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Overhead mounting of luminaires, lighting accessories, and other portable devices: specification and practice

Approved by the ANSI Board of Standards Review on _____

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Entertainment Services and Technology Association (ESTA)
271 Cadman Plaza PO Box 23200
Brooklyn, NY 11202-3200
USA
Phone: +1-212-244-1505
Email: standards@esta.org

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Contact Information

Technical Standards Manager

Richard J. Nix
ESTA
271 Cadman Plaza PO Box 23200
New York, NY 11202-3200
USA
+1-212-244-1505
richard.nix@esta.org

Technical Standards Council Chairperson

Alan Rowe
I.A.T.S.E Local 728
Phone: 1 310-702-2909
amrowe@iatse728.org

Electrical Power Working Group Co-chairpersons

Justin Bennett
University of the Incarnate Word
Phone: 1-210-829-3809
jbennett@uiwtx.edu

Mitch Hefter
Phone: 1-972-839-8488
mkhefter.p@DesignRelief.com

Acknowledgments

The Electrical Power Working Group members, when this document was approved by the working group on , are shown below.

Voting members:

Observer (non-voting) members:

Interest category codes:

CP = custom-market producer
DE = designer
DR = dealer rental company
G = general interest
MP = mass-market producer
U = user

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1 Introduction (informative)

This Standard is being drafted to address a problem that concerns Actors' Equity and its members. The Chief Outside Business Representative for Actors' Equity wrote to ESTA Technical Standards Manager, describing some near-misses with falling lighting equipment, and asking what standards exist or might be drafted to cover the proper rigging of equipment so it does not fall and endanger performers. There is very little now written that would tell anybody hanging lighting equipment how it should be hung and accessories installed, and if a safety cable should be used.

UL 1573, Stage and Studio Luminaires and Connector Strips, has tests for the structural strength of a luminaire and its mounting hardware, and also tests for safety cables and safety chains, but these tests only apply to the manufactured luminaires, not to after-market accessories. Furthermore, the standard says nothing about how a stage technician is to use these mounting devices.

The European standard for stage and studio luminaires, EN 60598-2-17, is similar to the UL standard in that it gives strength requirements for suspension devices, but it goes beyond the UL standard in that it requires a back-up suspension device (e.g., a safety cable) to be provided. However, the C-clamp or other primary mounting is optional—a luminaire can be considered complete even without any mounting device —and it doesn't require anyone to use it or a safety cable.

Luminaire manufacturer's instructions would be expected to tell a person how to safely hang an instrument. However, very few do, and those that do do not cover all aspects of instrument hanging.

Falling equipment is a big problem for the person standing under the equipment when it falls. Furthermore, equipment is falling often enough that actors are worried about it and are complaining to their business representatives. Worry is something that can grow with very little to feed it. Uncontrolled worry is a problem that affects the success of any show. The easiest way to control worry is to remove the source of it—in this case by reducing the frequency of falling equipment and by making it clear what wasn't done but should have been done when equipment does fall.

2 Scope (normative)

This Standard shall apply to the mounting of portable stage and studio luminaires and accessories mounted overhead in stages, auditoriums, and other places of public assembly, and also in film and video studios. It shall also apply to the mounting of portable effects machines such as fog machines, bubble machines, and other devices and loudspeakers of size and weight similar to that of stage and studio luminaires and normally mounted in a similar manner (e.g., mounted with c-clamps, hook-clamps, or similar luminaire suspension hardware).

This Standard does not apply to permanently mounted architectural luminaires or fixtures, nor does it apply to track lighting luminaires that are both supported and powered by electrical contacts that engage power buses inside a lighting track.

3 Definitions (normative)

3.1 Accessories: devices that are field-attached to equipment to modify its performance. Examples include barndoors, top-hats, and color changers attached to luminaires, and hoses or fans attached to fog machines.

3.2 Intended Load: the total weight that is to be supported by a mounting device. For example, the intended load for a C-clamp supporting a luminaire outfitted with a color changer and barndoors would be the sum of the weights of the luminaire, the color changer, the barndoors, the power or control cables hanging from the luminaire, and the C-clamp.

3.3 Mounting position: the part of the overhead rigging system or building structure to which Supported Equipment is to be attached. Examples would include rigging battens, truss tubes, box booms, and sidelight booms.

3.4 Primary mounting devices: the devices that are intended to be the main support for equipment within the scope of this Standard. Some supported equipment requires two Primary Mounting Devices. Examples would be c-clamps, stirrups, and hook-clamps.

3.5 Secondary safety devices: devices that are intended to stop the fall of Supported Equipment if the Primary Mounting Device(s) fails. Examples would be safety cables and safety chains.

3.6 Supported equipment: portable equipment that is within the scope of this Standard and attached to a Mounting Position.

3.7 Test load: a load used for testing the ability of a Primary or Secondary Safety Device to support an Intended Load.

3.8 Use: the act of installing a Primary or Secondary Safety Device to support equipment.

4 Hardware specifications (normative)

4.1 Primary Mounting Devices

Primary Mounting Devices (C-clamps, stirrups, etc.) shall be able to support the Intended Load. The ability of the Primary Mounting Device to support the Intended Load shall be certified by the mounting device being rated by the manufacturer or proof-tested per clauses 4.1.1 or 4.1.2.

4.1.1 Rated Primary Mounting Devices

Primary Mounting Devices shall be rated for a load equal to or greater than the Intended Load. The load rating shall be indelibly marked on the mounting device and indicated as "Safe Working Load," “SWL,” "Working Load Limit," “WLL,” or some other phrase that will indicate to the end-user the maximum load the Primary Mounting Device should be expected to hold. Unmarked devices shall be considered unrated.

4.1.2 Unrated Primary Mounting Devices

Unrated Primary Mounting Devices shall be individually proof-tested to twice the anticipated load, per clause 6.1 and its subclauses before use.

4.1.3 Environmental Suitability

The Primary Mounting Device shall be made of material suitable for the environment of its use. It shall be not be weakened by light, temperature, water, or solvents it reasonably might be expected to be exposed to in use.

4.2 Secondary Safety Devices

4.2.1 Rated Secondary Safety Devices

Secondary Safety Devices shall be rated to arrest a falling load equal to or greater than the Intended Load, when the Secondary Safety Device is installed according to the manufacturer's instructions. The load rating shall be indelibly marked on the Secondary Safety Device. Unmarked devices shall be considered as unrated.

4.2.2 Unrated Secondary Safety Devices

Unrated Secondary Safety Devices shall be individually proof-tested to six times the Intended Load per clause 6.2 and its subclauses before use.

4.2.3 Environmental Suitability

The Secondary Safety Device shall be made of material suitable for the environment of its use. It shall not be weakened by light, temperature, water, or solvents it reasonably might be expected to be exposed to in use.

5 Practice (normative)

5.1 Equipment Inspection

The Supported Equipment and Mounting Devices (primary and secondary) shall be inspected for structural integrity before use. Equipment with missing or broken parts, or otherwise defective, shall not be used.

5.2 Attaching Primary Mounting Device(s)

Primary Mounting Device(s) shall be attached to the Supported Equipment according to manufacturer's instructions. Unless the manufacturer's instructions specifically say the contrary, the fastening shall be firm, but not so tight as to damage the Supported Equipment.

Primary Mounting Device(s) shall be attached to the Mounting Position according to the mounting device manufacturer's instructions. Unless the manufacturer's instructions specifically say the contrary, the fastening shall be firm, but not so tight as to damage the Mounting Position.

The Supported Equipment shall be suspended vertically below the Primary Mounting Device(s); it shall not be above or to the side of the Primary Mounting Device(s) unless the Primary Mounting Device(s) is/are designed for that type of application.

5.3 Secondary Safety Devices

5.3.1 When Secondary Safety Devices are required to be used

Secondary Safety Devices are required to be used whenever the failure of Primary Mounting Device(s) might result in injury to a person. If two Primary Mounting Devices (clamps) are required by the manufacturer, then a Secondary Safety Device is also required. The second clamp should not be considered redundant.

Secondary Safety Devices are not required when the failure of a Primary Mounting Device is unlikely to result in injury to a person, for example, when a luminaire is mounted where there is no possibility of a person being underneath to be hit by falling equipment.

5.3.2 Attaching Secondary Safety Devices

Secondary Safety Devices shall be attached between the Supported Equipment and the Mounting Position to arrest the fall of the Supported Equipment if a Primary Mounting Device should fail. The connection to the Supported Equipment should be made to a point on the equipment designed for Secondary Safety Devices.

The Secondary Safety Device shall be installed so that the Supported Equipment can be easily adjusted, but any fall, if it should occur, shall be limited to a distance of 30 cm or less. The Secondary Safety Device shall be attached to the Mounting Position in such a way that it cannot slip off and become ineffective.

5.4 Securing Accessories

Unless an Accessory is unlikely to cause injury to a person if it falls, the Accessory shall be secured to the Supported Equipment. The Accessory shall be fastened to the Supported Equipment in such a way that it cannot fall if the Supported Equipment is bumped or inverted. Clips that are integral to the Supported Equipment and that require two motions to release them are preferred, but malleable wire of sufficient strength shall be permissible for securing the Accessories.

6 Proof-testing (normative)

6.1 Proof-testing Primary Mounting Devices

6.1.2 The Primary Mounting Device is to be secured to a rigid support and to a Test Load in a manner similar or identical to that described in clause 5.2.

6.1.3 Test Load is to have a weight of not less than twice the Intended Load.

6.1.4 The Primary Mounting Device shall continuously support the Test Load for 1 hour.

6.1.5 The structural members and joints of the Primary Mounting Device and attachment fittings shall not show any visible evidence of material failure such as breakage, cracking, stripping of threads, or slipping of joints.

A Primary Mounting Device that has been tested shall be considered as having a load rating if it is then marked with a marking that indicates the Intended Load.

6.2 Proof-testing Secondary Safety Devices

6.2.1 The Secondary Safety Device is to be secured to a rigid support and to a Test Load using the method described in clause 5.3.2.

6.2.2 The Test Load is to have a weight of not less than six times the Intended Load.

6.2.3 Swinging and movement of the Test Load shall be prevented when the support of the Test Load is transferred to the Secondary Safety Device. The Secondary Safety Device shall continuously support the Test Load for 1 hour.

6.2.4 The structural members and joints of the Secondary Safety Device and attachment fittings shall not show any visible evidence of material failure such as breakage, cracking, stripping of threads, or slipping of joints.

6.2.5 A Secondary Safety Device that has been tested shall be considered as having a load rating if it is then marked with a marking that indicates the Intended Load.

7 Explanatory material (informative)

This section gives the rationale behind the requirements, but it does not reduce the requirements. For example, the section on accessories might mention only a few accessories, but the fact that the list is not exhaustive does not mean that accessories not mentioned do not need to be used in compliance with this Standard. This Standard still applies to them, even if they are not mentioned in the explanatory material.

7.1 Scope

This document is being written primarily to address concerns with stage and studio luminaires coming loose and falling or being knocked during scene shifts and losing barndoors and top hats. However, small fog machines and bubble machines are often mounted on lighting battens with C-clamps or hook-clamps in a manner similar to the way that luminaires are mounted, were cited by Actors' Equity as also being a concern, and are being included in this Standard. Other special effects devices, such as snow drops, that are not normally attached to battens with lighting instrument C-clamps would not be included.

7.2 Attaching the Primary Mounting Device

Few Primary Mounting Devices are offered with instructions for their attachment. In general, the devices need to be attached firmly, but not so firmly as to crush a Mounting Position pipe or truss tube. One manufacturer that does provide instructions suggests tightening the C-clamp bolt affixing it to the batten to 15 to 20 ft. lbs., which is approximately finger tight plus a quarter turn additional with a wrench. The bolt attaching the C-clamp to the luminaire's yoke is to be tightened to about 5 to 10 ft. lbs., which is approximately finger tight with about another eighth turn with a wrench. Further tightening the C-clamp bolt against the batten can damage the batten and adds stress to the C-clamp, increasing the probability that it will fail.

Some Primary Mounting Devices, such as hook clamps, are only designed to support a luminaire hanging directly below the clamp, and the instructions for the clamp say that they are not designed for use with luminaire above the Mounting Position. Other Primary Mounting Devices, such as some brands of extruded aluminum C-clamps, have a load rating for a vertical load suspended directly below the clamp, but no rating if the clamp is used to support the load sticking out horizontally from a vertical boom. The technician attaching the Primary Mounting Device needs to pay attention to how the load will be supported and whether it is consistent with whatever load rating the device has.

7.3 When a Secondary Safety Device(s) is not required

There are a few cases where it will be inconvenient but not unsafe for a luminaire to fall, so a Secondary Safety Device would not be required. An instrument mounted just above the floor would be an example.

7.4 Attaching the Secondary Safety Device

It is common practice to run a safety cable through the inverted-U yoke of an instrument and then over the batten supporting it, next to the C-clamp. This works as long as the yoke of the instrument is not compromised (it is attached to the instrument at both ends and not broken at one end) and the safety cable cannot slip off the batten. If the instrument is mounted at the end of a batten, a C-clamp or other device should be used to keep the safety cable from sliding off.

Some equipment is designed with a mounting point for the Secondary Safety Device. If one is provided, it should be used.

7.5 Securing Accessories

Accessories, such as barndoors and top hats, are the things most likely to come loose and fall, if they are not secured. They need to be held in place with a catch or wired in place.

Gel frames are less likely to fall, but still can if caught by passing scenery or may fall if the luminaire is mounted up-side down. Falling metal gel frames can give nasty cuts if they land on someone. Some gel runners have springs to press against the frames but do not have latches to securely hold the frames in place. The spring pressure will stop rattles, but is unlikely to be adequate for safety.

Accessories do not need to be secured if it is unlikely that anyone will be injured if they fall. A lighting instrument mounted near the floor, so that no one can be underneath it, would be one such case.
Cardboard gel frames also are unlikely to hurt anyone if the fall, so they do not need to be secured. However, securing them might be desirable simply to avoid the embarrassment of one coming loose during a show and falling to the stage.

7.6 Mounting Device load rating and proof-testing

Devices with load-ratings are preferred, but much of the equipment used in North America has no rating. Rather than simply accepting an unrated clamp because it hasn't broken yet, or prohibiting its use, we require that this equipment be proof-tested. If a Primary Mounting Device will support twice its Intended Load for an hour and not break, it's likely to hold the Intended Load through a long Broadway run.

The proof-test for Primary Mounting Devices is taken from UL 1573, except that the Test Load is lower. UL 1573 requires a 6-times Test Load, but it is designed to establish a safe working load limit for an entire production run based on testing only a few samples. In the case of this Standard, we are requiring that each device be tested, so the test criteria can be lower. We are not suggesting that a few mounting devices be tested with the 6-times load and that the results be extrapolated to the whole inventory of unrated Primary Mounting Devices in a theatre or rental shop's inventory, as UL does, because that larger population of mounting devices might come from many different manufacturers or many different production runs.

The proof-test for Secondary Safety Devices in this Standard is essentially identical to the test in UL 1573. We do not lower the load because the UL standard is less stringent than the criteria found in IEC 60598-2-17: Luminaires - Part 2-17: Particular requirements - Luminaires for stage lighting, television and film studios, so we consider this already a derating. We do not suggest using the drop-test found in IEC 60598-2-17 because failure in that test is likely to result in parts flying. That is acceptable in a testing lab, but not in a rental house's shop or backstage in a theatre. The test in UL 1573 is safer for the person doing the testing and is still effective.