ANSI E1.8 - 2012
Entertainment Technology—Loudspeaker Enclosures Intended for Overhead Suspension—Classification, Manufacture and Structural Testing

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The PLASA Technical Standards Program

The PLASA Technical Standards Program was created to serve the PLASA membership and the entertainment industry in technical standards related matters. The goal of the Program is to take a leading role regarding technology within the entertainment industry by creating recommended practices and standards, monitoring standards issues around the world on behalf of our members, and improving communications and safety within the industry. PLASA works closely with the technical standards efforts of other organizations within our industry, including USITT and VPLT, as well as representing the interests of PLASA members to ANSI, UL, and the NFPA. The Technical Standards Program is accredited by the American National Standards Institute.

The Technical Standards Council (TSC) was established to oversee and coordinate the Technical Standards Program. Made up of individuals experienced in standards-making work from throughout our industry, the Council approves all projects undertaken and assigns them to the appropriate working group. The Technical Standards Council employs a Technical Standards Manager to coordinate the work of the Council and its working groups as well as maintain a “Standards Watch” on behalf of members. Working groups include: Control Protocols, Electrical Power, Floors, Fog and Smoke, Followspot Position, Photometrics, Rigging, and Stage Lifts.

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The Rigging Working Group, which authored this Standard, consists of a cross section of entertainment industry professionals representing a diversity of interests. PLASA is committed to developing consensus-based standards and recommended practices in an open setting.

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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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An asterisk (*) next to a clause number indicates there is a matching explanatory clause in Appendix A.

Foreword

The ANSI E1.8 project was initially conceived, developed and subsequently approved as an American National Standard to improve safety with respects to loudspeaker enclosures intended for overhead suspension.

This standard presents a coordinated set of rules that may serve as a guide to regulatory bodies, municipalities and others having jurisdiction responsibilities for inspection of the equipment covered by its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees.

Safety codes and standards are intended to enhance public safety. This revision of the original standard considers evolving changes in industry technology and acceptable practice occurring since the original standard's publication. Revisions do not imply that previous editions were inadequate. Compliance with this Standard does not itself confer immunity from legal obligations.

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1 Scope

1.1 General

This standard covers the requirements for enclosures specifically intended for overhead suspension, but addresses only the structural characteristics of the enclosure pertaining to its suspension, such as enclosure construction, component part security, enclosure suspension hardware, manufacturing control systems, structural testing, and product representation.

1.2 Annex Note References

This document uses annex notes to provide additional reference information about certain specific section requirements, concepts, or intent. Subject matter with a corresponding annex note reference is identified by the asterisk (*) symbol, and the associated reference text is found in the Annex section, identified with the referring text section number – e.g. an Annex Note to section 3.2 will be identified in the annex section as 3.2.

2 Definitions

2.1 competent person: A person who is capable of identifying existing and predictable hazards in the workplace and who is authorized to take prompt corrective measures to eliminate them.

2.2 component: Parts of a whole.

2.3 design factor: A ratio between working load limit and the material strength, expressed as either yield point or failure point depending upon the context of use**.** Example: a design factor of 10 relative to ultimate failure means that the enclosure component or assembly has a design capacity of 10 times the working load limit.

2.4 enclosure: All parts of the loudspeaker system housing or assembly exclusive of the enclosure suspension hardware, electrical wiring, electrical components, acoustical radiating elements and any cover material intended to be user-removable.

2.5 enclosure suspension hardware: Suspension components permanently affixed to the enclosure by the manufacturer.

2.6 manufacturer: Person or company that fabricates enclosures.

2.7 permanent: Not temporary. Affixed and formed in a fashion intended to be functional for the lifetime of use.

2.8 qualified person: a person who, by possession of a recognized degree or certificate of professional standing, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

2.9 shall: Denotes a mandatory requirement.

2.10 should: Denotes an advisory suggestion or recommendation; not mandatory.

2.11 ultimate failure: Stress causing fracture, rupture or other similar catastrophic failure of a component or material, generally designated as F*u* in material properties information.

2.12 ultimate strength: The capacity to resist the maximum force that can be applied without ultimate failure occurring.

2.13 user: Person or company who assembles or uses enclosures.

2.14 working load limit (WLL): Maximum allowable static or equivalent load intended to be applied to an enclosure or a component of an enclosure; rated load.

3 Reference to Other Codes and Standards

The following standards also shall be consulted when planning the design, manufacture, or testing of loudspeakers intended for overhead suspension.

ANSI/ASME B30.20-2010 Below-the-Hook Lifting Devices - Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

ANSI/ASME B30.26-2010 Rigging Hardware -Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

4 Enclosure Classification*

4.1 Enclosures weighing more than 0.0 kg (0 lbs) and less than or equal to 5 kg (11 lbs) shall be designated as Class A.

4.2 Enclosures weighing more than 5 kg (11 lbs) and less than or equal to 15 kg (33 lbs) shall be designated as Class B.

4.3 Enclosures weighing more than 15 kg (33 lbs) and less than or equal to 30 kg (66 lbs) shall be designated as Class C.

4.4 Enclosures weighing more than 30 kg (66 lbs) shall be designated as Class D.

5 Manufacture

5.1 Enclosure Construction

5.1.1 Mechanical

Enclosures shall be constructed in accordance with recognized standards pertaining to the components, materials, connections and construction methods used. When available, known standards should be cited on the print and/or control documentation.

5.1.2 Enclosure Design Documentation

Structural and mechanical strength aspects of enclosure designs shall be documented by the manufacturer.

5.1.2.1 Components included or excluded

Documentation shall include materials, components, processes and methods used to construct the enclosure. Aesthetic aspects, electronic circuitry or electrically powered components are not required in the documentation unless such elements are integral to enclosure strength.

5.1.3 Enclosure WLL*

The enclosure manufacturer shall publish a WLL for enclosures covered by this standard. What constitutes the working load shall be determined by the manufacturer and explained in the documentation for the end-user. Enclosures shall be designed using a minimum design factor of 10, based on the ultimate strength of the enclosure as tested in accordance with this standard.

5.2 Component Part Security

All enclosures containing component parts that can become loose or dislodged from the enclosure shall use installation methods to ensure component security to minimize this risk.

5.2.1 Class A*

Class A enclosures require no additional part security features.

5.2.2 Class B and Class C*

Class B and Class C enclosures requiring component part security shall have a barrier placed in front of component parts and affixed in a manner to minimize the risk of the barrier dislodging from the enclosure. This barrier shall function as a redundant safety measure should any of the enclosure component parts dislodge. Dislodged component parts shall not penetrate the barrier.

5.2.3 Class D*

Class D enclosure shall meet the component parts security requirements of Class C enclosures.

At least 50% of the component part and barrier fasteners shall be of sufficient length to extend through a structural section of the enclosure, and shall be installed in that manner.

5.3 Enclosure Suspension Hardware

Enclosure suspension hardware shall be constructed of materials that are appropriate for the intended use, as determined by a qualified person.

5.3.1 Design Quality

Enclosure suspension hardware shall be designed by a qualified person in accordance with acceptable engineering practice, or shall be tested in accordance with Section 7.

5.3.1.1 Design Calculations or Testing Results

Design calculations or testing results shall validate the suspension hardware strength, shall show that the suspension hardware meets design factor requirements and shall show that it is fit for the intended purpose.

5.3.1.2 Repeatability

The design calculations or testing results shall be repeatable for all material batches of individual components, where their respective material properties may vary for any reason due to component manufacturing processes.

5.3.1.3 Tolerances

The design calculations or testing results shall be repeatable within an acceptable tolerance as determined by a qualified person.

5.3.1.4 Hardware connections

Each hardware component shall be affixed to a minimum of one (1) structural surface of the enclosure. There shall be no less than two suspension points provided for any overhead suspension application. The hardware shall be affixed on the interior of the enclosure with the aid of a reinforcement device so as to prevent all reasonable and foreseeable failure of the enclosure material. The forces imposed on the enclosure shall not exceed the enclosure's design capacity. All orientations allowed by the manufacturer must be considered.

5.3.2 Vibration*

Enclosure suspension hardware utilizing threaded fasteners shall employ a method of resisting the tendency for a fastener to loosen.

5.3.3 Corrosion Resistance

Enclosure suspension hardware shall be corrosion resistant when the foreseeable intended use criteria includes exposure to moisture or other similarly corrosive environments.

5.3.4 Strength

Enclosure suspension hardware shall be designed using a minimum design factor of 5, based on the ultimate strength of load-bearing structural components of the suspension hardware.

6 Quality Control Systems

6.1 Product Identification Marking

Product identification markings shall be permanently affixed to the exterior of the enclosure, and shall be visible under normal working conditions. The product identification marking system should have a minimum ten-year cycle, but shall have a cycle no less than the anticipated design lifecycle of the enclosure. Product identification markings shall include the following information:

The manufacturer's legal name, trade name and other descriptive marking by which the organization responsible for the product can be identified.

The manufacturer's primary location of business operation. If the manufacturer has more than one factory at which the same product is produced or assembled, each product should have a distinctive marking to identify the factory of origin.

A distinctive product number, catalog number or equivalent designation.

Serial numbers or batch numbers that are traceable to the manufacturer.

The WLL of the enclosure.

Instructions shall contain the manufacturer’s recommendations for enclosure suspension and an advisory for the consequences of misuse.

The enclosure classification as defined by this standard.

6.2 Enclosure Traceability

Fabrication and quality assurance processes related to the enclosure's structural integrity and to its rated WLL should be documented as part of the enclosure product traceability system. The manufacturer should retain this information for the anticipated design lifecycle of the enclosure.

6.3 Hardware Traceability

All structural load path components shall be traceable using unique serialization, batch or lot numbers.

6.3.1 Exceptions

For structural load path components where serialization is not practical or feasible, and for raw materials, the manufacturer shall maintain material certifications of physical properties showing that the materials meet or exceed the minimum design criteria necessary to achieve the rated WLL. The manufacturer should retain this information for the intended design lifecycle of the enclosure.

6.4 Quality Control

Enclosure manufacturers shall maintain a written quality control policy for all structural and mechanical strength aspects of enclosures within the scope of this standard. This policy should include procedures for inspection, documentation, product variance, and product approval.

6.5 Quality Assurance

Enclosure manufacturers shall maintain a quality assurance check and sign off procedure for all products within the scope of this standard.

6.6 Training Program

Enclosure manufacturers shall educate all staff involved with the design, manufacture, sale, and support of products within the scope of this standard on the procedures and policies surrounding these products. Training

should be performed no less than annually. Untrained staff shall not be permitted to perform work on products within the scope of this standard, unless directly supervised by a competent person.

6.7 Documentation Revision Policy

Enclosure documentation shall be updated for every modification. Only the most current version shall be used for the manufacture of products. The documentation control identification shall be referenced in the enclosure traceability documentation. A written documentation revision control policy shall be maintained.

7 Testing

Enclosure designs shall be destructively tested to determine an appropriate WLL.

7.1 Test Method

Test methods shall be designed by a qualified person. Any modification or revision to the enclosure structural design effecting a change in WLL shall require a new enclosure test.

7.1.1 Complete Testing

The enclosure design shall be tested in each design load suspension orientation permitted by the manufacturer, using approved enclosure hardware attachment methods.

7.1.2 Test loads

The enclosure shall be tested with a method of gradually increasing load tension until material and/or component failure.

7.1.3 Failure mode

The test shall determine the ultimate strength value for the weakest structural suspension point in the enclosure. If multiple suspension points are used during the test, a reduction in the ultimate strength shall be incorporated to determine the ultimate strength value for a single suspension point. The reduction ratios will vary with material type and shall be determined through independent testing.

7.1.4 Repeatability of Test Results

Tests shall be repeated four (4) times for each design configuration and orientation.

7.1.4.1 Variations in Test Results

The variation of test results from the mean shall not exceed 10 percent. If the variation of any test result from the mean exceeds 10 percent, then the test shall be repeated not less than three (3) more times. The lowest ultimate strength in the test series shall be used as the ultimate strength value for design purposes.

7.1.5 Alternative Test Methods

Alternative testing methods shall be permitted provided that the intent of this section is met, with no exception.

7.2 Test Controls

A qualified person shall perform tests using properly calibrated and maintained test equipment.

7.2.1 Documentation of results

A written performance report, photographs and/or video recording, and a load chart shall document the enclosure design test. The load chart shall indicate the material and/or component failure point. All test procedures and methods shall be written and included with the load chart.

7.2.2 Test information

All documentation shall be clearly marked with the appropriate test name and date information.

8 Manufacturer Product Representation

8.1 Rigging Inquiry Policy

Enclosure manufacturers should maintain a written policy with regard to rigging hardware and overhead suspension product application inquiries. This policy should detail whom, how and under what circumstances loudspeaker manufacturer customer service personnel may offer advice regarding overhead suspension hardware and application.

8.2 Print or Control Documentation Availability Policy

Enclosure manufacturers should maintain a current print or control documentation library for products designed for overhead suspension. These prints or control documents should include dimensions, weights, hardware specifications, location of center of gravity, and all other information that may be required for the proper and safe suspension of the enclosure. This information should be made available in accordance with the manufacturer's print availability policy.

9 Instructions for the Installer and User

The enclosure manufacturer shall provide instructions for installation, use, maintenance and inspection.

9.1 Enclosure Suspension Instructions

Instructions shall include manufacturer's suspension hardware attachment methods for suspending the enclosure in a manner that will not exceed the enclosure's WLL for supporting itself and for any load suspended from the enclosure, if the enclosure is designed for such an application. The load limit Instructions shall include a warning notice to inform the user of the dangers associated with the misuse of the product, for example, "Misuse of product may result in damage, injury, or death."

9.2 Maintenance and Inspection Instructions

Instructions shall include routine maintenance and inspection procedures.

9.3 Customer Service

Enclosure manufacturers shall publish methods of contact for user inquiries about enclosure suspension.

10 Annex Notes (informative)

A.4 Enclosure classification considers that applications more likely to represent risk will also more likely require larger, heavier speaker enclosures. Semi-professional and professional sound reinforcement applications typically occur in larger venues, where the size of audience space requires the use of multiple enclosures connected together in an array configuration. Often, those arrays are configured in a manner where enclosures in the array are suspended from adjacent enclosures. Those types of configurations require special attention to enclosure structural integrity.

A.5.1.3 The working load could be the enclosure itself and nothing more, or it could be the enclosure and a load suspended from it, if the enclosure is designed for that purpose.

A.5.2.1 An example may be a enclosure with a front mounted woofer: in this example the front mounted woofer might be installed utilizing rear-mounted reinforced nuts on the inside of the enclosure with machine screw type fasteners installed with a friction aid such as thread lock adhesive to mount the woofer component.

A.5.2.2 An example may be a enclosure with a front mounted horn and woofer: in this example the front mounted horn and woofer might be installed utilizing rear-mounted reinforced nuts on the inside of the enclosure with machine screw type fasteners installed with a friction aid such as thread lock adhesive to mount the horn and woofer components. Additionally, a metal grill might be installed in front of the horn and woofer to prevent the components and/or fasteners from falling should a component part loosen.

A.5.2.3 Since Classifications are based on the weight of the enclosure, Class D enclosures will generally contain individual components that require structural attachment as part of the component part connection redundancy.

A.5.3.2 Examples include but are not limited to thread lock adhesive, crimped nuts or nylon insert nuts, or nylon patch fasteners.

