091. THEATER STAGE RIGGING AND MACHINERY (7-1-97)

01. Scope: (7-1-97)

a. This section contains fundamental requirements essential to providing a safe work area. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. Theater operations shall comply to all other applicable requirements of this standard, as well as the following provisions. (7-1-97)

02. Definitions: For definitions of terms used in this section, see sub-section 010 of this standard. (7-1-97)

a. Batten is a steel pipe or wooden bar used to support scenery, curtains, and lights. Usually suspended from the gridiron or roof structure. (7-1-97)

b. Bridge is a movable steel structure suspended over a stage or audience area usually used for suspended lighting instruments. (7-1-97)

c. Captured Stage Equipment is machinery, such as electro-mechanically or hydraulically driven wagons or turntables, that are part of the structure of the building or are contained in a temporary stage floor. (7-1-97)

d. Catwalk is a steel structure over the stage and/or the audience area used by stage personnel to cross from one side to the other. (7-1-97)
e. Controlled Stop is a timed deceleration of a moving device. (7-1-97)

f. Counterweights are a system of variable weights used to counterbalance loads placed on battens that are moved vertically. (7-1-97)

g. Counterweight Carriage is a metal frame that holds the counterweights used to balance the weight of flown scenery. Also referred to as the arbor, cradle, or carriage. (7-1-97)

h. Dead Hung is when battens or similar equipment is permanently supported from the rig and cannot be easily lowered to the stage floor. (7-1-97)

i. Fly is to move scenery or similar devices vertically on the stage. (7-1-97)

j. Fly Gallery is a platform attached to the side wall of the stage house used to operate the rigging devices. (7-1-97)

k. Fly Loft is the space above the presidium of the stage and below the grid. (10-1-06)

l. Grid, Gridiron is a steel framework above the stage area used to support the rigging system. (7-1-97)

m. Hard Contact is a sudden or uncontrolled stop of the counterweight carriage caused by hitting the upper or lower limits of the system. (7-1-97)

n. Head Block is the first sheave or pulley that is directly above the counterweight carriage or winch with the principal function of changing the direction of the lifting lines from vertical to horizontal. (7-1-97)

o. Hemp System is a system of non-stretching ropes used to support or raise and lower scenery. (7-1-97)

p. Loading Gallery Platform is a platform attached to the side walls of the stage house used for the loading or unloading of the counterweight carriages. (7-1-97)

q. Loft Block is the pulleys or sheaves directly above the batten used to change the direction of the working lines from the horizontal to the vertical. (7-1-97)

r. Motorized Rigging is a system of electric or hydraulic motors used to raise and lower battens or counterweight carriages. (7-1-97)

s. Pin Rail is a part of the hemp system consisting of a wooden rail or metal pipe attached to the fly gallery and fitted with removable steel or wooden pins used in the tying off of the working lines. (7-1-97)

t. Pit is a recessed area in front of the stage used principally by musicians. It can also be covered and used as an extended forestage. (7-1-97)
u. Rigging is the general term describing systems used to raise and lower or move stage equipment. (7-1-97)

v. A Line Set is a unit of rigging consisting of the batten and all other support cables, sheaves, and mountings. (7-1-97)

w. Spreader Plates are movable steel plates on a counterweight carriage/arbor used to keep the arbor rods from spreading and preventing the counterweights from falling out in case of a sudden stop. (7-1-97)

x. Stage House is that portion of a theater building containing the stage area, fly loft, grid, and galleries. (7-1-97)

y. Stage Supervisor is a person charged with the responsibility of directing the work of others and the safe operation of stage equipment. (7-1-97)

z. Sheave is a grooved wheel in a block or pulley. (7-1-97)

aa. Technical Stage Equipment is a general term indicating the equipment used on a stage to support the movement of scenery, lighting equipment, or people (7-1-97)

bb. Traps are sections of the stage floor that can be removed to access the under stage area. (7-1-97)

c. Turntable is a rotating platform or portion of the stage floor. (7-1-97)

dd. Winch is a manual or power operated device used to wind a wire rope to raise and lower stage equipment. (7-1-97)

ee. Wagon is a movable platform on casters or wheels. (7-1-97)

ff. Well is the space between the beams on the grid over which loft blocks are placed and that allow the working lines to drop to the batten. (7-1-97)

03. General Requirements: (7-1-97)

a. Operation, maintenance, and repair work on stage equipment shall be done only by those persons having proper training and qualifications. (7-1-97)

b. Persons charged with the operation of stage equipment shall be thoroughly instructed as a minimum in the following: the operation and functioning of the equipment, the safe recommended use of the equipment, the necessary routine maintenance necessary for safe operation of stage equipment, the operation of all safety devices, possible dangers during normal operations as well as the increased danger potential during improper operation, and procedures for accidents and malfunctions. (7-1-97)
c. Warnings for a given piece or similar group of stage equipment shall be visibly mounted at the operation and/or control station. Such warnings shall be brief and concise. (7-1-97)

d. Where suspended scenery components are moved by guided hand-pulled ropes or wire ropes, the maximum pull weight of the components shall not exceed forty (40) pounds. Should this not be the case, the scenery component shall be balanced with a counterweight to bring the imbalanced to less than forty (40) pounds. EXCEPTION: During load-in and strike of scenery when proper precautions are taken. When using types of riggings that make it impossible to accomplish a maximum pull weight of less than seventy-five (75) pounds. (7-1-97)

04. Equipment:

a. Stage equipment shall be installed, operated, and maintained according to the manufacturers recommendations. (7-1-97)

b. Stage equipment shall be inspected before use, after any alterations, and at regular intervals. These inspections shall be conducted by a person with training and knowledge in the field of stage rigging and stage machinery. (7-1-97)

c. Stage equipment found to have defects which may result in personal injury or property damage shall be declared unsafe and rendered inoperative until such time as the defects have been corrected. (7-1-97)

d. Buffering or shock absorbing devices, which reduce the hard contact between the counterweight carriage and the upper and the lower stops, shall be installed. (7-1-97)

e. The installed counterweights shall be secured against falling from the counterweight carriage during operation. (7-1-97)

f. Counterweights stored on the deck of the gallery/platform shall not exceed seventy-five (75) percent of the total deck area. (7-1-97)

g. The area of the deck immediately in front of the counterweight carriages shall be kept clear at all times. (7-1-97)

h. Motorized counterweight systems shall have safeguards to prevent persons from accidentally reaching or walking into the path of the moving counterweight carriages. (7-1-97)

i. Spreader plates, top spacers, hold down plates, and related equipment shall be manufactured in such a way as to be safely secured until needed. Spreader plates shall be employed at all times. Each counterweight carriage shall have enough spreader plates to allow one plate for every 3-lineal feet of applied counterweight. Counterweight carriages shall be marked in such a way as to indicate the appropriate locations of spacer plates during loading process. (7-1-97)
j. The floor of the loading gallery or catwalk, and the bottom of the counterweight carriage at maximum high trim, shall allow for safe access at all times to the entire counterweight carriage. (7-1-97)

k. The flying system design and installation shall provide an alternate mechanism, other than the rope lock, to prevent counterweight carriage travel during loading and unloading operations. (7-1-97)

l. Manual rigging systems without a loading floor shall be provided with a capstan winch capable of raising or lowering a fully loaded out of balance counterweight carriage. (7-1-97)

m. Trim chains shall have a safety factor of eight-to-one (8:1) and shall be attached to the lifting line or wire rope with use of appropriately sized thimbles and wire rope clamps or thimbles and Nicopress sleeves. For temporary attachment to a batten, one and one-half (1 1/2) wraps around are around the batten with the chain attached to itself with load rated hardware. (7-1-97)

n. A manufacture's label shall be conspicuously and permanently (original not to be removed) attached to each piece of technical stage equipment, rigging, and wire ropes. (7-1-97)

o. Visible and permanent system capacity information shall be posted at a location which is easily seen by the operator. (7-1-97)

p. Master switches, emergency switches, emergency keys, or other devices with a similar purpose shall be identified and conspicuously marked. (7-1-97)

q. Those parts of technical stage equipment which requires lubrication and maintenance shall be safely and easily accessible and serviceable. (7-1-97)

r. Rotating and moving machinery parts shall be covered and/or protected so that persons cannot be injured. (7-1-97)

s. The speed of moving equipment shall be adapted to operating conditions. (7-1-97)

t. When moving stage equipment is used, the operator shall have constant visual contact with the moving piece. If this is not possible, a spotter or visual monitoring device shall be used. (7-1-97)

u. A control switch shall be located within reach of the operator. (7-1-97)

v. Moveable or temporary lights hung on a batten or similar device shall have safety chains or cables. (10-1-06)

05. Suspended Work Areas: (7-1-97)

a. Gridiron, catwalks, and loading galleries shall be accessed only by personnel directly engaged in work in these areas. (7-1-97)
b. Prior to engaging in overhead work all line sets shall be secured and all areas below shall be secured to prevent unauthorized entry. (7-1-97)

c. No overhead work shall be accomplished above the audience without proper safety precautions to protect the audience. (7-1-97)

d. Personnel, engaged in operations where overhead work is being accomplished above, during load-in, and during strike, shall wear hard hats. (7-1-97)

e. No objects may be stored or temporarily placed on the gridiron. Proper containers shall be provided for those items used during maintenance, set up, and strike. (7-1-97)

f. All tools shall be tethered to either the structure or the user. (7-1-97)

g. All temporary equipment such as lights shall be provided with a safety tether. (7-1-97)

h. Galleries, gridiron, and catwalks shall be equipped with standard guardrails and toe boards that meet the requirements of sub-sections 070.14.b and 070.16.c of this section. Where needed for the proper placement or operation of equipment railings may be temporarily removed provided other suitable fall protection is provided and used. (7-1-97)

i. An Idaho licensed Structural Engineer shall determine the capacity of the galleries, gridiron, and catwalks and these capacities shall be clearly posted. (7-1-97)

j. Lighting bridges and work gangways, which are not permanently connected to the structure of the building, shall be equipped to assure safe access. (7-1-97)

06. Hoisting: (7-1-97)

a. Hoisting equipment shall be secured against unauthorized and inadvertent use. (7-1-97)

b. Wire ropes for the suspension of flying equipment shall have a minimum safety factor of not less than 8. (7-1-97)

c. Permanent powered pulling, lowering, and lifting devices shall have two (2) limit switches for the lowest and two (2) limit switches for the highest positions. Temporary powered pulling, lowering, and lifting devices shall have one (1) limit switch for the lowest and one (1) limit switch for the highest positions. (7-1-97)

d. Individual counterweights used in working sets shall not exceed forty (40) pounds. Weights used to offset heavy permanent loads on electrics, light bridges, house curtains, and the like shall be sized as required. (7-1-97)

e. All components utilized in stage rigging equipment shall be specifically recommended by their manufacturer or trade organization for hoisting applications. They shall be installed and used in accordance with the manufacturer's specifications. (7-1-97)
07. Drives: (7-1-97)

a. Positive locking connecting devices between the drive and the driving pulley, the wire rope drum, the shaft, the sprocket wheel, etc., are permitted without restriction. Only positive connecting devices which connect the drive with the driven shall be allowed. The drive and the driven may be disconnected for servicing only after the load has been secured against any movement. Before and during any servicing which requires the drive to be disconnected from the driven, all attached loads shall be safely restrained from movement. (7-1-97)

b. Technical stage equipment with hydraulic drives shall safely prevent impermissible pressure increases. (7-1-97)

c. Hydraulic and electro-mechanical power systems shall have adjustable limit stops for the final operating positions. (7-1-97)

d. When the direction of travel is to be changed in hydraulically driven equipment, the movement of the device shall come to a controlled stop before the change of direction is executed. (7-1-97)

e. Hoses for hydraulic devices shall be certified by the manufacture for the maximum design pressure for the given application. (7-1-97)

f. High pressure tubing and piping shall be correctly and rigidly secured to the structure in order that whipping is prevented should a rupture occur. In temporary and permanent installations care shall be taken to secure the devices to the floor, the building structure, and equipment frame. (7-1-97)

g. Technical stage equipment with optional manual or power drive, selection shall be mutually exclusive, so that one drive is completely switched off while the other drive is in use. (7-1-97)

h. Manually operated technical stage equipment shall be designed in such a way that the force used by the operator does not exceed 50-pounds. (7-1-97)

i. Press fits alone shall not be permitted in drive elements which transmit torque for vertical load movements. (7-1-97)

j. Lowering of loads shall be done under power. EXCEPTION: Protective curtains. (7-1-97)

08. Brakes and Locking Devices: (7-1-97)

a. Manually operated winches shall be equipped with an effective locking device against return motion and with a self locking brake. This equipment is not necessary if self locking gears are used. (7-1-97)
b. The brakes of manually operated winches shall be designed as load-pressure brakes. If the winch is equipped with a ratchet handle, the movement of the handle shall not exceed sixty (60) degrees total travel, or plus/minus thirty (30) degrees from center with the brakes set. (7-1-97)

c. Winches with hand cranks designed to hold suspended loads shall have a brake that is normally in the set position. The locking element used for this purpose shall create a positive lock with the drum. (7-1-97)

d. Power driven hoisting units shall be equipped with spring loaded electrically or hydraulically released brake capable of stopping the rated load within a reasonable distance. (7-1-97)

e. Horizontal pulling devices not driven via worm gears shall have one brake. Horizontal pulling devices driven via worm gears with a 40:1 or greater ratio bo not require a brake. (7-1-97)

09. Wire Ropes:

a. The safe working loads of a wire rope shall be determined by dividing the manufacturer's stated breaking strength by the applicable wire rope safety factor. (7-1-97)

b. For horizontally moved stage equipment the pulling lines shall have a minimum safety factor of six (6). (7-1-97)

c. For vertically moved stage equipment the wire rope shall have a minimum safety factor of eight (8). (7-1-97)

d. Braided wire ropes and plastic fiber wire ropes shall not be used as load bearing wire ropes. (7-1-97)

e. Natural and synthetic fiber lines are permitted for use as the principal suspension components only in "hemp" flying systems or in horizontally moved devices. Natural and synthetic fiber lines shall not be used as load bearing lines in winch and counterweight flying systems. (7-1-97)

f. Wire ropes shall be attached safely and durably. Installation of attachment devices shall meet manufacturer's specifications. (7-1-97)

g. Wire rope ends attached to drums shall be positively secured within the drum. (7-1-97)

h. Motorized vertically moving stage equipment using wire rope wound on drums shall be equipped with a device which will immediately stop the drive when the wire rope becomes slack. (7-1-97)

i. Motor driven drums shall be manufactured so that the wire rope is wound in a single layer only. All metal drums shall have machined grooves. EXCEPTION: Drums which allow the wire rope to stack only on its own width on the drum. (7-1-97)
j. Motor driven winches shall be manufactured so as to prevent the wire rope from leaving the ends of the drum. (7-1-97)

k. Winches using grooved drums shall include a device or procedure which will prevent the wire rope from jumping the assigned groove. (7-1-97)

l. Winch drums shall be dimensioned so that a minimum of three (3) windings or dead wraps of wire rope remain on the drum at all times. (7-1-97)

m. The diameter of drums and pulleys shall be no less than thirty (30) times the diameter of the wire rope used. (7-1-97)

n. The fleet angle of the wire rope leaving the drum shall be no more than plus or minus two (2) degrees. (7-1-97)

o. Shivs and pulleys shall be grooved to match the diameter of the rope or cable being used. (7-1-97)

10. Machinery Captured in the Stage Floor: (7-1-97)

a. Safety measures for removable and disassembly type turntables shall be explained in an operations and procedures manual. Appropriate warning labels shall be permanently attached to the equipment. (7-1-97)

b. The horizontal distance between fixed and movable stage floor surfaces shall not exceed three-eighths (3/8) inch. The vertical distance between the fixed and movable floor surfaces shall not exceed one-eighth (1/8) inch. (7-1-97)

c. The movement of captured stage equipment shall be indicated by both audible and visual warning signals. The audible signal may be disabled during performances if the signal interferes with the performance. The visual signal shall remain in operation during all periods of movement. The visual signals shall be placed in locations so as to be visible to persons endangered by the movement of equipment. Visual and audible signals shall be placed at all operating locations. (7-1-97)

d. All personnel, including new employees and persons who are temporarily present on the stage, shall be instructed on the purpose and the use of the signals. Instructions shall be posted at the stage entrance(s). (7-1-97)

e. Trap door covers shall be opened or closed only under the direction of the stage supervisor. The openings in the stage floor shall be promptly secured when not in use. (7-1-97)

f. Permanent trap covers which are built into the stage floor shall incorporate flush mounted lifting devices accessible from the stage surface. (7-1-97)
g. Temporary guardrails and warning signs shall be promptly erected around the floor opening. The guardrails and warning signs may be removed during performances and rehearsals but shall be replaced promptly upon completion of the performance or rehearsal. (7-1-97)

h. Captured stage machinery shall be accessed only after instruction of the stage supervisor. All safety requirements shall be observed with the utmost care. When entry or egress from moving captured stage wagons is required, measures shall be taken to ensure safe footing and adequate training is provided. (7-1-97)

i. Combustible decorations, scenery, properties, etc. shall not be stored in the trap room or machinery areas. (7-1-97)

11. Electrical: (7-1-97)

a. All electrical installations shall be in compliance with the National Electrical Code and this standard. (7-1-97)

b. All switches shall be of the externally operable type. (7-1-97)

c. Dimmers, including rheostats, shall be placed in cases or cabinets that inclose all live parts. (7-1-97)

d. Stage switchboards shall be of the dead-front type. (7-1-97)

e. Stage switchboards having exposed live parts on the back of such boards shall be enclosed by the building walls, wire mesh grills, or by other approved methods. (7-1-97)

f. All electrical supply conductors and connectors shall be protected against physical damage. (7-1-97)

g. Electrical devices used for simulating lightening, waterfalls, and the like shall be so constructed and located that flames, sparks, or hot particles cannot come into contact with combustible material. (7-1-97)