Entertainment Services and
Technology Association

American National Standard
E1.2 - 2006
Entertainment Technology
Design, Manufacture and Use of Aluminum Trusses and Towers

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Rig/2002-2019r5

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This edition of ANSI E1.2 was approved by American National Standards Institute on July 13, 2006.

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Published By:

Entertainment Services and Technology Association

875 Sixth Avenue, Suite 1005
New York, NY 10001 USA
Phone: +1-212-244-1505
Fax: +1-212-244-1502
Email: standards@esta.org

For Electronic Copies of this Document Contact:

www.estafoundation.org

For Additional Copies of this Document Contact:

ESTA Publications

The ESTA Foundation
875 Sixth Avenue, Suite 1005
New York, NY 10001 USA
Phone: +1-212-244-1505
Fax: +1-212-244-1502

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, PLASA, 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 as Accredited Standards Committee E1, Safety and Compatibility of Entertainment Technical Equipment and Practices.

The Technical Standards Committee (TSC) was established by ESTA's Board of Directors to oversee and coordinate the Technical Standards Program. Made up of individuals experienced in standards-making work from throughout our industry, the Committee approves all projects undertaken and assigns them to the appropriate working group. The Technical Standards Committee employs a Technical Standards Manager to coordinate the work of the Committee and its working groups as well as maintain a "Standards Watch" on behalf of members. Working groups include: Camera Cranes, Control Protocols, Electrical Power, Floors, Fog and Smoke, Photometrics, and Rigging.

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 two 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 manufacturers, consultants, dealers, and end-users. ESTA is committed to developing consensus-based standards and recommended practices in an open setting. Future Rigging Working Group projects will include updating this publication as changes in technology and experience warrant, as well as developing new standards and recommended practices for the benefit of the entertainment industry.

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Contents

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Foreword *(This foreword contains no mandatory requirements and is not part of E1.21)*

There are no specific American National Standards that cover the design, manufacture and use of aluminum trusses in the entertainment industry. It should be noted that other ANSI Standards may be relevant, depending on the application and intended use. In an attempt to improve safety and standards in the industry, the Entertainment Services and Technology Association (ESTA) convened a series of meetings to prepare a draft standard.

Columbus McKinnon Corporation kindly hosted these meetings at their facilities in Buffalo, New York and Abingdon, Virginia,

It is the intention of ESTA that this standard be put forward as the basis for an American National Standard to the American National Standards Institute.

The preparation of the standard was entrusted to the Truss Team working as part of the Rigging Work Group for the Technical Standards Committee (TSC) of ESTA. The Truss Team is generally comprised of manufacturers and their structural engineering advisors.

It has been assumed in the drafting of this standard that the execution of its design provisions are entrusted to appropriately qualified and experienced people, and that the fabrication and use is carried out by qualified and suitably experienced people and organizations.

This standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within 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. Revisions result from committee consideration of factors such as technology advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

Compliance with this Standard does not of itself confer immunity from legal obligations.

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1 Scope

This document describes the design, manufacture and use of aluminum trusses, towers and associated aluminum structural components such as head blocks, sleeve blocks, bases, and corner blocks in the entertainment industry. This does not cover individual, separate rigging hardware such as 1/2 couplers and shackles.

The standards described herein are for a variety of uses that are confined to the entertainment industry and apply to a range of structures subjected to normal atmospheric conditions.

The standards described herein do not cover aerospace alloys, the detail design of castings, curved shell structures or structures subjected to severe thermal or chemical conditions. They are not intended to be used for the design of containment vessels, airborne structures or vessels, or for any application where a specific standard exists.

If “truss” is referred to in a particular clause in this standard, then it shall equally apply to ‘tower’ and vice versa. It shall also apply to associated aluminum hardware.

2 Definitions

2.1 Definitions

abrasion: loss of material due to wear.

allowable load: maximum static equivalent load imposed on truss / tower in addition to the self-weight.

ancillary: supplementary.

AWS: American Welding Society.

bent member, truss or tower: permanent inelastic deviation from the intended center line.

bolted connection: a connection of two truss modules using bolts.

camber: intended vertical deviation of a truss, usually radiused.

chord: the element of the truss or tower module that carry axial forces associated with flexure or axial loading.

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.

components: parts of a whole.

connecting plates: plates welded to the ends frames of a truss or tower module that are used to connect adjacent modules together.

consumables: items that require regular replacement with use.

CPL - central point load: a load that is applied to the center of the truss.

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crack: a crevice type discontinuity in the material.
damage: condition that adversely affects the intended use of truss module (usually load carrying capacity).

dent: local deformation resulting in measurable change in cross section of member or element.

design strength: capacity of the elements of the structure to withstand normal design loading.

diagonal: elements of the truss or tower module that are at an angle to the main chords.

drift test / flare test: a standard test undertaken on aluminum tubing to check structural integrity of the tube walls, in particular, the test highlights splits in the tube which can occur in the extrusion process. Refer to ASTM Standard B210-04: Specifications for Aluminum and Aluminum-Alloy Drawn Seamless Tube. Section 10: Flaring Properties covers 10.1 Limits, 10.2 Number of Specimens, 10.3 Preparation of Specimens and 10.4 Test Methods for Flare Testing.

dye penetrant testing: a standard non-destructive test that highlights cracks in welds but that does not affect the integrity of the weld or the parent metal.

dynamic loading: a load which moves or vibrates.

end plate: a plate on end of a truss module allowing connection to adjacent truss module(s).

incident: occurrence where damage to one or more truss module is or may be sustained.

manufacturer: person or company that fabricates truss / tower modules or systems.

module: singular framed structure that is built up entirely from tension and compression members, arranged in panels so as to be stable under load.

multiple use: truss or tower system assembly designed specifically for use at one or more locations and erected on more than one occasion.

NDT: Non-destructive testing.

pinned connector: end tube connector that uses a removable pin to effect a connection between truss modules.

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 problems relating to the subject matter and work.

regular service: normal repetitive use.

repetitive use: truss or tower modules assembled and dismantled on multiple occasions.

single use: truss or tower system assembly designed specifically for one location, erected once and left in place.

shall: indicates that the rule is mandatory and must be followed.

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should: indicates that the rule is a recommendation, the advisability of which depends on the facts and conditions in each situation.

skin: a material cover to a truss structure (usually on a roof system).

span: the distance between support points.

static load: a load which is not moving.

sweep: intended lateral deviation of a truss, usually radiused.

temporary: not permanent. Reference shall be made to local building codes for relevant definitions.

tower: one or more modules assembled vertically to carry primarily axial load usually square or triangular.

truss: one or more modules assembled to carry load over a distance, generally horizontal, primarily in flexure.

user: person or company who assembles or uses truss or tower modules or systems, or who assembles and uses truss or tower modules or systems.

UDL - uniformly distributed load: a load that is evenly spread over the length of the truss.

2.2 Reference to Other Codes and Standards

Refer to the following publications, copies of which may be obtained from the publishers as indicated.

Aluminum Design Manual, Specifications and Guidelines for Aluminum Structures 2005
The Aluminum Association
900 19th Street
Washington, DC 20006

AWS D1.2/D1.2M:2003, Structural Welding Code – Aluminum American Welding Society
550 N.W. LeJune Road
Miami, FL 33126

ANSI/ASCE 7-02, Minimum Design Loads for Building and Other Structures
American Society of Civil Engineering
1801 Alexander Bell Drive
Reston, VA 20191-4400

For dated references, subsequent amendments to, or revisions of, any cited publications do not apply. For undated references, the latest editions of the publications referred to apply.

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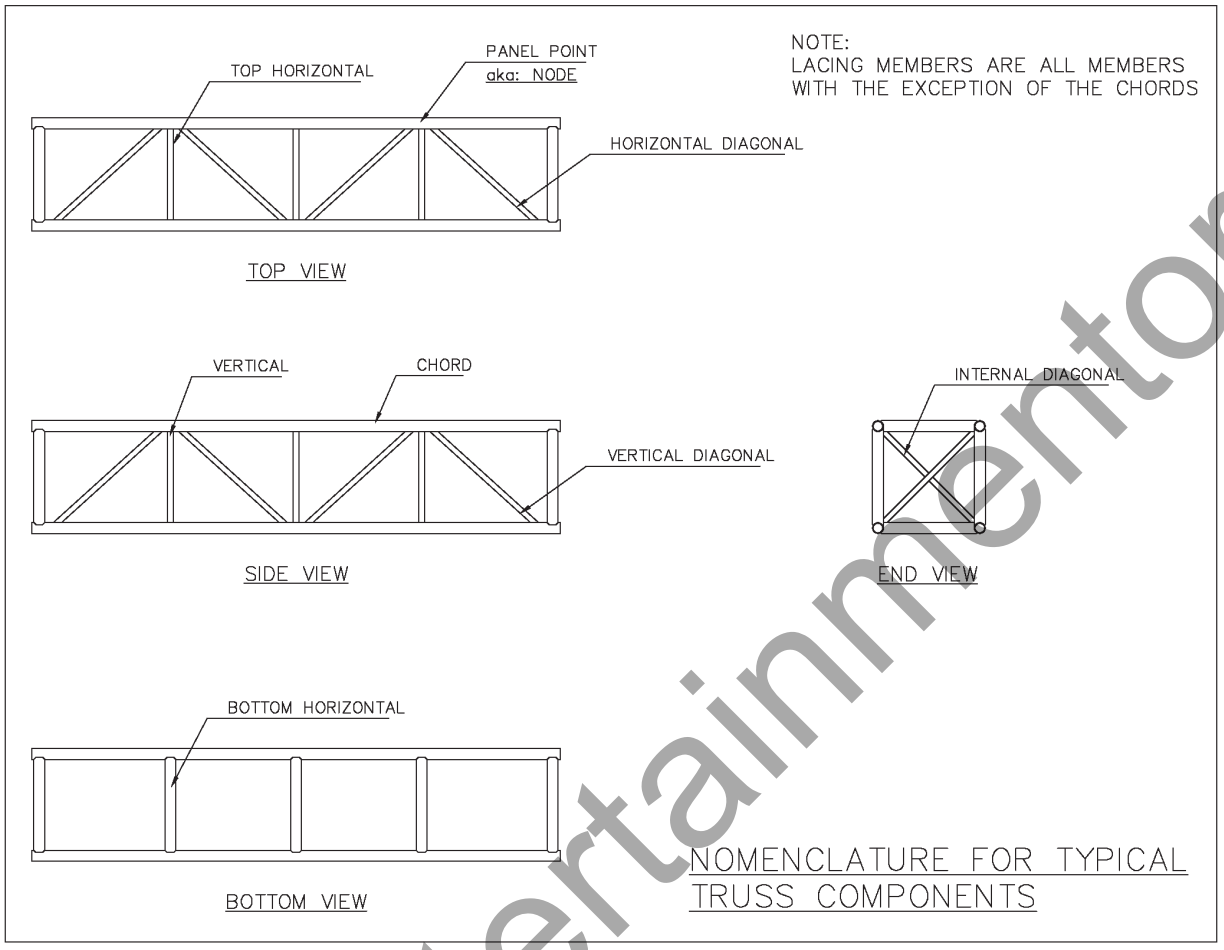

3 Engineering

3.1 Intent

The intent of this section of the standard is to provide the engineer with the minimum basis on which aluminum trusses and towers shall be designed.

3.2 Design

3.2.1 Design shall be performed in accordance with established engineering practice. The Aluminum Association “Specifications & Guidelines for Aluminum Structures”, 2005 edition and any other relevant standard for the intended conditions of use shall be used. The following additional standards shall apply:

a. Welds shall be designed and detailed per AWS Standard D1.2/D1.2M:2003 “Structural Welding Code/ Aluminum” by the AWS.

b. Fasteners and other components of material other than aluminum shall be designed in accordance with pertinent standards.

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c. Design loading including wind shall be in accordance with ANSI/ASCE 7-02, "Minimum Design Loads for Building and Other Structures"

3.2.2 All conditions of use considered in design shall be explicitly outlined in the engineering documentation. Strength can be established using either Load Factor Resistance Design, allowable stress design methods or by physical testing.

3.2.3 Two engineering design categories of truss are defined as follows:

a. Design of truss or tower structures for single use: Such structures shall be designed in accordance with the provisions of the standards cited herein.

b. Design of truss or tower modules for repetitive use: The design strength determined in accordance with the standards cited herein shall be reduced by multiplying the strength by a factor of 0.85. The reduced design strength shall be greater than or equal to the allowable load for intended loading conditions.

3.3 Analysis

3.3.1 Analysis of the truss or tower structures for the intended load conditions shall be performed by calculation, modeling, physical testing or combination of these methods.

3.3.2 Analysis shall consider the worst combination, application, and configuration of loads and effects possible within the use guidelines.

3.3.3 Consideration shall be given to overall structural stability and bracing requirements for all applications within the use guidelines.

3.3.4 Consideration shall be given to the effects of eccentricities in element and module connections.

3.3.5 Truss and tower deflections should be calculated for load conditions provided in the user information.

3.3.6 Consideration shall be given to any coating or surface finishing techniques used in manufacturing that may affect the structural properties and load-bearing capabilities of the truss or tower structures.

3.4 Engineering Documentation

3.4.1 Engineering drawings of the truss or tower designs shall be developed and maintained. Engineering drawings shall include dimensions, components, subassemblies, material types, fastener types and specifications, weld sizes and types, and welding consumables.

3.4.2 All weld types and sizes shall be indicated in accordance with AWS Standard D1.2/D1.2M:2003. All welding procedures that are not prequalified under AWS shall be documented in accordance with AWS procedures.

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3.4.3 Engineering calculations, design notes and/or test results shall be developed and maintained that demonstrate compliance with this standard for the intended load conditions and uses.

3.4.4 Where designs are claimed in user information to have greater margins or factors of safety than required by this standard, engineering documentation that supports claimed attributes shall be maintained.

3.4.5 If the User Information includes a statement about design factor, commonly known as safety factor, then the manufacturer shall clearly state to what condition the safety factor refers.

4 Manufacturing

4.1 Intent

The intent of this section is to ensure that all manufacturers maintain a satisfactory level of quality throughout the manufacturing process and that each and every piece of truss is traceable back to the manufacturer in the event of defect.

4.2 Material

4.2.1 The aluminum used shall comply with The Aluminum Association “Specification and Guidelines for Aluminum Structures” 2005 edition ensuring component dimensions are within set limits and tolerances.

4.2.2 All extruded aluminum tubes shall be drift tested to reduce the possibility of splitting.

4.3 Welding

4.3.1 All welders employed to manufacture the truss or who are involved in producing the truss module through the welding process shall be certified in accordance with the AWS Standard D1.2/D1.2M:2003.

4.3.2 All welding processes shall be carried out in accordance with applicable AWS Standards.

4.4 Inspection

4.4.1 After the welding process has been fully completed, all welds shall be visually inspected.

4.4.2 Any welds that do not appear sound shall be tested further by using the NDT method of dye penetration and repaired as required.

4.4.3 Inspection during and after fabrication shall verify the product has been built in accordance with design drawings.

4.5 Coatings and Surface Finishes

4.5.1 Coatings and surface finishes shall be applied only in accordance with those techniques considered as part of the analysis referred to in 3.3.6.

4.5.2 The application of powder coating shall use a process whereby the heating of truss and

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tower modules is only be done in accordance with section 6.3 of The Aluminum Association “Specification and Guidelines for Aluminum Structures” 2005 edition.

4.5.3 All preparations for painting or coating using a chemical process shall include a procedure to completely flush out or neutralize all corrosive materials that may have entered the tubes.

4.5.4 Removal of coatings and surface finishes if done with chemicals shall be carried out only after consulting with the chemical manufacturer to insure the chemical will not affect the mechanical properties of the aluminum. Abrasion-blasting shall not be used on aluminum less than or equal to 1/8 inch (3mm) thick.

4.6 Identification

4.6.1 The manufacturer shall mark each truss module with an identification mark unique to that manufacturer and to that module. The mark shall be easily recognizable. The mark shall be durable and difficult to remove. The identification mark shall include the manufacturers name and the date of manufacture.

4.6.2 The manufacturer shall be responsible for keeping appropriate records relating to the truss identification marks.

5 Use and Care

5.1 Intent

The intent of this section of the standard is to provide the end-user with sufficient information to ensure that the individual truss modules are handled correctly during storage, transportation, erection, and dismantling, and that the assembled truss systems are used on site within the limitations of the manufacturer’s loading tables.

5.2 User Information

5.2.1 Manufacturers shall produce User Information sheets or documentation with each type of truss in a consignment and shall include at least the following minimum information:

- the maximum span into which truss modules may be assembled and safely used;
- the maximum load that can be applied to a truss, UDL and CPL for given spans;
- theoretical deflection expected at given load and span;
- the maximum height to which a tower can be erected;
- the maximum load that can be supported by the tower;
- manufacturer shall state to what standards truss has been designed and shall clearly state to what extent, if any, dynamic loading has been considered in the design.
- the proper way to store, handle, transport, and erect the trussing;
- the correct method of making connections;
- requirements for regular inspections of the trussing in accordance with Section 6;
- the existence of full engineering documentation, and where to obtain it.

5.2.2 It is stressed that the above requirements are the MINIMUM information that a Manufacturer shall supply with each type of truss in a consignment.

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5.2.3 The Manufacturer may also include any additional information that is considered appropriate to the truss or assemblage of trussing that is being supplied.

5.3 Coatings and Surface Finishes

5.3.1 Coatings and surface finishes shall only be applied after consultation with the coating or finish manufacturer or other party qualified to evaluate the possible effects of the coating or surface finish on the structural properties and load-bearing capabilities of the truss or tower module.

5.3.2 The application of powder coating shall use only a low cure process. The heating of truss and tower modules shall only be done in accordance with section 6.3 of the Aluminum Association "Specification and Guidelines for Aluminum Structures" 2005 edition.

5.3.3 Records shall be kept detailing the application of any coating or surface finish with particular detail regarding processes requiring the application of heat.

5.3.4 Removal of coatings and surface finishes if done with chemicals shall be carried out only after consulting with the chemical manufacturer to insure the chemical will not affect the mechanical properties of the aluminum. Abrasion-blasting shall not be used on aluminum less than or equal to 1/8 inch (3mm) thick.

5.4 Applied Loads

5.4.1 When assessing all loads on the fully assembled truss system, full consideration shall be made of weight of all equipment, including, but not limited to, any motors, light and sound equipment, multicore cables, follow-spot chairs, temporary personnel occupancy and reactions from fall protection systems.

5.4.2 Consideration shall be given to the following:

a. disposition of the loads on the trusses, and whether they are evenly balanced beneath the centerline of the truss, or, as is more often the case, they are mainly concentrated to one side or the other.

b. the increase in weight of the multicore cables towards the point of entry of those cables onto the trussing.

c. the possible dynamic effects on the trusses from the raising and lowering of the suspended equipment, or from the raising and lowering of the completed truss system.

d. the wind forces that may be applied to the truss system during erection, when complete and when in an unloaded as well as fully loaded state. Consideration must be given to items attached to the truss structure such as banners, roof skins, sound and lighting equipment, projection screens, scenery, etc.

e. the effects of changes in temperature during the use of the truss system, of the weight of snow that may lie on the system or any covering, of the possibility of seismic action affecting the overall stability of the system, and of the possibility of accidental impact damage occurring during the period in which the system is operational. The requirements of the Local Building Codes shall be carefully appraised and adhered to in all cases.

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f. any attaching hardware shall be applied in a manner so as not to cause damage. Refer to Section 6, User Inspection.

5.5 Handling

5.5.1 Individual modules and fully assembled trusses, together with any ancillary components which may form part of a complete system, shall be carefully handled to avoid impact damage or abrasive wear and tear.

5.5.2 The trusses shall not be dragged around, but shall be carried or moved on dollies or trolleys; the trussing shall not be dropped, but shall be laid down carefully.

5.5.3 The trusses shall be adequately secured and supported during transportation, and shall be stacked with sufficient spacers between successive heights to limit abrasive wear and tear.

5.5.4 End connections shall be protected from damage.

5.6 Erection

5.6.1 Proper layout drawings and calculations shall be prepared for each time that the trussing is to be used, and shall include the following information:

a. accurate overall dimensions,
b. the location of applied loads,
c. the location of suspension points.

5.6.2 Reasonable care shall be taken to ensure that the trussing is assembled and erected correctly in accordance with the layout drawings and calculations.

5.6.3 The truss modules shall be inspected before assembly in accordance with Section 6 (User Inspection) of this document - and shall be assembled, joined together, and erected by competent persons.

5.6.4 If the trusses are to be supported on towers which form part of the complete trussing system, then a full assessment shall be made by a qualified person of the load bearing capabilities of the ground on which the towers are to be erected, and if necessary, the ground shall be improved to provide a suitable bearing surface. Load bearing spreader plates of sufficient capacity shall be provided beneath the tower bases if required by the specifics of the installation.

5.6.5 If the trusses are to be suspended from the roof beams or other structure within an existing building, or from a framework that is not part of the complete trussing system, then a full assessment shall be made, by a qualified person, of the roof beams or other structure from which the trusses are to be suspended, and if necessary the position of the suspension points shall be moved to new acceptable locations, or suitable strengthening measures shall be made to the existing structure.

5.6.6 The completed truss assembly shall be inspected by a competent person prior to each performance and/or use for which the truss system is to be used in accordance with Section 6 (User Inspection) of this document.

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6 User Inspection

6.1 Intent

The intent of this section is to establish minimum required inspection routines and guidelines for the truss user. While every effort is made to provide a thorough listing of situations and inspection criteria, complete listings are beyond the scope of this standard. Specific advice should be sought by the user for specific inspection routines from the manufacturer or a qualified person.

6.2 Inspection Classifications

Inspection procedures are described in two primary classifications:

Frequent Inspections — Visual inspections with records not required to be kept. Frequent inspections shall be performed in accordance with Section 6.4, (Frequent Inspection Procedures).

Periodic Inspections — Visual inspections with records to be kept. Periodic inspections shall be performed in accordance with Section 6.5 (Periodic Inspection Procedures).

6.3 Inspection Intervals

6.3.1 Initial Inspection

When purchased or acquired, whether new from the manufacturer or used, all truss modules shall be inspected in accordance with Section 6.4 of this standard but records shall be kept and maintained for the duration of possession. Such action shall establish the basis for the record keeping requirements.

6.3.2 Truss in Regular Service

Truss modules in regular service shall be subjected to both Frequent and Periodic Inspections as described in Sections 6.4 and 6.5 of this standard.

6.3.3 Truss Not in Regular Service

Frequent Inspections shall be performed on all truss modules not in use for a period of one month or more. Periodic Inspections shall be performed on all truss modules not in service for a period of one year or more.

6.3.4 Permanent Installations, Stationary

Periodic inspections shall be performed on all truss modules that are permanently installed in a stationary and non-movable configuration, and the frequency for such inspections shall be determined based upon exposure to prevalent conditions.

6.3.5 Permanent Installations, Moving

Periodic Inspections shall be performed every three months on all truss modules that are installed in a permanent configuration where movement of the truss system is an integral part of its use.

6.4 Frequent Inspection Procedures

Frequent inspections shall be performed by a competent person on behalf of the user, and shall be conducted prior to each use and immediately after an incident that might in anyway have caused damage to the truss system.

The following items shall be inspected:

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Chords for:
- denting
- bends
- abrasion

Diagonals for:
- denting
- bends
- abrasion
- missing

Connecting plates (if used) for:
- flatness
- deformation or excessive wear of holes

Pinned connectors (if used) for:
- deformation

Welds for:
- Cracks by visual inspection - 100% all welds
- Abrasion by visual inspection - 100% all welds

The user shall undertake dye penetrant or other form of nondestructive testing on any weld that is thought to be or may be defective. These tests shall be performed by a qualified person.

Fasteners (proprietary 1/4 turn fasteners, bolts, pins) for:
proper grading - must be matched
deformation
excessive wear
Geometry of truss for:
twisting of truss
squareness of truss
bending of truss

6.5 Periodic Inspection Procedures

Periodic Inspections shall be performed by a qualified person on behalf of the owner and shall be conducted at least once each year. Truss shall be taken out of service during inspection. For permanent installations, whether fixed or moving, inspections shall be permitted during non-show times, with the units remaining in place.

The following items shall be inspected:

Chords for:
- denting
- bends
- abrasion

Diagonals for:
- denting
- bends
- abrasion
- missing

Connecting plates (if used) for:
- flatness
- deformation or excessive wear of holes
- corrosion

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Pinned connectors (if used) for:
- excessive abrasion
- deformation of connection pin holes
- method of connection to truss

Welds for:
- Cracks by visual inspection - 100% all welds
- Abrasion by visual inspection - 100% all welds

The user shall undertake dye penetrant or other form of nondestructive testing on any weld that is thought to be or may be defective. These tests shall be performed by a qualified person.

Fasteners (proprietary 1/4 turn fasteners, bolts, pins) for:
- Proper grade of fasteners - must be matched
- No deformation of fasteners
- Excessive wear

Geometry of truss for:
- twisting of truss
- squareness of truss
- bending of truss
- sweep
- camber

6.6 Records

Records shall be kept on file by the owner for each truss module and shall be dated and signed by the person conducting the inspection.

6.7 Repair and Removal from Service

6.7.1 If any truss or tower module shows significant visible damage or is suspected of containing a damaged element, whether visible or not, the truss shall be removed from service and marked accordingly. A qualified person shall perform and document an assessment of the truss and tower module to determine if it can be repaired and subsequently returned to service, and also the type of repair required so that the structural performance is not reduced.

6.7.2 Any module containing damage that is deemed unrepairable shall be permanently removed from use or service.

6.7.3 Damaged modules shall be permanently marked in a manner that clearly and visibly indicates its condition.

6.7.4 Repairs shall be made by a qualified person.

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Contact Information

E1 Secretariat
Entertainment Services and Technology Association
Karl G. Ruling
Technical Standards Manager
ESTA
875 Sixth Avenue, Suite 1005
New York, NY 10001
Phone: +1-212-244-1505
FAX: +1-212-244-1502
email: standards@esta.org

Technical Standards Committee Chairperson
Mr. Mike Garl
President
James Thomas Engineering, Inc.
10240 Caneel Drive
Knoxville, TN 37931
Phone: +1-865-692-3060
FAX: +1-865-692-9020
email: mikeg@jthomaseng.com

Rigging Working Group Chairpersons
Kent H. Jorgensen
IATSE Local 80
Phone: +1-818-526-0701
FAX: +1-818-526-0711
email: kentboy@earthlink.net

Bill Sapsis
Sapsis Rigging, Inc.
Phone: +1-215-228-0888
FAX: +1-215-228-1786
email: bill@sapsis-rigging.com

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Acknowledgments:
Listed below are the Rigging Working Group members with their company affiliations, voting statuses, and interest categories at the time this standard was approved by the working group on March 29, 2006.

Principal voting members:

William Beautyman; Limelight Productions, Inc. [DR]
Keith Bohn; Tomcat USA, Inc. [MP]
Ron Bonner; PLASA [G]
William Bradburn; Clowes Memorial Hall at Butler University [U]
Michael J. Carnaby; Mikan Theatricals [DR]
Joseph Champelli; Fisher Technical Services, Inc. [CP]
William Conner; Bill Conner Associates LLC representing the American Society of Theatre Consultants [U]
Olan Cottrill; Staging Productions, Inc. [DR]
Dan Culhane; SECOA [CP]
Don Dimitroff; Columbus McKinnon Corp. [MP]
M. Brad Dittmer; Downhome Productions [U]
James B. Evans; Mountain Productions Inc. [DR]
Mike Garl; James Thomas Engineering, Inc. [MP]
Jerry Gorrell; Theatre Safety Programs [G]
Tim Hansen; Oasis Stage Werks [DR]
Pete Happe; Walt Disney Imagineering (Walt Disney Company) [U]
Jeffrey Hoffend; Hoffend & Sons, Inc. [CP]
Ted Jones; Chicago Spotlight, Inc. [U]
Kent H. Jorgensen; IATSE Local 80 [G]
Rodney F. Kaiser; J.R. Clancy Inc. [CP]
Christine L. Kaiser; Syracuse Scenery & Stage Lighting Co., Inc. [DR]
Edwin S. Kramer; I.A.T.S.E. Local 1 [U]
Reid Neslage; H & H Specialties Inc. [MP]
Mark Newlin; Texas Scenic Company [CP]
James Niesel; Theatre Projects Consultants, Inc. [G]
Richard J. Nix; Performance Systems Integration [G]
Shawn Nolan; Entertainment Structures Group (Steven Schafer Associates) [G]
Howard R. Ott; D.E.O. Associates, Inc. [G]
Bill Sapsis; Sapsis Rigging, Inc. [U]
Peter A. Scheu; Scheu Consulting Services [G]
John C. Snook; Thermotex Industries Inc. [CP]
Harvey Sweet; LA ProPoint, Inc. [DR]
Hans van der Moolen; Stagemaker Division Europe (Verlinde Spa. France) [MP]
Steve Walker; Steve A. Walker & Associates [G]
Charlie Weiner [U]
Jeff Wilkowski; Thern, Inc. [MP]

Alternate voting members:

Tray Allen; James Thomas Engineering, Inc. [MP]
Damon Atwood; Hoffend & Sons [CP]
Wally Blount; Columbus McKinnon Corp. [MP]
Mitch Clark; Tomcat USA, Inc. [MP]
Carlos Garcia; R&M Materials Handling (Verlinde Spa. France) [MP]

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Alternate voting members continued:

Peter Hoffend; Hoffend & Sons, Inc. [CP]
John James; Tomcat USA, Inc. [MP]
Jerald Kraft; SECOA [CP]
Bob Medve; Limelight Productions, Inc. [DR]
Jack Suesse; J.R. Clancy, Inc. [CP]
Thomas S. Young; J.R. Clancy Inc. [CP]

Observer members:

Michael Akrep; Polar Focus, Inc. [MP]
Warren A. Bacon [U]
Rinus Bakker; Rhino Rigs B.V. [G]
Robert Barbagallo; Solotech Inc. [DR]
Roger Barrett; Star Events Group Ltd. [DR]
Gian Carlo C. Bartolotti; Ibeam SP / Banco de Eventos [U]
F. Robert Bauer; F.R. Bauer & Associates, LLC [G]
Lee J. Bloch; Bloch Design Group, Inc. [G]
Louis Bradfield [U]
Paul Brady; Grand Stage Company, Inc. [U]
Buddy Braile; Bestek Lighting & Staging [U]
Alan Broadhurst; The Broadhurst Partnership; P
Andre Broucke; ADB - TTV Technologies (ADB-TTV Group) [MP]
John R. Burgess [U]
David M. Campbell; Geiger Engineers [G]
Ian Coles; Total Structures, Inc. [MP]
Gregory C. Collis; I.A.T.S.E. Local 16 [G]
Robin Crews; Wrightson, Johnson, Haddon & Williams, Inc. [G]
Randall W. A. Davidson; Risk International & Associates, Inc. [U]
Robert Dean; ZFX Inc. [CP]
François Deffarges; Nexo [MP]
Cristina Delboni; Feeling Structures [MP]
Kevin Denis; Gravitec Systems, Inc. [CP]
Michael Di Ieso; IATSE Local 481 [U]
Harry Donovan; Donovan Rigging, Inc. [G]
Jim Fletcher; American Sling Company, Inc. [MP]
Tim Franklin; Theta-Consulting [G]
Douglas Franz; QVC Network [U]
Jay O. Glerum; Jay O. Glerum & Associates, Inc. [U]
Rand Goddard; W.E. Palmer Co. [CP]
Reuben Goldberg; Technic Services [U]
Steve Gonnella; City of Phoenix, Theater Division (City of Phoenix) [U]
Charles E. Gorgen [G]
Thomas M. Granucci; Associated Students, Cox Arena at San Diego State University [U]
Robert A. Grenier Jr.; Ocean State Rigging Systems Inc. [DR]
Delbert Hall; Hall Associates Inc. [U]
Dean Hart; Stage Rigging, Inc. (Freeman Companies) [U]
Ben Hayes; Freedom Flying [G]
Marc Hendriks; Prolyte [MP]
Ted Hickey; OAP Audio Products [MP]
Peter Hind; Anthony Ward Partnership Ltd. representing Total Structures, Inc. [MP]

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Observer members continued:

Wes Jenkins; Down Stage Right Industries [CP]
Peter Johns; Total Structures, Inc. [MP]
Gary Justesen; Oasis Stage Werks [DR]
John Kaes [U]
JoAnna Kamorin-Lloyd; Vincent Lighting Systems [U]
Bradford A. Kegel; National Production Services Inc. [U]
Michael Keppler; Bogen (IFF) [MP]
Nevin Kleege; Kleege Industries [U]
Jon Lagerquist; South Coast Repertory [U]
Mylan Lester; Creation Logics Ltd. [U]
Baer Long; Ninja Rigging (Act 1 Rigging Inc.) [G]
Dennis J. Lopez; Automatic Devices Co. [MP]
Andrew T. Martin; ATM Group, Inc. [MP]
Chuck McClelland; Jeamar Winches Inc. [MP]
Richard C. Mecke; Texas Scenic Company [CP]
Hank Miller; W.E. Palmer Co. [CP]
Timothy Mills; Geiger Engineers [G]
Scott Mohr; R&R Cases and Cabinets [G]
Rikki Newman [U]
Ed Nicholas; Theatrical Lighting Systems, Inc. [DR]
Tracy Nunnally; Northern Illinois University [U]
Edward Paget; Jones & Phillips Associates, Inc. [G]
Thomas Paterson [G]
Michael Patterson; Pook Diemont & Ohl, Inc. [CP]
Rocky Paulson; Stage Rigging, Inc. (Freeman Companies) [DR]
Todd Petersen; Mixed Productions [U]
G. Anthony Phillips; I.A.T.S.E. Local 16 [U]
Christopher Purpura; Jones & Phillips Associates, Inc. [G]
Joseph Rapier; Parkhill, Smith & Cooper, Inc. [CP]
Thomas Reaoch; RC Consultoria e Representação Ltda. representing Feeling Structures [MP]
Doug Recher; Total Structures, Inc. [MP]
Michael Reed; Reed Rigging, Inc. [U]
Ray Robins; XS Lighting, Inc. [CP]
Julie Rogers; City of Phoenix Civic Plaza (City of Phoenix) [G]
Michael L. Savage, Sr.; Middle Dept. Inspection Agency, Inc. [G]
Luigi Sbalzarini; Selvolina SNC [MP]
Heinz Siller; RST Prasentationssysteme [G]
Olaf Sööt; Olaf Sööt Associates [CP]
Eckart Steffens; SOUNDLIGHT representing VPLT [G]
Joachim Stoecker; CAMCO GmbH [MP]
Andy Sutton; AFX UK Ltd. [U]
Paul Tardue; BML Inc. [MP]
Richard D. Thompson; Thompson Associates [G]
Jerrold S. Tiers; St. Louis Music Inc. [MP]
Eric Todd; BML Inc. [MP]
John Van Lennep; Theatrix Inc. [DR]
Michael G. Wiener; Aerial Rigging & Leasing, Inc. [U]
Mark M. Witteveen; Chicago Flyhouse Inc. [U]
Jiantong Wu; Beijing Special Engineering Design & Research Institute [G]

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

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