092. ARENA AND MULTI-PURPOSE FACILITY RIGGING AND MACHINERY

01. Scope

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. Arena and Multi-Purpose Facility operations shall comply to all other applicable requirements of this standard, as well as the following provisions. (7-1-97)

02. Definitions

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. 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)

c. Drive Damage is any event that would impair, alter, or diminish the safe operation of the drive. (7-1-97)

d. Fly is to move equipment, scenery, light trusses, or similar devices vertically. (7-1-97)

e. Grid, Gridiron is a steel framework used to support the rigging system. (7-1-97)
f. 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)

g. Motorized Rigging is a system of permanently installed electric or hydraulic motors used to raise and lower battens. (7-1-97)

h. Rigging is the general term describing systems and equipment used to raise and lower or move stage equipment. (7-1-97)

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

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

k. Technical Stage Equipment is a general term indicating the equipment used on a stage. (7-1-97)

l. 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)

m. Winch is a manual or power operated device used to wind a wire rope to raise and lower stage equipment. (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 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. Brief and concise instructions for a given piece or similar group of stage equipment shall be visibly mounted at the operation and/or control station. (7-1-97)

04. Equipment:

a. All rigging equipment shall be manufactured, installed, operated, and maintained in accordance with the manufacturers recommended specifications. (7-1-97)

b. All rigging equipment shall be inspected before use, after any alterations, and at regular intervals. These inspections shall be conducted by a person having extensive training and knowledge in the field of rigging and stage machinery. (7-1-97)
c. Rigging 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. For overhead lifting, the minimum safety factor of five-to-one (5:1). All lifting lines consisting of wire rope must contain appropriately sized thimbles and wire rope clamps or thimbles and Nicopress sleeves. For the lifting of humans, the minimum safety factor must be ten-to-one (10:1). (7-1-97)

e. Manufacture's labels shall not be removed from technical stage equipment and rigging equipment. (7-1-97)

f. System capacity information shall be posted at a location which is easily seen by the operator. (7-1-97)

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

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

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

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

a. Gridiron and catwalks shall be accessed only by competent personnel directly engaged in work in these areas. (7-1-97)

b. Prior to engaging in overhead work, all areas below shall be secured to prevent unauthorized entry. (7-1-97)

c. No overhead work shall be accomplished above 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 and other protective equipment as appropriate. (7-1-97)

e. No unsecured 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 movable equipment such as lights, etc. shall be provided with a safety tether. (7-1-97)

h. Gridiron and catwalks shall be equipped with standard guardrails and toeboards that meet the requirements of sub-sections 070.14.b and 070.16.c of this standard. 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. A competent structural engineer shall determine the capacity of the gridiron and catwalks and these capacities shall be clearly posted. (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 five (5). (7-1-97)

c. Powered pulling, lowering, and lifting devices shall have limit switches for the lowest and highest positions. EXCEPTION: Chain hoists used in temporary installations. (7-1-97)

d. All components utilized in 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. Technical stage equipment with hydraulic drives shall safely prevent impermissible pressure increases. (7-1-97)

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

c. Hydraulically and electro-mechanically driven equipment shall have acceleration/deceleration ramps which prevents sudden inertial changes to any attached items. These ramps shall function at all times and in all positions. EXCEPTION: In an emergency situation when the emergency stop switch is activated. (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. Press fits alone shall not be permitted in drive elements which transmit torque for vertical load movements. (7-1-97)

i. 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 forty-to-one (40:1) or greater ratio do 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. In temporary applications, for overhead lifting, the minimum safety factor is five-to-one (5:1). (7-1-97)

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

d. Installation of wire ropes and attachment devices shall meet manufacturer's specifications. (7-1-97)

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

g. Motor driven winches shall be manufactured so as to prevent the wire rope from leaving the ends of the drum. (7-1-97)

h. Winches using grooved drums shall include devices which will prevent the wire rope from jumping the assigned groove. (7-1-97)

i. 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)

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

k. Sheaves and pulleys shall be grooved to match the diameter of the rope or cable. (7-1-97)

10. 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 shall be placed in cases or cabinets that inclose all live parts. (7-1-97)

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

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

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