and clearly labeled as specified and shown in drawings.
2. Test all circuits for proper wiring, polarity, and connection and inspect for correct labeling.
3. Test all power receptacles.
4. Test all extension cables, adapters, etc.
5. Repair or replace any equipment that fails to conform to specification.
6. Upon completion of testing, Provide Owner, and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.15 COMPLETION CHECKOUT

- A. Schedule inspection by Owner, and Consultant no earlier than upon receipt of above specified report, but no later than four (4) weeks prior to Beneficial Occupation of facility, or portion of facility containing Theater Equipment.
- B. At request of Consultant, repeat any and all test specified in "Field Testing and Adjustment" above in presence of Owner and Consultant.
- C. Should Owner or Consultant judge that any Theater Equipment fails to conform to specification, repair or replace that equipment within 15 days. Should work inspected not

be substantially complete at time of Completion Checkout, complete that work and schedule a second checkout. Provide all equipment and personnel specified above.

3.16 FINAL SUBMITTALS

A. After Completion Checkout, submit all of the following to the Owner:

1. Receipts for delivery of uninstalled miscellaneous items, including all spare parts as detailed in Part 2.
2. 1 hard copy and 1 pdf of the Operations Manual, as detailed in Part 1.
3. Record Drawings, as detailed in Part 1.
4. Guarantee and Warranty, as detailed in Part 1.
5. Maintenance proposal, as detailed in Part 1

End of Section