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

Document number Rig/1997-2021r16
ANSI E1.8 - 2012
Entertainment Technology—Loudspeaker Enclosures Intended for Overhead Suspension—Classification, Manufacture and Structural Testing

This edition of ANSI E1.8 was approved by the American National Standards Institute on January 15, 2013.

This standard was originally published when the Entertainment Services and Technology Association was operating under the name of PLASA North America. ESTA has reverted to its original name, and this document has been rebranded with the current corporate name and logo. No changes have been made to the contents of the standard.
Notice and Disclaimer

ESTA does not approve, inspect, or certify any installations, procedures, equipment or materials for compliance with codes, recommended practices or standards. Compliance with a ESTA standard or an American National Standard developed by ESTA is the sole and exclusive responsibility of the manufacturer or provider and is entirely within their control and discretion. Any markings, identification or other claims of compliance do not constitute certification or approval of any type or nature whatsoever by ESTA.

ESTA neither guarantees nor warrants the accuracy or completeness of any information published herein and disclaims liability for any personal injury, property or other damage or injury of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. In issuing and distributing this document.

In issuing this document, ESTA does not either (a) undertake to render professional or other services for or on behalf of any person or entity, or (b) undertake any duty to any person or entity with respect to this document or its contents. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstance.

Published by:
Entertainment Services and Technology Association
630 Ninth Avenue, Suite 609
New York, NY 10036
USA
Phone: 1-212-244-1505
Fax: 1-212-244-1502
standards@esta.org
The ESTA Technical Standards Program

The ESTA Technical Standards Program was created to serve the ESTA 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. ESTA works closely with the technical standards efforts of other organizations within our industry, including USITT and VPLT, as well as representing the interests of ESTA 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, Event Safety, Floors, Fog and Smoke, Followspot Position, Photometrics, Rigging, and Stage Lifts.

ESTA encourages active participation in the Technical Standards Program. There are several ways to become involved. If you would like to become a member of an existing working group, as have over four hundred people, you must complete an application which is available from the ESTA office. Your application is subject to approval by the working group and you will be required to actively participate in the work of the group. This includes responding to letter ballots and attending meetings. Membership in ESTA is not a requirement. You can also become involved by requesting that the TSC develop a standard or a recommended practice in an area of concern to you.

The Rigging Working Group, which authored this Standard, consists of a cross section of entertainment industry professionals representing a diversity of interests. ESTA is committed to developing consensus-based standards and recommended practices in an open setting.
Contact Information
Technical Standards Manager
Karl G. Ruling
Entertainment Services and Technology Association
630 Ninth Avenue, Suite 609
New York, NY 10036
USA
1-212-244-1505
karl.ruling@esta.org

Assistant Technical Standards Manager
Erin Grabe
Entertainment Services and Technology Association
630 Ninth Avenue, Suite 609
New York, NY 10036
USA
1-212-244-1505
erin.grabe@esta.org

Technical Standards Council Chairpersons
Mike Garl
Mike Garl Consulting LLC
1-865-389-4371
mike@mikegarlconsulting.com

Mike Wood
Mike Wood Consulting LLC
1-512-288-4916
mike@mikewoodconsulting.com

Rigging Working Group Chairpersons
Bill Sapsis
Sapsis Rigging, Inc.
1-215-228-0888 x206
bill@sapsis-rigging.com

Christine Kaiser
Syracuse Scenery & Stage Lighting Co., Inc.
1-315-453-8096
ckaiser@syracusescenery.com
Acknowledgments
The Rigging Working Group members, when this document was approved by the working group on 19 September 2012, are shown below.

Voting members:
- Mark Ager; Stage Technologies Group; CP
- Tray Allen; James Thomas Engineering, Inc.; MP
- Dana Bartholomew; Fisher Technical Services, Inc.; CP
- William Beautyman; Limelight Productions, Inc.; DR
- Keith Bohn; Vitec Group plc; MP
- Ron Bonner; PLASA EU; G
- Vincent J. Cannavale; Motion Laboratories; CP
- Joseph Champelli; ZFX Flying Inc.; CP
- Benjamin Cohen; Reed Rigging, Inc.; DR
- Kimberly Corbett; Schuler Shook; DE
- Stu Cox; ZFX Flying Inc.; CP
- Dan Culhane; SECOA; CP
- Bruce Darden; Rigging Innovators, Inc.; CP
- Don Dimitroff; Vitec Group plc; MP
- Brad Dittmer; Stage Labor of the Ozarks; U
- Scott Fisher; Fisher Technical Services, Inc.; CP
- Adrian Forbes-Black; Total Structures Inc.; MP
- Howard Forryan; Harting KGAA; G
- Mike Garl; Vitec Group plc; MP
- Ed Garstkiewicz; Harting KGAA; G
- Ethan William Gilson; Advanced Lighting and Production Services; U
- William B. Gorlin; M.G. McLaren, P.C.; G
- Jerry Gorrell; Theatre Safety Programs; G
- Pat Grenfell; Mainstage Theatrical Supply; DR
- Joshua Grossman; Schuler Shook; DE
- Joel A Guerra; Texas Scenic Company; DR
- Rod Haney; I.A.T.S.E. Local 891; U
- Tim Hansen; Oasis Stage Werks; DR
- Pete Happe; Walt Disney Company; U
- Herb Hart; Columbus McKinnon Corp.; MP
- David Herrmann; Motion Laboratories; CP
- Peter Herrmann; Motion Laboratories; CP
- Wendy Holt; Alliance of Motion Picture and Television Producers; G
- Joseph Jeremy; Niscon Inc.; CP
- Rodney F. Kaiser; Wenger Corp.; CP
- Christine L. Kaiser; Syracuse Scenery & Stage Lighting Co., Inc.; DR
- Theresa Kelley; Total Structures Inc.; MP
- Kandie Koed; Total Structures Inc.; MP
- Jerald Kraft; SECOA; CP
- Edwin S.; Kramer; I.A.T.S.E. Local 1; U
- Kyle Kusmer; Steven Schaefer Associates; G
- Roger Lattin; I.A.T.S.E. Local 728; U
- Michael Lichter; Electronic Theatre Controls, Inc.; MP
- Dan Lisowski; University of Wisconsin - Madison; U
- Joseph McGough; Foy Inventerprises, Inc.; CP
- Orestes Mihaly; Production Resource Group; DR
- Jeff T. Miller; Walt Disney Company; U
- John (Jack) Miller; I Weiss; CP
- Rick Montgomery; R&M Materials Handling; MP
- Reid Neslage; H & H Specialties Inc.; MP
- Mark Newlin; Xtreme Structures and Fabrication; MP
James Niesel; Arup; DE
Richard J. Nix; Steven Schaefer Associates; G
Shawn Nolan; Production Resource Group; DR
Tracy Nunnally; Hall Associates Flying Effects; CP
Edward A. (Ted) Paget; Daktronics Inc.; CP
Miriam Paschetto; Geiger Engineers; G
Rocky Paulson; Freeman Companies; DR
Troy Post; R&M Materials Handling; MP
Woody Pyeatt; A V Pro, Inc.; DR
Gregory Quinkert; Motion Laboratories; CP
John Ringelman; Freeman Companies; DR
Rick Rosas; Texas Scenic Company; DR
Shawn Sack; Columbus McKinnon Corp.; MP
Bill Sapsis; Sapsis Rigging, Inc.; U
Steven C. Shaw; Aerial Rigging; DR
Stephen G. Surratt; Texas Scenic Company; DR
Peter V. Svitavsky; Wenger Corp.; CP
Harvey Sweet; Electronic Theatre Controls, Inc.; MP
Will Todd; Vitec Group plc; MP
Elmer Velth; Total Structures, Inc.; MP
Steve Walker; Steve A. Walker & Associates; G
Charlie Weiner; Charlie Weiner; U
Michael Wells; Xtreme Structures and Fabrication; MP
Marty Wesstrom; Mountain Productions Inc.; DR
Jeff Wilkowski; Them, Inc.; MP
Frank Willard; Syracuse Scenery & Stage Lighting Co., Inc.; DR
R. Duane Wilson; Amer. Society of Theatre Consultants; DE
Robert Young; Arup; DE
Art Zobal; Columbus McKinnon Corp.; MP

Observer (non-voting) members:
Brent Armstrong; U
William Ian Auld; Auld Entertainment; U
Warren A. Bacon; U
Rinus Bakker; Rhino Rigs B.V.; G
Robert Barbagallo; Solotech Inc.; DR
Roger Barrett; Star Events Group Ltd.; DR
F. Robert Bauer; F.R. Bauer & Associates, LLC; G
Maria Bement; MGM Grand; U
Roy Bickel; G
Lee J. Bloch; Bloch Design Group, Inc.; G
David Bond; Show Restraint Ltd.; U
William Bradburn; Aerial Arts, Inc.; U
Louis Bradfield; U
Buddy Braile; Bestek Lighting & Staging; U
Barry Brazell; U
André Broucke; André Broucke; G
David M. Campbell; Geiger Engineers; G
Michael J. Carnaby; Mikan Theatricals; DR
Daniel J. Clark; Clark-Reder Engineering, Inc.; G
Ian Coles; Total Structures, Inc.; MP
Gregory C. Collis; I.A.T.S.E. Local 16; G
Randall W. A. Davidson; Risk International & Associates, Inc.; U
Robert Dean; ZFX Flying Inc.; DR
François Deffarges; Nexo; MP
Cristina Delboni; Feeling Structures; MP
Jim Digby; Linkin Park Touring/The Collective; U
Noga Eilon-Bahar; Elon Engineering Industrial Weighing Systems; MP
James B. Evans; Mountain Productions Inc.; DR
Tim Franklin; Theta-Consulting; G
Luca Galante; Alfa System Sas; CP
Jay O. Glerum; Jay O. Glerum & Associates, Inc.; U
Rand Goddard; W.E. Palmer Co.; CP
Reuben Goldberg; Technic Services; U
Thomas M. Granucci; San Diego State University; U
Sean Harding; High Output, Inc.; G
Greg Hareld; Kleege Industries; U
Dean Hart; Freeman Companies; U
Ben Hayes; Freedom Flying; G
Marc Hendriks; Prolyte; MP
Ted Hickey; OAP Audio Products; MP
Chris Higgs; Total Solutions Group; G
Daniel Lynn Houser; Real Rigging Solutions, LLC; U
Donald Hoffend III; Avista Designs, LLC; G
Wes Jenkins; Down Stage Right Industries; CP
Peter Johns; Total Structures, Inc.; MP
Ted Jones; Chicago Spotlight, Inc.; U
Kent H. Jorgensen; IATSE Local 80; G
Donald A. Hoffend Jr.; Avista Designs, LLC; G
Gary Justesen; Oasis Stage Werks; DR
John Kaes; John Kaes; U
JoAnna Kamorin-Lloyd; Vincent Lighting Systems; U
Nevin Kleege; Kleege Industries; U
Ken Lager; Pook, Diemont & Ohl, Inc.; DR
Jon Lagerquist; South Coast Repertory; U
Eugene Leitermann; Theatre Projects Consultants, Inc.; G
Jon Lenard; Applied Electronics; MP
John Van Lennep; Theatrix Inc.; DR
Mylan Lester; Creation Logics Ltd.; U
Baer Long; Act 1 Rigging Inc.; G
Dennis J. Lopez; Automatic Devices Co.; MP
Darren Lucier; North Guard Fall protection Inc.; U
Sam Lunetta; Michael Andrews; DR
Aleksandr Lupinskis; Real Rigging Solutions, LLC; U
Gary Mardling; Kish Rigging; DR
Chuck McClelland; Jeamar Winches Inc.; MP
Richard C. Mecke; Texas Scenic Company; DR
Orestes Mihaly; Production Resource Group; DR
Hank Miller; W.E. Palmer Co.; CP
Shaun Millington; SEW-Eurodrive, Inc.; MP
Timothy Mills; Geiger Engineers; G
Scott Mohr; R&R Cases and Cabinets; G
Martin Moore; Martin Moore; G
John “Andrew” Munro; animaenagerie; U
Bob Murphy; Occams Razor Technical Services; G
Steve Nelson; Educational Theatre Association; U
Rikki Newman; U
Michael Patterson; Pook Diemont & Ohl, Inc.; CP
Rocky Paulson; Freeman Companies; DR
G. Anthony Phillips; I.A.T.S.E. Local 16; U
Philip J. Pisczak; The National Telephone Supply Company; G
Michael Powers; Central Lighting & Equipment, Inc.; DR
Kurt Pragman; Pragman Associates, LLC; G
Michael Reed; Reed Rigging, Inc.; DR
Mark Riddlesperger; LA ProPoint, Inc.; CP
Timo Risku; Akumek; DE
Jean-Philippe Robitaille; Show Distribution Group, Inc.; DR
Peter A. Scheu; Scheu Consulting Services, Inc.; G
Peter "Punch" Christian Schmidtke; Hollywood Lighting, Inc.; DR
Monica Skjonberg; Skjonberg Controls, Inc.; CP
Knut Skjonberg; Skjonberg Controls, Inc.; CP
William Scott Sloan; U
John C. Snook; Thermotex Industries Inc.; CP
Michael L. Savage, Sr.; Middle Dept. Inspection Agency, Inc.; G
Rob Stevenson; SEW-Eurodrive, Inc.; MP
Joachim Stoecker; CAMCO GmbH; MP
Andy Sutton; AFX UK Ltd.; U
Katherine Tharp; LA ProPoint, Inc.; CP
Stephen Vanciel; U
Bill Waters; Conductix-Wampfler; MP
Michael G. Wiener; Aerial Rigging & Leasing, Inc.; U
Jiantong Wu; Beijing Special Engineering Design & Research Institute; G

Interest category codes:
CP = custom-market producer  DE = designer
DR = dealer rental company  G = general interest
MP = mass-market producer  U = user
Contents

Notice and Disclaimer ........................................................................................................................................... i
Contact Information .................................................................................................................................................. iii
Acknowledgments ................................................................................................................................................ iv
Foreword ................................................................................................................................................................ ix
1 Scope ................................................................................................................................................................. 1
  1.1 General .......................................................................................................................................................... 1
  1.2 Annex Note References ................................................................................................................................ 1
2 Definitions ............................................................................................................................................................. 1
3 Reference to Other Codes and Standards ........................................................................................................... 2
4 Enclosure Classification* .................................................................................................................................. 2
5 Manufacture .......................................................................................................................................................... 2
  5.1 Enclosure Construction .................................................................................................................................. 2
    5.1.1 Mechanical .......................................................................................................................................... 2
    5.1.2 Enclosure Design Documentation .......................................................................................................... 2
    5.1.3 Enclosure WLL* ................................................................................................................................... 2
  5.2 Component Part Security ............................................................................................................................... 2
    5.2.1 Class A* .............................................................................................................................................. 2
    5.2.2 Class B and Class C* ............................................................................................................................... 3
    5.2.3 Class D* .............................................................................................................................................. 3
  5.3 Enclosure Suspension Hardware .................................................................................................................... 3
    5.3.1 Design Quality ..................................................................................................................................... 3
    5.3.2 Vibration* ............................................................................................................................................ 3
    5.3.3 Corrosion Resistance ............................................................................................................................. 3
    5.3.4 Strength .............................................................................................................................................. 3
6 Quality Control Systems .................................................................................................................................. 4
  6.1 Product Identification Marking ....................................................................................................................... 4
  6.2 Enclosure Traceability ................................................................................................................................... 4
  6.3 Hardware Traceability ................................................................................................................................... 4
    6.3.1 Exceptions .......................................................................................................................................... 4
  6.4 Quality Control ............................................................................................................................................... 4
  6.5 Quality Assurance ......................................................................................................................................... 4
  6.6 Training Program ......................................................................................................................................... 4
  6.7 Documentation Revision Policy .................................................................................................................... 5
7 Testing ................................................................................................................................................................. 5
  7.1 Test Method ................................................................................................................................................... 5
    7.1.1 Complete Testing .................................................................................................................................. 5
    7.1.2 Test loads ............................................................................................................................................. 5
    7.1.3 Failure mode ....................................................................................................................................... 5
    7.1.4 Repeatability of Test Results ................................................................................................................ 5
    7.1.5 Alternative Test Methods .................................................................................................................... 5
  7.2 Test Controls .................................................................................................................................................. 5
    7.2.1 Documentation of results ...................................................................................................................... 5
    7.2.2 Test information .................................................................................................................................. 5
8 Manufacturer Product Representation ................................................................................................................... 6
  8.1 Rigging Inquiry Policy ................................................................................................................................... 6
  8.2 Print or Control Documentation Availability Policy ........................................................................................ 6
9 Instructions for the Installer and User ................................................................................................................ 6
  9.1 Enclosure Suspension Instructions ................................................................................................................. 6
  9.2 Maintenance and Inspection Instructions ...................................................................................................... 6
  9.3 Customer Service ....................................................................................................................................... 6
10 Annex Notes (informative) ............................................................................................................................... 6

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.

PLASA does not approve, inspect, or certify any installation, procedure, equipment or material. Compliance with this standard is voluntary. Product markings, identification or other claims of compliance do not constitute certification or approval whatsoever by PLASA.

PLASA neither guarantees nor warrants the accuracy or completeness of any information published herein and disclaim liability for any personal injury, property or other damage or injury of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document.

Users of this document should rely on their independent judgment or, as appropriate, seek the advice of a qualified person in determining reasonable care in any given circumstance.

PLASA does not warrant that standards contain no protected intellectual property or that they can be implemented without the use of protected intellectual property.
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.