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BSR E1.56-202x
Rigging Support Points

Approved by the ANSI Board of Standards Review on _____

Rig/2024-2024r1

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Entertainment Technology – Rigging Support Points

1 GENERAL

1.1 Scope

This standard applies to rigging points attached to a facility structure where both the rigging point and the structure are permanent and stationary while in use. Loads may be permanently or temporarily applied. This standard provides minimum requirements for the design, fabrication, installation, inspection, and documentation of these rigging points for their use to support rigging loads. This standard does not govern the use of rigging points.

E1.1 While this standard is intended to cover all structures, it is hoped that non-traditional entertainment structures, such as hotel ballrooms, atriums in office buildings, schools, and other structures will particularly benefit from this standard.

This standard does not apply to engineering analysis of structures supporting rigging points. The application of new loads to existing structures, and the location of those loads, must be considered by the user. Concentrated loads, multiple loads acting in close proximity and other load combinations have the potential to exceed existing building structural capacity. It is strongly recommended that structures supporting new loads be reviewed by a qualified person.

A review of the capacity of existing structures to support loads as imposed by rigging points is beyond the scope of this standard. Users are referred to the International Building Code, latest edition for guidance regarding the evaluation of the structural capacity of existing structures.

The designer should exercise all due diligence to ensure that the owner of the existing structure has taken appropriate action to ensure that the rigging point loads can be safely connected to and supported by the existing structure.

This standard does not apply to

- *Connection of any loads to the rigging point*
- *Connections to temporary entertainment structures.*
- *Equipment “below the hook”.*
- *Rigging points that are intended to be temporary in nature.*

1.2 Purpose

The purpose of this document is to provide standards for the design, fabrication, installation, inspection and documentation of rigging points. These standards are intended for the use of the entertainment rigging community, facility managers and design professionals.

It is the intent of this document to ensure that design and use criteria as established within this document are met by those materially affected by the standards contained within this document.

The design and installation of rigging points shall occur according to the generally accepted principles of structural engineering, this document, and applicable codes and standards as referenced herein.

E1.2 It is the intent of this document to clearly define the types of loading acting on rigging points including, but not limited to:

- *Horizontal*
- *Vertical*
- *Dynamic*
- *Cyclical*

This standard will provide guidance on adequate capacity to support the intended loads; including criteria for appropriate load factors and load combinations.

This standard provides means of validating the allowable load capacity of existing rigging points.

This document describes the various types of loading that may be encountered in the use of rigging points and provides design factors for the safe use of the points.

It is the hope of this committee that this standard is useful to the broad engineering and facility management community including professionals not specializing in the entertainment field, as well as code officials and others.

1.3 Application

This standard applies to rigging as typically used by the entertainment industry and allied industries. The criteria contained in this document are intended to be used by design professionals for the design of rigging points and by workers using rigging points. It provides requirements for the design and use of rigging points to be used for support of entertainment loads on structures.

E1.3 This standard addresses the following issues regarding the use and application of rigging points:

- *Structural integrity*
- *Functionality*
- *Intended use*
- *Environmental*
  - *Corrosion*
- *Applicable standards*

1.4 References

The documents listed below are provided for informational purposes. This standard incorporates by reference only specifically noted sections and provisions.

Where there is a conflict between design criteria provided by this standard and any of the documents incorporated herein by reference, the most stringent standard shall apply.

Where the version year is not shown, the most current version shall apply.

E1.4 Referenced standards are those documents referenced in the 2021 International Building Code. For documents not referenced in the 2021 IBC, the referenced document is the version current at the time this document was published.

American Institute of Steel Construction

- ANSI/AISC 360—22, *Specification for Structural Steel Buildings,*
- ANSI/AISC 341—22, *Seismic Provisions for Structural Steel Buildings,*

Aluminum Association

- *Aluminum Design Manual; ADM – 2020*

American Concrete Institute

- 318-19(22), *Building Code Requirements for Structural Concrete*
- TMS 402/602-22*, Building Code Requirements and Specification for Masonry Structures*

American National Standards Institute

- E1.6-1, *Entertainment Technology – Powered Hoist Systems*
- ANSI E1.6-3, *Selection and Use of Chain Hoists in the Entertainment Industry*
- ANSI E1.8-2023, *Entertainment Technology--Loudspeaker Enclosures Intended for Overhead Suspension--Classification, Manufacture and Structural Testing*

American Society of Mechanical Engineering

- *Below-the-Hook Lifting Devices--Safety Standard for Cableways, Cranes, Derricks, Hoist, Hooks, Jacks, and Slings:*
  - *ASME B30.9 – Slings*
  - *ASME B30.10 – Hooks*
  - *ASME B30.20 – Below the Hook Lifting Devices*
  - *ASME B30.26 – Rigging Hardware*
  - *Design of Below-the-hook Lifting Devices; ASME BTH-1 – 2023*

American Welding Society

- D1.1/D1.1M:2020, *Structural Welding Code—Steel*
- D1.2/D1.2M:2014, *Structural Welding Code—Aluminum*
- *2021 International Building Code,* International Code Council

The suite of ASME B30 Standards for Overhead Lifting is a useful guide for many overhead rigging and lifting operations. Items where these standards may be useful include:

- *Proper use of hardware*
- *Use of pre-fabricated hardware that may be used in assembly of permanent rigging points*
- *Standards for the use of equipment and materials that are similar to equipment and materials used in the installation of rigging points*

2. DEFINITIONS

2.1 Allowable Stress Design (ASD): a structural engineering analysis method in which service load stresses remain below a given stress limit divided by a specified safety factor.

E2.1 The stress limits and factors vary depending on what failure mode is being examined, such as tensile rupture of flexural yielding.

2.2 design factor: a ratio of the design load limit to the nominal strength of a material or component.

2.2.1 For ASD (see definition), the minimum design factor specified shall replace the appropriate safety factor from the design code being applied.

2.2.2 For LRFD (Load and Resistance Factor Design—see definition), the LRFD live load factor divided by the minimum design factor specified, shall replace the resistance factor from the design code being applied.

2.3 dead load: the self-weight of the rigging point.

2.4 detachable rigging hardware: portable, serially manufactured equipment and hardware, intended for general rigging, with a rated Working Load Limit**.**

E2.4 The use of serially manufactured portable hardware (i.e. slings, beam clamps, etc…) may be acceptable for this standard provided that this hardware has a marked WLL and a known breaking strength or Design Factor and is tagged with a unique installation location.

2.5 fabricated component: unique, site-specific rigging hardware designed and manufactured for rigging use in a single location.

2.6 fabricated rigging point: unique, site-specific rigging point for rigging use in a single location.

E2.6 Fabricated components and rigging points typically consist of weldments, bolted hardware connections, concrete anchors and other similar items that are designed and fabricated to be permanently installed in specific installations.

2.7 installer: a person who by demonstration of training or certification has successfully demonstrated the appropriate knowledge to install rigging points.

E2.7 Certification may be required in areas such as welding and/or installation of certain types of embedded anchors.

2.8 Load Resistance Factor Design (LRFD): a structural engineering analysis method in which factored load stresses in a structure remain below a given stress limit.

E2.8 The load factors and stress limits and factors vary depending on what type of load or combination of loads is being applied and what failure mode is being examined.

2.9 live load: forces externally applied to the rigging point, which occurs during normal use and occupancy of the structure.

2.10 lug: alternate name for a rigging point; commonly used in the general structural engineering and rigging communities.

2.11 mousing: securing from rotation or loosening of any threaded device.

2.12 nominal strength: strength of a structure or a component (without the ASD safety factor or the LRFD resistance factor applied) to resist load effects, as determined in accordance with this specification.

E2.12 This definition is used as a replacement for ultimate strength. Nominal strength is the maximum capacity of any structural element based upon the appropriate failure mode.

2.13 peak load: the maximum force applied to a rigging point resulting from abnormal conditions whether or not the load acting on the rigging point is at rest or in motion.

E2.13 Examples include the effects of emergency stops, uncontrolled stops, stalling of equipment and extreme environmental conditions.

2.14 stinger (pendant): a fixed length of wire rope or chain with mechanical fittings at both ends for positioning rigged elements.

2.15 person, authorized: a person who is assigned by the employer to take particular actions or execute tasks.

E2.15 For the purposes of the standard, the term generally refers to a person authorized to apply loads to a rigging point.

2.16 person, competent: 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.

2.17 person, designated: a competent person designated by the employer to perform a task.

2.18 person, qualified: 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.

2.19 registered design professional: an individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

E2.19 A registered design professional engaged in the design of rigging points should have a background in structural analysis.

2.20 rigging point, permanent: a rigging point that is intended to remain in place for the life of the structure. Rigging points that are intended to remain in place for a period greater than 90 days shall be treated as permanent.

2.21 rigging point, temporary: a rigging point that is intended to remain in place for a designated period of less than 90 days.

2.22 static load: a constant force, that may be applied to a rigging point, often measured as weight.

2.23 user: a person who performs activities related to the use of rigging points.

2.24 working load limit (WLL): the maximum weight static load that the user may apply to a rigging point.

E2.24 “Rated Capacity” and “Rated Load” are commonly used to describe Working Load Limit.

3 DESIGN

3.1 General requirements

3.1.1 The intent of this section is to establish requirements for the design and engineering of rigging points. Variations on the design requirements shall be permitted pursuant to review and approval by a Registered Design Professional.

3.1.2 Design shall reference all applicable loads and load combinations. Load combinations shall be based upon the most current International Building Code.

E3.1.2 The design factors in this document are based on ASD (Allowable Strength Design) methods. Load Factored Resistance Design (LRFD) may also be used.

3.1.3 Design shall be performed by a Registered Design Professional.

3.1.3.1 Exception. Rigging points exclusively assembled with detachable rigging hardware and connected to the structure by use of clamps, slings or similar attachments that do not require drilling or welding may be designed by a qualified person.

3.1.4 As an alternative to component design, components may be approved by proof testing according to the provisions of Section 7.

3.2 Design coordination

Installation of rigging points shall be coordinated with the facility. This shall include, but not be limited to:

1. Working Load Limit (WLL).
2. Location of rigging points within the existing structure.
3. Line of action of loads and forces (load direction) acting on the rigging point(s).
4. Protection of the rigging points from environmental deterioration.
5. Accessibility for inspection and maintenance.

E3.2 Although it is outside of the scope of this standard; prior to first use of any new rigging points (or use of any existing rigging points that have been reviewed according to this standard), it is strongly recommended that the existing structure's capacity to support loads from rigging points be approved by a qualified person.

Entertainment industry equipment suppliers and consultants can provide guidance in the area of rigging point layout.

Common rigging design loads in the entertainment industry are 1,000 pounds and 2,000 pounds. These design loads are often based on common hoists as used in this industry. ½-ton, 1-ton and 2-ton hoists are very common. It is strongly suggested that rigging points be designed at a minimum to meet these common criteria. The self-weight of the hoist should also be taken into consideration; self-weight values range from 200 to 500 pounds. The effect of dynamic forces should also be considered.

Special attention should be paid to situations where the total allowable rigging capacity is limited by the building structure. An example would be where the venue has (5) 1-ton rigging points but the building structure can only support a total of 4 tons. Loading diagrams and instructions should clearly identify the allowable loading configurations and rigging limitations.

The facility structure should take into account the location and layout of the rigging points. Rigging is typically installed in a grid pattern that aligns with industry standard components such as truss, used in 10' sections.

Consideration should be given to the layout of the rigging points within the facility.

Ease of access and visibility for future inspections is very important. Designing with inspections in mind by limiting the number of hardware pieces used and marking hardware to be visible from below can help to keep inspectors from working at height, further limiting risk and liability.

3.3 Loads

3.3.1 Analysis shall be based on all applicable load combinations. Analytical review shall include the rigging point, rigging point connections and the strength of any connection to the supporting structure.

3.3.2 Loads, forces and force effects acting on the rigging point shall include (as applicable):

1. Dead loads
2. Live loads
3. Dynamic forces
4. Environmental loads

E3.3.2: Consideration should be given to all loads and forces including:

User design loads
The determination of loading criteria for rigging points in day-to-day use is primarily the responsibility of the end user. It has become accepted practice to qualify some types of loads according to the terms "characteristic load" and "peak load". Typical definitions for these terms are:

Characteristic load:
The maximum force applied to a rigging point resulting from normal intended operating conditions whether or not the load acting on the rigging point is at rest or in motion. This includes the working load limit (WLL), self-weight including the weight due to load carrying devices and lifting medium, and forces due to inertia and dynamics in normal use.

Peak load:
The maximum force applied to a rigging point, resulting from abnormal conditions or irregular operation whether or not the load acting on the rigging point is at rest or in motion (e.g., effects of emergency stops, uncontrolled stops, drive electronics or power failure, stalling of the actuation equipment, extreme environmental conditions).

Especially in the case of overhead lifting and "flying" effects, it has become accepted practice to use relatively high design factors for characteristic loads and relatively lower design factors for peak loads.

For example, Characteristic loads acting on elements used in overhead lifting of flying systems may have design factors that range from 4:1 to 8:1 vs. component or element failure. Peak loads may have design factors on the same component or element that range from 1.5:1 to 3:1. This design theory is an attempt to balance the need to keep component size as small as practical (for both aesthetic and monetary reasons) while still providing adequate protection against failure in the event of a peak load condition. The use of peak or characteristic loads is frequently also tied to the use of a formal risk assessment/risk reduction process. The ultimate goal being to balance the competing elements of risk with system performance criteria and, to always ensure a rationally safe system. If done with care, a well-designed, rationally safe and balanced design is the end result.

It is essential to note that either characteristic loads or peak loads shall not, under any circumstances, exceed the code-defined minimum strength of a rigging point. Allowable strength cannot be exceeded, no matter the logic applied to the determination of load criteria.

Forces that may contribute to load include:

Forces
1. Vertical forces
2. Horizontal forces
3. Lateral forces
4. Rotational forces
5. Seismic forces

Force Effects
1. Forces that cause rotational effects
2. Forces that cause cyclical effects

Forces and force effects should be combined when they occur simultaneously to ensure that the worst case has been considered.

3.3.2.1 WLL shall be used to design all standard rigging points.

3.3.2.1.1 Loads, forces and force effects shall be considered in the design of purpose specific rigging points. This shall include dynamic load factors.

E3.3.2.1 A dynamic load factor of (2.8 to 3.15 and/or DIN criteria) is frequently applied to rigging hardware and equipment intended for support of powered chain hoists, which are typically used to support temporary loads resulting from equipment used in the concert touring industries and, for similar events. Higher dynamic load factors may be appropriate for rigging points that support high-speed lifting and lowering operations.

WLL:	should not exceed 20% of ultimate capacity.
Characteristic loads:	should not exceed 33% of ultimate capacity.
Peak loads:	should not exceed 50% of ultimate capacity.

3.3.3 Load analysis shall include the effect of stress reversal. This shall include the consideration of fatigue due to multiple stress reversals.

E3.3.3 Initiation of failure due to fatigue is complex. Failure at stresses below yield can occur when fatigue or brittle fracture conditions govern. These phenomena can occur in areas of high combined stresses; at locations of impact loading; at locations with notches or abnormalities that can lead to stress concentrations and due to other circumstances.

Repetitive loading and unloading, and cyclical application of loads may also be causes of fatigue.

Resources for information regarding fatigue analysis and design include:

- *The Steel Construction Manual, American Institute of Steel Construction, 15th Edition; See Fatigue & Fracture Control Appendix 3*
- *Specification for Structural Steel Buildings, American Institute of Steel Construction, August 1, 2022, Appendix 3 Fatigue, Page 16.1-204*
- *The Aluminum Design Manual 2020, The Aluminum Association; Part 1: Specification for Aluminum Structures, Appendix 3, Design for Fatigue*

3.3.4 The allowable direction of loads applied to a rigging point shall be defined.

3.3.5 Working Load Limit (WLL)

3.3.5.1 All rigging points shall have a WLL. The WLL shall define the maximum weight or static load that can be applied to the rigging point.

Determination of the maximum weight or static load applied shall be the responsibility of the User.

It is the responsibility of the User to ensure that the applied weight or Static Load shall not exceed the WLL.

3.4 Load combinations

3.4.1 Design criteria shall be based on the controlling load combination.

3.4.2 Load combinations shall be based on the International Building Code, current edition.

3.5 Design criteria

3.5.1 Design of rigging points shall include any necessary supplemental framing to resolve loads to the main structure.

E3.5.1 This section is based on ASME "BTH-1—2023: Design of Below-the-Hook Lifting Devices". BTH-1 provides design criteria for items such as lifting beams & spreader beams. For the most severe category of lifting beams (those with loads that can be unpredictable, variable, or severe), BTH-1 uses a basic design factor of 3.0. Design factors in this standard derive from stress values in BTH-1.

Design of rigging points shall include any necessary supplemental framing to resolve loads to the main structure. Additionally, load factors as contained within this document apply to the rigging point and any supplemental structural framing.

While the building structure is outside of the scope of this standard, designers should be aware that load factors on the building structure itself are typically defined by the applicable building code, not this standard.

3.5.2 Design Factors

3.5.2.1 General

3.5.2.1.1 Design factors (DF) and material specific design criteria are contained in this section.

3.5.2.1.2 Nominal design factors shall be used in the absence of material specific design criteria.

3.5.2.1.3 Nominal design factor for static load bearing components: 5.0X the WLL as compared to nominal strength.

E3.5.2.1 This standard does not address the strength of existing structures to support rigging points. However, the designer should exercise all due diligence to ensure that the owner of the existing structure has taken appropriate action to ensure that the rigging point loads can be safely connected to and supported by the existing structure. This includes an understanding of load factors as they apply to the building structure and knowledge of the strength of materials within the existing structure.

The provisions of this section can be applied to unusual materials and situations where conventional reference and design criteria are not available. However, the strength of items that cannot be determined by stress analysis methods may be determined by approved test methods.

3.5.2.2 Steel

3.5.2.2.1 Design factors for steel shall be 5.0X the WLL as compared to the nominal strength of the component based on American Institute of Steel Construction: ANSI/AISC 360 -22, Specification for Structural Steel Buildings.

E3.5.2.2 Small steel components subject to highly concentrated stresses may be subject to additional failure modes including local distortion, local tensile failure at holes adjacent to plate edges and other unusual failure modes.

3.5.2.3 Aluminum

3.5.2.3.1 Design factors for aluminum shall be 5.0X the WLL as compared to the nominal strength of the component, based on the Aluminum Association: Aluminum Design Manual; —ADM—2020.

3.5.2.3.2 Design of aluminum rigging points shall include consideration of stress concentrations due to stress risers within the rigging point and/or stress concentrations due to concentrated bearing loads or forces acting on the rigging point.

3.5.2.3.3 Welded aluminum rigging points shall consider the effects of the heat affected zone.

E3.5.2.3 Small aluminum components subject to highly concentrated stresses may be subject to additional failure modes including local distortion, local tensile failure at holes adjacent to plate edges and other unusual failure modes.

3.5.2.4 Concrete

3.5.2.4.1 Design factors for concrete shall be 6.0X the WLL as compared to the ultimate strength of the component, based on the American Concrete Institute: Building Code Requirements for Structural Concrete; 318-19 (22).

E3.5.2.4 Connections to concrete structures are potentially subject to multiple failure modes. Analysis of these connections may be complex and can be affected by a wide variety of conditions including material strength, type and location of reinforcement, edge distance, other stresses acting on the concrete and many other factors.

New connections to existing concrete structures may require additional analysis of the existing structure that is beyond the scope of this document.

Rigging points that will be attached to existing concrete structures may require detailed knowledge of the existing structure and coordination with the Engineer of Record for that structure. Concentrated loads on concrete structures, for example, may appear to be acceptable when ONLY the strength of a connection anchor is considered. However, the new rigging point load may affect the strength of the existing concrete structure in unanticipated ways.

3.5.2.5 Masonry

3.5.2.5.1 Design factors for masonry shall be 6.0X the WLL as compared to the nominal strength of the component, based on the American Concrete Institute: Building Code Requirements and Specifications for Masonry Structures; TMS 402/602-22.

E3.5.2.5 See explanatory note E3.5.2.4, masonry structures are subject to considerations similar to concrete structures.

3.5.2.6 Connections

3.5.2.6.1 Rigging point design shall include design of the connection of the rigging point to all structures.

3.5.2.6.2 Design of connections shall be based on design criteria as set forth in this document, the International Building Code, current edition and related material standards.

3.5.2.6.3 Design factors for connections shall be 6.0X the WLL as compared to the ultimate strength of the component.

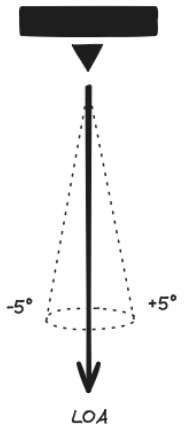
E3.5.2.6 Connection types can include welded connections, bolted connections, friction connections or other proprietary connections (i.e.: Connectors as manufactured by Lindapter, LNA, Unistrut, Doughty and others), and methods similar to “temporary” or “rock and roll/arena rigging”, which are intended to be permanently installed.

Design factors for connections are higher than for materials due to the fact that there is a greater variability in connection conditions. Additionally, connections may be subject to additional forces due to prying action and other secondary effects which justify higher design factors.

3.6 Rigging points - Types

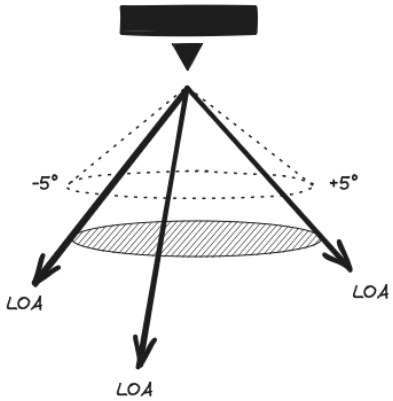
E3.6 The rigging point must include the "full assembly". A "full assembly" includes all components that are in the load path, including connection of the rigging point to the supporting structure.

3.6.1 A Standard Rigging Point is intended to support the working load limit applied along one line of action in any direction not more than 3 degrees from the vertical.



E3.6.1 Standard Rigging points are intended to support forces along a single line of action with some degree of robustness to account for moderate off-line-of-action loads.

3.6.2 A 45-Degree Rigging Point is intended to support the working load limit applied along one line of action in any direction not more than 45 degrees from the vertical.



E3.6.2 45-Degree Rigging Points are very common in active environments where rigging is installed and removed frequently. The system designer should consult with the client to be sure that they are using the correct design criteria for each type of rigging point.

45-Degree Rigging Points may be used with bridles and other configurations that impose lateral (sideways) forces on the point.

3.6.3 Design of rigging points shall consider all applicable load and force combinations.

3.6.4 Rigging points shall consider all combined stresses.

E3.6.4 Analysis methods for considering combined stresses may include a principle stress analysis using Mohr's circle methods, computerized FEA methods or other methods to ensure that all maximum stress combinations are considered during design. Well-designed tests may also be utilized to ensure a safe design.

3.7 Wear and Abrasion

3.7.1 Rigging points subject to wear and abrasion shall be designed to be within accepted tolerances at the end of their anticipated life.

3.7.2 Allowable wear limits shall be established, wear should be monitored by a permanent wear mark or by use of a gauge or other acceptable means on each rigging point.

3.8 Distortion and Displacement

3.8.1 Rigging points shall be designed to prevent distortion or displacement of the rigging point assembly.

3.8.1.1 Rigging point components that are assembled from flexible materials (such as steel wire rope) shall be designed and installed in such a way that any displacement under load (whether vertical or horizontal) shall not cause the assembly to interfere with the structure or other rigging points or cause the hung assembly to behave unsuitably.

E.3.8.1 Rigging point components that are subject to elastic behavior (such as steel or aluminum plates) should not experience significant local distortion under load.

3.8.2 Rigging points shall be prevented from unintended rotation.

E.3.8.2 Swivel rings are an example of a rigging point intended to rotate. Care should be taken to ensure that mounting hardware for these types of systems are prevented from loosening.

3.8.3 *Mounting hardware shall be prevented from loosening by appropriate locking methods.*

4 FABRICATED COMPONENTS

4.1 General

4.1.1 This section addresses rigging points assembled from fabricated components or a combination of Fabricated Components and detachable rigging components.

E4.1.1 Additional information regarding testing and design factors for mass manufactured items may be found in ASME B30 documents. See Section 2.5 for a definition of "Fabricated component" as referenced in this document. Additional information regarding testing and design factors for fabricated items may be found in the 2021 IBC, see section 17.

4.1.3 The WLL of fabricated component assemblies shall be determined by design or by testing.

E4.1.3 Design shall be according to the provisions of Section 3. Testing shall be according to the provisions of Section 7.

4.2 Fabrication

4.2.1 Rigging points shall be fabricated from new materials of verifiable origin.

4.2.2 Where the components are in contact with, or are fastened to dissimilar materials, reactive materials shall be kept from direct contact with other dissimilar materials.

E4.2.2 Isolation or direct contact may be achieved by painting, powder coating, use of a barrier material or other similar means.

5. DETACHABLE COMPONENTS

5.1 General

5.1.1 This section shall address rigging points assembled from serially manufactured components intended for overhead rigging.

5.1.2 Detachable component rigging points are manufactured from detachable rigging hardware. Individual or multiple detachable components may be used to assemble a rigging point.

E5.1.2 See the referenced standards in Part 2 for design guidance.

5.1.3 All detachable components used in the assembly of rigging points shall have use criteria defined by the manufacturer. Use criteria shall include WLL and any use limitations such as the allowable direction of the applied load or force acting on the component.

E5.1.3 Additional use criteria may include a diagram indicating the allowable direction of applied load or language indicating that the component may not be subject to side loading.

5.1.4 Detachable components shall be visibly secured.

E5.1.4 Tamper-evident methods such as mousing, installation of cotter pins, heat-resistant thread lock or, other methods shall be of a type that, once applied, cannot be removed without showing evidence of having been removed.

This section applies to items that can often be installed without the use of tools or special equipment. The intent is to ensure that items of this type are secured in such a way that they CANNOT be removed without special effort.

5.1.5 Stingers shall be assembled with permanent termination methods and shall have a permanent label indicating the allowable working load limit.

6 INSTALLATION

6.1 Supervision

6.1.1 All installation of materials and equipment shall be performed or supervised by a competent person.

6.2 Welding

6.2.1 All welding shall comply with the appropriate AWS standard. All welding shall be performed by certified welders.

6.3 Friction connections

6.3.1 Friction connections shall be installed according to an approved installation plan as provided by a qualified person. Proprietary friction connectors shall be installed in accordance with the manufacturer’s specification.

6.4 Embedded Hardware

6.4.1 Embedded hardware (plates, bolts, channels, etc.) shall be installed according to an approved installation plan as provided by a qualified person and in accordance with the manufacturer’s specification.

E6.4.1 Users and installers should clearly understand that embedded hardware should be installed so that it does not locally over-stress the material to which the embedded hardware is attached.

6.4.2 The location of embedded hardware shall be approved by a qualified person.

6.5 Anchors

6.5.1 Chemical anchors shall be installed according to approved installation methods, and specified locations as provided by a qualified person and in accordance with the manufacturer’s specification.

6.5.2 Expansion anchors shall be installed according to approved installation methods, and specified locations as provided by a qualified person and in accordance with the manufacturer's specification.

E6.5 This section applies to "drill-in" anchors installed in existing concrete and masonry. Users and installers should clearly understand that anchors should be installed so that it does not locally overstress the material to which the anchor is attached.

Concrete beams typically have an uncracked and a cracked zone. The cracked zone is typically located at the bottom of the beam, below the "neutral axis". The design of anchors installed in this area of a concrete beam, for example, needs to be considered to ensure a safe installation. The designer should consider the stress state of the concrete into which the anchor is installed.

6.5.3 Anchors shall not interfere with existing embedded steel reinforcing bars, steel pre-stress cables, steel post-tensioned cables or any other embedded items located within existing structure. Holes drilled for the installation of anchors shall not cut any embedded bars, cables or other embedded items.

E6.5.3 Under the best circumstances, it can be difficult to ensure that concrete anchors installed into existing structures do not interfere with existing reinforcing. Caution must be employed when drilling into existing structures. Installation should not proceed without plans approved by a qualified person.

6.6 Interference

6.6.1 Rigging points shall not interfere with adjacent systems or access requirements.

E6.6.1 Rigging points fabricated from flexible components may move when a load is applied. Care should be taken to ensure that these points do not interfere with other systems when in either weighted or unweighted condition.

6.7 Hardware

6.7.1 Hardware shall be of known material and verifiable origin.

6.7.2 Hardware shall have a Working Load Limit (WLL) or a rated capacity.

6.7.3 If a rated capacity or WLL is unknown, a written minimum breaking strength must be obtained from the manufacturer or supplier prior to use.

7 TESTING

7.1 New Rigging Points

7.1.1 General

7.1.1.1 Rigging points shall be proof tested according to the provisions of this section and appropriate standards.

7.1.1.2 Exception: Fabricated-component rigging point assemblies that have been designed by a qualified person are not required to be proof tested.

7.1.1.2 Exception: Detachable rigging hardware used to form a rigging point installed by a qualified person is not required to be proof tested.

7.1.2 Fabricated rigging point assemblies

7.1.2.1 Prior to installation, all new fabricated component rigging point assemblies shall be proof tested. Proof test criteria shall be developed by the manufacturer or a qualified person.

E7.1.2.1 ANSI B.30.26 has provisions for similar proof load requirements for rigging hardware and accessories.

7.1.2.2 Prior to initial installation, representative samples of identical fabricated component rigging point assemblies may be approved based upon a test procedure incorporating probabilistic methods developed by a qualified person that simulates applicable loading and deformation conditions.

7.1.2.3 The proof load for assemblies tested prior to installation shall be a minimum of 2X the required WLL. The direction of application of the proof load shall be the same as the intended use.

7.1.3 Detachable rigging hardware assemblies

7.1.3.1 Inspection and/or testing shall be according to recommendations of the manufacturer or a qualified person.

E7.1.3.1 Generally, detachable rigging hardware assemblies do not require testing as they are made from engineered serially manufactured components. However, under some circumstances, it may be desirable to test these assemblies based on expert guidance.

7.1.4 Embedded anchor connections

7.1.4.1 Prior to initial use, all new rigging points incorporating embedded anchors shall be proof tested.

7.1.4.2 Exception: Probabilistic methods may be used to test a sample of embedded anchors, see 7.1.4.5

7.1.4.3 Testing criteria shall be developed by a qualified person.

7.1.4.4 Testing shall be performed by a competent person.

7.1.4.5 Proof load requirements for embedded anchors: The proof load shall be a minimum of 1.25X the required WLL. The direction of application of the proof load shall be the same as the intended use.

E7.1.4.5 Higher proof load requirements may be used if they are approved by a qualified person. Care must be taken to ensure that existing structural systems are not overloaded during testing.

7.1.4.6 Representative samples of identical embedded anchor assemblies may be approved based upon a test procedure incorporating probabilistic methods developed by a qualified person.

E7.1.4.6 Older concrete or masonry structures may require testing of all embedded anchors due to potential cracking and deterioration. This especially applies to structures built prior to 1960.

7.1.5 Welded and Bolted Connections

7.1.5.1 Prior to initial use, a representative sample, based on probabilistic methods, of new rigging points incorporating welded or bolted connections shall be proof tested.

7.1.5.2 Testing criteria shall be developed by a qualified person.

7.1.5.3 Testing shall be performed by a competent person.

7.1.5.4 The proof load for welded and bolted connections shall be a minimum of 1.50X the required WLL. The direction of application of the proof load shall be the same as the intended use.

E7.1.5.4 WARNING. IT IS BEYOND THE SCOPE OF THIS DOCUMENT TO ANALYZE SUPPORTING STRUCTURES. PRIOR TO THE APPLICATION OF TEST LOADS TO EXISTING STRUCTURES, DUE DILIGENCE MUST BE EXERCISED TO ENSURE THE CAPACITY OF THE EXISTING STRUCTURE TO SUPPORT THE TEST LOAD.

7.1.5.5 Probabilistic testing shall be based upon a test procedure incorporating approved methods developed by a qualified person.

7.2 Existing Rigging Point Load Test Requirements – In-Situ Load Tests

7.2.1 Whenever there is doubt as to the load-bearing capacity of an existing rigging point or portion thereof for the expected loads, an engineering assessment shall be required.

7.2.2 The engineering assessment shall involve either a structural analysis, an in-situ load test, or both as determined by a qualified person. The structural analysis shall be based on actual material properties and other as-built conditions that affect stability or load-bearing capacity, and shall be conducted in accordance with applicable design standards.

E7.2.2 Qualifications for the development of testing plans differ from the qualifications required for design or approval of rigging points. Development of testing plans requires knowledge of test methods, probability analysis and code compliance.

7.2.3 If the rigging point or portion thereof is found to have inadequate capacity for the expected loads, modifications to ensure structural adequacy, derating of allowable loads, or the rigging point shall be removed from service.

8 INSPECTION, DOCUMENTATION, REMOVAL, AND REPAIR,

8.1 General

8.1 INSPECTION-NEW OR MODFIED POINTS

8.1.1 Inspection criteria shall be defined by a qualified person.

8.1.2 Inspection shall be performed by a competent person.

8.1.3 Initial inspection shall be performed prior to first use. A written record of the inspection referencing the individual components of the rigging point, along with the unique identification of the rigging point, is required.

8.1.4 Rigging point assemblies shall be inspected to ensure that all elements are installed as intended and functioning as per the design documents and/or per manufacturer’s recommendations.

8.1.5 Rigging points found with conditions that exceed the criteria of the appropriate reference standard or, that exceed the criteria of this standard shall be removed from service. Rigging points shall not be returned to service until approved by a qualified person.

8.1.6 Frequency of inspection:

8.1.6.1 Prior to Each Use: A visua**l** inspection of the rigging point shall be performed by the user or other designated person each shift before the rigging point is used. The inspection may be performed by the user immediately prior to use of the rigging point. Written records are not required.

8.1.6.2 Periodic inspection intervals shall not exceed 1 year unless determined by a qualified person. Inspections shall include any specific criteria as defined by a qualified person. Written records are required for periodic inspections.

8.1.7 The rigging point owner, at their expense, is responsible to ensure proper training and inspection procedures.

8.2 Modification or Repair

8.2.1 Altered, modified or repaired rigging points shall be inspected to verify compliance with this standard.

8.3 Documentation

8.3.1 Date of inspection and inspector shall be identified in the report.

8.4 Component Inspection

E8.4 The use of methods such as marking nuts with a paint pen to verify that the nut has not loosened in service (and other methods visible from a distance) can be useful for inspection from a distance.

8.4.1 Slings shall be inspected in accordance with the requirements of ASME B30.9, Slings (latest edition) and the manufacturer's recommendations.

8.4.2 Welds shall be inspected in accordance with IBC (Chapter 17) and AWS D1.1 & D1.4

8.4.3 Rigging hardware shall be inspected in accordance with the requirements of ASME B30.26, Rigging Hardware (latest edition) and the manufacturer's recommendations.

8.4.4 Anchors installed in concrete and masonry shall be inspected in accordance with the 2021 IBC & ACI (318) and manufacturer's recommendation.

8.4.5 Beam clamps shall be inspected in accordance with ASME B30.20 (check reference).

8.5 Inspection Records

8.5.1 Dated records of periodic inspection shall be kept by the rigging point owner for the duration of the life of the rigging point. Records shall identify the name of the inspecting party and the date of the inspection.

8.5.2 The most recent periodic inspection record shall be kept on-site by the owner and available for review.

8.5.3 Clear and legible copies of inspections shall be transferred in the event of a change of ownership.

8.5.4 See Section 10, Documentation for record keeping requirements.

8.5.5 Records may be kept either as physical copies or electronically.

8.6 Removal-from-service criteria

8.6.1 A Rigging Point shall be removed from service if any of the following conditions are present:

1. Missing or illegible identification
2. Cracks or breaks
3. Excessive wear, nicks, or gouges in chain, shackles, swivel eyes and any similar devices
4. Stretched chain links or fittings
5. Bent, twisted, or deformed chain links or fittings
6. Evidence of heat damage
7. Excessive pitting or corrosion
8. Lack of ability of chain or fittings to hinge (articulate) freely
9. Weld splatter
10. For hooks, removal criteria as stated in ASME B30.10
11. For rigging hardware, removal criteria as stated in ASME B30.26
12. For beam clamps, removal criteria as stated in ASME B30.20 (check reference)
13. Other conditions, including visible damage or movement, that cause doubt as to the continued use of the component

9 EXISTING RIGGING POINTS

9.1 Verification by analysis

9.1.2 Approval of existing rigging points according to the provisions of this standard shall be made by a registered design professional.

9.1.2.1 Exception: Rigging points exclusively assembled with detachable rigging hardware and connected to the structure by use of clamps, slings or similar attachments that do not require drilling or welding may be approved by a qualified person.

9.1.3 Verification of the capacity of existing rigging points shall be according to Section 7.2.

9.1.4 Documentation of analysis shall be provided to the facility owner and shall be maintained according to Section 10.

9.2 Verification by testing

9.2.1 Verification of the capacity of existing rigging points shall be according to Sections 7.2

9.2.2 Documentation of the testing shall be provided to the facility owner and shall be maintained according to Section 10.

10 DOCUMENTATION

10.1 General

10.1.1 All documentation shall be provided by the installer in English and shall be available at the work site. Documentation shall be provided prior to first use. Documentation may be kept either as physical copies or electronically.

10.1.2 Design documents shall provide the following information:

1. WLL and allowable direction of loading
2. Construction
3. Installation location
4. Maintenance requirements

10.1.3 The facility or building owner is responsible for maintaining documentation regarding the capacity of rigging points.

10.2 Documentation for manufactured items shall be provided to the facility by the installer and maintained on site with the system design documents.

10.3 An identifying mark or code shall be affixed to the rigging point (with the date of the last periodic inspection) in accordance with Section 11, Labeling.

10.3.1 Exception: Rigging points that are identified according to the exception noted in 11.1 shall have a permanent record identifying each rigging point. This record shall be maintained by the owner and kept with the design documents. This permanent record shall also include the date of the last periodic inspection.

E10.3 This applies to serially manufactured and custom items.

11 LABELING

11.1 General

The capacity and allowable loading for each rigging point shall be identified.

11.1.1 Each rigging point shall have a permanent label with the following information:

1. WLL for all allowable load configurations.
2. Allowable direction of applied load.

11.1.2 Each rigging point may be identified by coordination with the design documents. The design documents shall identify a unique location, WLL for all allowable load configurations, and allowable direction of applied load.

11.1.3 Rigging point identification shall be maintained by the user so as to be legible during the life of the rigging point.