

Section 116133 - Performance Manual Rigging

PART 1 - GENERAL

1.1 SUMMARY

- A. Performance manual rigging includes manually operated equipment assemblies, systems and components required for locating scenic, acoustic, lighting and masking elements in variable vertical planes.
- B. Section includes provision of materials, components, modifications, assemblies, equipment and services as specified herein. These include:
 - 1. Provisions as required under Division 1.
 - 2. Demolition of existing rigging equipment.
 - 3. Verification of site dimensions and conditions.
 - 4. Submission of Shop Drawings signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of installation.
 - 5. Engineering of equipment and systems as required by the Contract Documents.
 - 6. Manufacture of equipment and systems as required by the Contract Documents.
 - 7. Scheduling, sequencing and coordination with other trades.
 - 8. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
 - 9. Testing, demonstration, and certification of equipment and systems as specified herein and elsewhere in the Contract Documents.
- C. Provide systems including:
 - 1. Overhung single purchase counterweight sets and pipe battens.
 - 2. Additional battery of counterweight guide tracks as indicated in drawings.
 - 3. Cable management rigging and equipment for connector strip(s), as well as any additional multicable devices.
 - 4. Misc. Loose and Manual rigging components as detailed on schedule
 - 5. Additional support structures as required to meet the intent of the Contract Documents.
 - 6. Provide devices and components that are NEMA compliant and UL approved for the applications.
 - 7. New flexible power and control cables to feed existing lighting raceways as noted
 - 8. Wiring and electrical service shall be performed by a licensed electrician and conform to all applicable local, regional, and national codes.
 - 9. Addition system and equipment as indicated on contract drawings.

Products Installed but Not Furnished Under This Section:

- 10. Modifications to existing Proscenium Safety Curtain Systems detailed under Section 116137.

D. Related Sections:

1. General and Supplementary Requirements as detailed in Invitation to bid.
 - a. 116100: Performance Machinery General Requirements.
 - b. 116137: Proscenium Safety Curtain.
2. Division 26: Electrical.

1.2 DEFINITIONS

- A. Hemp Set: An adjustable rigging system consisting of synthetic rope, moveable, grid mounted, upright loft blocks and sandbag counterweights.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements:
 1. Section 116100 establishes minimum requirements for the system. Where Federal, State, Local Legislation and consensus standards address these topics, the more stringent requirements take precedence. The minimum standards for construction and installation shall meet or exceed the requirements of the Applicable Project Building Code (per project) and ANSI E1.4-1 (2016) except as exceeded by these specifications. Where standards requirements conflict, the construction shall conform to the following order: Federal, State, and Local Legislation; Applicable Project Building Code; ANSI E1.4-1; these specifications.
 2. Factors listed below in no way relieve this Contractor from the sole responsibility of providing safe systems.
- B. Provide assemblies, cable components, connections, equipment, hardware and linkages employed in supporting, in whole or in part, overhead loads that are rated and designed for that application. Base loading for each component on the maximum percentage of the capacity of the set in which the component is employed. Base the set capacity on the batten length multiplied by a thirty pound per linear foot (30 plf) load, in addition to self weight and associated impact factors.
- C. Provide mule blocks, rollers and guides as required to provide proper alignment and maintain allowable fleet angles.

1.4 SUBMITTALS

- A. In addition to submittals required under Division 1 and Section 116100, for items listed herein, provide manufacturer's data and certification of compliance

1.5 WARRANTY

- A. Special Warranty:

1. Warrant systems and equipment to be free of defective components, faulty workmanship and improper adjustment for a period of two years from the date of Final Acceptance. Paint and exterior finishes are excluded relative to failure due to unusual exposure. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being, and or property within 48 hours of notification.
2. Designate warranties on manufactured equipment to the Owner on the date of Final Acceptance.

1.6 MAINTENANCE

A. Maintenance Service:

1. Provide maintenance service one year after final acceptance of the installation. This service consists of checking and adjusting of equipment for proper operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide the rigging systems from components (except where otherwise stated) that are the products of one of the following manufacturers. Additional manufacturers may be used if approved in writing by the Architect, or as defined in Division 1.

1. H&H Specialties Inc., South El Monte, CA.
2. J.R. Clancy, Inc., Syracuse, NY.
3. Thern Stage Equipment, Winona, MN
4. Texas Scenic Company, San Antonio, TX

B. Bearings:

1. Dodge/Reliance Electric Corp., Cleveland, OH
2. FAG Bearings Corp., Stamford, CT.
3. Timken Co., Canton, Ohio.

C. Cable and chain connection hardware:

1. Chicago Hardware and Fixture Company, Chicago, IL.
2. Columbus Mckinnon Corporation, Chain Division, Amherst, NY.
3. Cooper Industries, Campbel Chain Division, Inc., NC.
4. The Crosby Group, Inc., Tulsa, OK.
5. Loos & Co.Inc., Naples,FL.
6. J.R. Clancy, Inc., Syracuse, NY.

D. Compression sleeves:

1. Loos & Co.Inc., Naples,FL.
2. National Telephone Supply Company, Cleveland, OH.

E. Synthetic ropes:

1. All Line Inc. Naperville, IL.
2. American Manufacturing Company, Honesdale, PA.
3. Atlantic Cordage Corporation, Carteret, NJ.
4. New England Ropes, Inc. New Bedford, MA.

F. Wire Rope: Refer to Section 116100, Performance Machinery Basic Requirements.

2.2 MATERIALS

1. Pipe Battens: 1-1/2" nominal Schedule 40 Seamless Black Steel Pipe (ANSI B36.10-1970).

B. Guide Track and Hardware

1. Guide Tracks

- a. Provide guide tracks of steel or aluminum with brackets, fishplates and clips of compatible materials.
- b. Provide rails with a "T" section at the guide shoe connection point sized to allow adjacent guide shoes to pass each other without interference. Provide track sections with a sectional area and material properties to withstand the forces resulting from the fully loaded guided counterweight arbors.
- c. Provide tracks sufficiently true and smooth to operate properly with the guiding members.

2. Brackets, Fastenings, Joints and Supports

- a. Provide guide track brackets, fastenings and supports capable of resisting horizontal forces imposed by anticipated loading with the total deflection at the point of support not in excess of 1/8" (3.2mm).
- b. Provide track joints so that they are equivalent to or greater strength than the track and adequately maintain the accuracy of the rail alignment.

2.3 MANUFACTURED UNITS

A. Blocks:

1. Refer to Section 116100, Performance Machinery Basic Requirements for performance criteria.
2. Single Purchase Headblocks, Upright:
 - a. Provide upright headblocks with sheave aligned to permit the purchase and lift lines to operate, within the tolerances specified herein, with the arbors, loftblocks, and rope locks.

- b. Provide head blocks each with a single sheave of multiple grooves as specified herein.
- 3. Loftblocks, Upright:
 - a. Provide blocks that allow positioning of the cable to pass through the grid well at its center line.
 - b. Provide appropriate mounting hardware to allow attachment to the gridiron and well structure.
 - c. Provide clips as necessary to attach to loft wells. J BOLTS ARE NOT ACCEPTABLE
 - d. Refer to Section 116100, Performance Machinery Basic Requirements for additional performance criteria.
- B. Temporary Rope Loft Blocks
 - a. Provide blocks as required designed for electrical multi-cable management. Provide additional blocks of the quantity specified herein for temporary rigging points.
 - b. Refer to Section 116100, Performance Machinery Basic Requirements for additional performance criteria.
- 2. Tension Blocks:
 - a. Provide with appropriately sized side plates and a kick plate located at the upper on-stage corner.
 - b. Provide tension blocks of sufficient weight to maintain constant tension on purchase line.
 - c. Configure the block mounting to ride freely in the guide tracks on 2 sets of guide shoes of similar arrangement as the associated counterweight arbor. Ensure that the tension block properly engages track and remains in set location while purchase line is under tension.
- C. Sheaves: Refer to Section 116100, Performance Machinery Basic Requirements for performance criteria.
- D. Counterweight Arbors:
 - 1. Provide each set with a counterweight arbor provided at a length sufficient to contain the counterweights required for balancing the load within fifty (50) pounds the weight of the batten loaded at twenty-five pounds per linear foot (25 plf) for general purpose battens, and thirty pounds per linear foot (30plf) for stage electrics, in addition to the batten weight. Weight dimensions as specified herein. Size length to permit the loading and unloading of weights when arbor is loaded to its capacity. Provide the arbor assembly to be of sufficient strength to safely support weight on the arbor, load on cables and operating pull.
 - 2. Support the arbor from a cable clew arrangement mounted at the arbor top with a sufficient number of shackle attachment points to accommodate the total number of cables in addition to the purchase line. Support arbor such that the load is centered between all lift lines.

3. Secure the top and bottom of the arbor with two appropriately sized steel rods. Provide tie rods for counterweight arbor from appropriately sized rod with cut threads and double full nuts top and bottom as well as single full nuts on the inside. Provide washers between nuts and arbor tops and bottoms.
4. Space the rods to accommodate counterweights. Do not allow counterweights to rest on nuts.
5. Provide safety collars to lock the counterweights in place. Tap and fit safety collars with a thumb screw to allow adjustment on the tie rods. Secure the safety collars to the top spreader plate to permit storage during loading and to secure the weights.
6. Mount the top and bottom frames to the guide tracks via guide shoes on a vertical tie bar rigidly connecting the top and bottom of the arbor together.
7. Provide each arbor with adjustable diaphragms (spreader plates) to ensure tie rods remain parallel throughout their length under anticipated loading conditions and retain the counterweights. Provide diaphragms to be held captive in the horizontal planes by the tie rods. Provide plates to resist deformation of the arbor and evenly distribute the counterweights in a compact fashion. Provide quantity of plates required to retain weights in the arbor in the case of an impact event.
8. Incorporate an attachment point with fiber rope thimbles to the arbor top and bottom for the connection of the purchase line.
9. Configure guide arrangement to maintain arbor stability throughout travel and restrain arbor from lateral movement due to impact and lateral forces.

E. Rope Locks:

1. Provide the rope lock with a 9" encapsulated steel eccentric lever and steel, ductile or malleable iron cams to provide quick action locking. When locks are fully engaged handles shall be perpendicular to the floor. Provide a thumb screw with jam-nuts for pressure adjustment. Provide locks with nylon spacers between the locking dogs, levers and casting to reduce noise.
2. Bolt the rope locks to the locking rail with appropriate fasteners.
3. Provide locks with elliptical slip rings to prevent movement of lever by tensioning against the purchase line. Encapsulate slip rings in plastic of the same color as the handle.
4. Provide a synthetic rubber bumper on lock mounting angle to prevent noise from handle impact.
5. Encapsulate identified items in red poly-vinyl chloride, 25 mils thick and testing between fifty (50) and sixty (60) on a durometer scale.
6. Provide locks designed to comply with the control of hazardous energy plan in compliance with 29 CFR 1910.147 The control of hazardous energy (lockout/tagout).

F. Pipe Battens:

1. Reutilize existing battens unless noted otherwise in drawings

G. Truss Battens

1. Provide truss battens for linesets indicated . Refer to schedule on drawings.

2. Fabricate truss battens from rolled steel sections arranged to meet the deflection and loading requirements of the Contract Documents. Provide battens with a bottom chord of 1-1/2" nominal Seamless Black Steel Pipe. Provide the top chord of a square or rectangular section no greater than 2" in width to minimize lateral deflection of the truss. Arrange webs so as to minimize interference with equipment mounting to the bottom chord.
3. Secure trusses to lift lines with formed cable eyes and compression sleeves, jaw-jaw turnbuckles and formed steel clamps bolted around the top and bottom truss chords with appropriately rated fasteners.
4. Truss Panel Splices
5. Provide truss length depicted for each set on the Drawings. Incorporate full pipe sections for each member with only one partial section located on center line. Drill both ends of the bottom chord for extensions.

H. Batten Hanging Devices:

1. Provide one type of batten hanging device within the system as described below.
2. Batten Clamps:
 - a. Provide connections to each lift line turnbuckles by removable steel clamps which encircle the complete circumference of the batten and allow for direct connection to the jaw of the turnbuckle. Employ appropriately rated fasteners with locking devices for connections.
 - b. Configure the devices to each resist the complete loads of both adjacent spans with the additional imposed impact factors. Configure the devices to resist rotation of the batten with a load of 30 pounds per linear foot of the longest adjacent span applied at 12 inches horizontally from the section's centroid.
 - c. Configure devices so that the bottom and sides do not exceed the diameter of the batten by more than one batten diameter. Configure devices so that no sharp edges or corners greater than 45 degrees are presented.
3. Trim Chain:
 - a. Provide 36-inches long fabricated from 1/4-inch alloy, specifically designed for overhead lifting applications. Provide chain that is rated to resist the complete loads of both adjacent spans with the additional imposed impact factors.
 - b. Wrap chain 1 1/2 times around the batten and terminate with appropriately rated and installed hardware. Provide appropriately rated fasteners and hardware with locking devices for connections.
 - c. Provide chain that is compatible with industry-recognized chain hardware. Chain link size shall match the Welded Steel Chain Specifications for Grade 30 Proof Coil Chain as specified by the National Association of Chain Manufacturers.
 - d. Provide chain that is stamped with the manufacturer's identifying mark.
 - e. Provide chain that is lot traceable, with a coded date stamp on each piece of trim chain.
 - f. Provide chain and connection devices specifically designed for overhead lifting as defined to OSHA (29 CFR 1926.251).
 - g. The use of hardware not designed for connections in overhead lifting, such as bolts used as safety devices, will not be accepted.
 - h. Provide certification of compliance from the manufacturer for the intended application.

4. Provide batten clamps, as described above, for all lighting raceway and orchestra shell battens.

2.4 COMPONENTS

- A. Clips, Wire Rope: Size "U"-bolt wire rope clips (Crosby Clips) appropriately for the cable construction, diameter and lay of the cable with which they are employed.
 1. Saddle material: Drop forged steel
 2. "U" bolt and nut material: Steel
 3. Finish: Hot dip galvanized
 4. Federal Specification: FF-C-450 Type 1 Class 1
- B. Compression Sleeves: Size compression sleeves appropriately for the cable construction and diameter of the cable with which they are employed.
 1. Material: Copper
 2. Cable connection sleeves: Oval pattern
 3. Cable stop sleeves: Cylindrical pattern
 4. Military Specification MIL-51844
- C. Eyebolts: Size eyebolts for the intended application. Employ dropped forged steel shoulder pattern eyebolts.
- D. Shackles: Size shackles appropriately for the intended application. Execute chain connections with chain shackles; other connections may employ anchor shackles.
 1. Shackle Material: Forged Steel
 2. Pin Material: Alloy Steel
 3. Treatments: Heat Treat and Temper
 4. Pin Type: Safety type bolt type pin or safety type round pin.
 5. Federal Specification: RR-C-271D Type IV or IVB, Grade A or greater, Class 1.
 6. Size the screw pin to ensure that the threads are not included in the bearing surface of the bolt.
- E. Thimbles, Wire Rope: Size wire rope thimbles appropriately for the cable construction and diameter of the cable with which they are employed.
 1. Material: Hot dipped galvanized carbon steel.
 2. Finishing: Free of characteristics detrimental to the rope or adjacent elements.
 3. Federal Specification: FF-T-276b., Type III.
- F. Thimbles, Manila/Fibrous and Synthetic Rope: Size appropriately for the rope construction and diameter of the rope with which they are employed.
 1. Material: Hot dipped galvanized carbon steel.
 2. Finishing: Free of characteristics detrimental to the rope or adjacent elements.
- G. Turnbuckles: Size turnbuckles appropriately for the cable construction and diameter of the cable with which they are employed.

1. Material: Drop forged carbon steel
2. Finish: Galvanized
3. Type: Employ Jaw - jaw type unless otherwise noted.
4. Pins: Round pins and cotter keys.
5. Designation: F 1145 – 92 (Reapproved 2001) An American National Standard Standard Specification for Turnbuckles, Swaged, Welded, Forged. Type 1, Class G.

H. Rigging Lines:

1. Suspend lifted elements by wire ropes, unless specified otherwise herein. Determine the classification of wire rope construction to suit the system operational requirements. Unless specifically required in the Contract Documents, the Contractor's engineer shall determine the classification.
2. Employ continuous lines from the same spool/length, free of knots, splices or mechanical fasteners along their length unless specifically required otherwise in the Contract Documents. Do not employ damaged or deformed cables. Excluding prefabricated systems, cut cable at the site from the manufacturer's spool.
3. Wire Rope: Refer to Section 116100.
4. Synthetic Laid Rope:
 - a. Material: filament and staple/spun polyester wrapped around a polyolefin core.
 - b. Average tensile strength: 10,500 pounds ASTM D-4268 testing.
 - c. Melting point: 330oF.
 - d. Progressive strength loss occurring at: 200oF.
 - e. Resistant to: Chemical and limited ultraviolet corrosion, anticipated physical wear.
 - f. Diameter: 3/4" or as noted in drawings
 - g. Color: White
 - h. Acceptable: Multi-line II, New England Ropes, Inc.

I. Factory Finishing Colors: Refer to Section 116100 for finishing requirements.

J. Signage:

1. Refer to Section 116100 for signage requirements.

2.5 SOURCE QUALITY CONTROL

- A. Work on the systems may be reviewed at the point of manufacture a minimum of one time during fabrication. This review will occur during the final factory checkout prior to shipping, unless the Manufacturer and Architect agree on a more advantageous inspection date.

2.6 SUPPLEMENTARY

- A. Furnish equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Contractor is responsible for the removal of all existing rigging equipment. This includes but not limited to:
 - 1. Battens, rope, sand bags, and blocks from existing hemp system.
 - 2. Main Drape and Main Valences shall be taken down, stored, and reinstalled by the contractor at project completion.
 - 3. Drapery tracks shall be taken down, stored, and reinstalled by the contractor at project completion.
 - 4. Prior to disposal, confirm with owner if any materials or items are desired for retention and turn over for storage. All other material shall be disposed of by contractor.

3.2 ERECTION, INSTALLATION AND APPLICATION

- A. Refer to Section 116100 for execution requirements
- B. Trim sets to provide horizontal track and batten set-up.
- C. Align the center of each batten with the center line of the proscenium opening.
- D. Counterweight Guide Tracks:
 - 1. Locate a complete battery of guide tracks against the stage wall as indicated on the drawings. Extend tracks from the stage floor to the underside of the headblock beam and certify vertical.
 - 2. Splice joints in proper alignment free of burrs and irregularities.
 - 3. Align vertically and horizontally by means of slot holes punched in the fixtures at the mounting and adjusting locations. Achieve final rigid adjustment by use of lock washers.
 - 4. Install guide track system to ensure compliance with the performance requirements of this Section and Section 116100.

3.3 CONSTRUCTION/RIGGING

- A. General:
 - 1. Rig the counterweight system to allow battens to reach the maximum height above the stage floor based on arbor travel and an average low trim of 4'-0" above the finished floor.
 - 2. Rig arbors such that, unless otherwise indicated in the documents, the dead load of the arbor is even with the floor of the loading gallery.
 - 3. Immediately inform the Architect of conflicts between trim height, obstructions, and arbor capacities.
 - 4. Rig other loads as specified in the Contract Documents.
- B. Block Connection:
 - 1. Align blocks as required by the Drawings and accompanying schedules. Conform alignment to the requirements set forth herein.

2. Secure blocks as per accepted mounting design. Where connection device contact is not uniform, employ shims. Perform mounting to ensure blocks are securely attached to the support structure and are immobile except by intentional user action.

C. Fiber Rope Connection and Reeving:

1. Purchase Line Employ rope fastenings which develop not less than 75% of the manufacturer's rated breaking strength of the rope employed.
2. Reeve typical linesets with the specified wire rope for the lift lines and 3/4" synthetic rope for the purchase lines.
3. Employ one continuous length of rope for each purchase line. The lengthening, joining or repairing of two or more sections of rope is prohibited. Mid-line splices are unacceptable.
4. Dead tie line with a thimble at the top of the arbor and two half hitches. Finish free end with two (2) serrated, self locking nylon cable ties, which should completely and neatly align rope dead end to live end. Trim ties after tightening. Whip the free end then cut. Pass the line up and over the headblock, down through the rope lock, under the tension block and tie off at the underside of the arbor, employing the same method of attachment as described above. Finish synthetic lines per manufacturer's recommendations.
5. Adjust the length of the line after initial stretch to ensure proper function of the tension block.

- D. Counterweights: Balance battens hung with permanent attachments (connector strips, traveler tracks, etc.).

3.4 DRAPERY AND TRACK INSTALLATION

- A. Remove and store drapery track for reinstallation at end of project.
- B. Reinstall drapery track at end of project.

3.5 ADDITIONAL INSTALLATION

- A. Cable Management: Install electrical cable management as specified herein, and/or as indicated on the drawings.
- B. Signage:
 1. Install signage employing mechanical fasteners.
 2. Install signage as described in 1161 00.

3.6 TESTING, DEMONSTRATION AND INSTRUCTION

- A. Refer to Section 116100 for requirements.

3.7 MANUALS, DEMONSTRATION AND INSTRUCTION

- A. Provide a total of twelve (12) hours of training on this equipment. Training may occur in conjunction with other systems under this contractor's scope over multiple days.

- B. Training shall be scheduled at a time agreed upon by the owner, and may not be concurrent with system commissioning and testing.
- C. Provide instruction and maintenance manuals pursuant to Section 116100

3.8 EQUIPMENT AND COMPONENT SCHEDULES

- A. See Drawings

END OF SECTION 116133