ANSI E1.6-3 – 2012
Selection and Use of Serially Manufactured Chain Hoists in the Entertainment Industry

Rig/2008-2019r5

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Approved as an American National Standard by the ANSI Board of Standards Review on 3 July 2012.

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The PLASA Technical Standards Program

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

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

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

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Interest category codes:

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

ANSI E1.6-3
SELECTION AND USE OF SERIALLY MANUFACTURED CHAIN HOISTS IN THE ENTERTAINMENT INDUSTRY

Table of Contents

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

1 GENERAL

1.1 Scope

This standard establishes minimum safety requirements for the selection and use of serially manufactured electric link chain hoists having capacity of 2 tons or less in the entertainment industry. This standard does not address the design or maintenance of these hoists.

E1.1 *While provisions in this standard require that neither the hoist user nor the operator overload the anchorage or any rigging, hoist or load system component through the operation of the hoist system, the standard does not address how these load limits are determined.*

1.2 Purpose

The purpose of this document is to provide standards for the use of chain hoists in the entertainment industry. These standards are intended to reduce injury and provide for the protection of life, limb and property.

1.3 Application

This standard applies to hoists used in the entertainment industry including, but not limited to, hoists used in theatre, musical touring, film, trade show and television industries.

1.4 References

BSR E1.6-2 Design, Inspection and Maintenance of Serially Manufactured Electric Chain Hoists for the Entertainment Industry.

BSR E 1.6-4 Portable Control of Fixed-Speed Electric Chain Hoists in the Entertainment Industry

STANDARD REQUIREMENTS	EXPLANATORY INFORMATION (Not part of the requirements of E1.6-3)

2 DEFINITIONS

2.1 Anchorage: The point on the support structure where the hoist, or the hoist through the rigging system, connects to the support structure. See figure 1, section 12.

2.2 Bump (Inch): The momentary operation of a hoist; used for checking operation, direction, or leveling a load system.

2.3 Capacity, Hoist Rated: The maximum load allowed to be lifted or lowered by a hoist as specified by the hoist manufacturer.

E2.3 *The user must realize that lifting a load at or near the hoist rated capacity will require anchorages and rigging with a rated capacity greater than the hoist rated capacity due to the dynamic forces caused by starting and stopping the hoist.*

2.4 Capacity, Rated: The maximum load allowed on an object as specified by the manufacturer.

E2.4 *In order to insure that the actual load does not exceed the rated capacity, all dynamic and anticipated forces need to be added to the static load when comparing the actual load to the rated load.*

2.5 Compound Flown System: A combination of load systems arranged such that one load system is supporting the other.
See figure 4, section 12.

E2.5 *"Super Grid" is sometimes used to refer to the upper load system of a compound flown system.*

2.6 Determinate Structure: A structure in which load distributions to supports are influenced by load and support locations alone. In terms of entertainment rigging in this document, a determinate structure is a load system supported by multiple hoists in such a fashion that small moves of one hoist do not cause large load shifting to occur between hoists in the lifting system. See figure 5, section 12.

E2.6 *Examples of a determinate structure are:*

1. *A rigid straight truss or beam being lifted with two hoists.*
2. *A rigid curved or triangular structure being lifted with three hoists.*

2.7 Hazard: A situation that poses a level of threat to life, health or property.

2.8 Hoist: A serially manufactured electric lifting device using a link chain and a lift wheel to perform the lifting and lowering of the load system.

2.9 Hoist Owner: The person or entity who has legal title to the hoist.

2.10 Hoist User: The person or entity who either by ownership, lease or other arrangement controls the use and installation of the hoist.

E2.10 *In most cases the hoist user would be the lighting, sound, rigging or other contractor charged by the production to provide and oversee the installation and use of the rigging equipment.*

2.11 Indeterminate Structure: A structure in which load distributions to supports are influenced by structure stiffness and load and support locations. In terms of entertainment rigging in this document, an indeterminate structure is a load system supported by multiple hoists in such a fashion that it is not practical to calculate with accuracy the dynamic load on any one of the hoists due to load shifting. See figure 5, section 12.

E2.11 *If a straight line can be drawn through all the hoists supporting a load system, the structure will be indeterminate if it is supported by more than two hoists. If a straight line cannot be drawn between all the hoists supporting a load system, the structure will be indeterminate if it is supported by more than three hoists.*

2.12 Interested Party: A person or entity who may be directly or indirectly affected.

2.13 Lifting Operation: The act of moving a load system either up or down. Small movements of individual hoists for the purpose of load balancing or leveling a load system are not considered to be a lifting operation.

2.14 Load: The total superimposed force on the hook or load block of the hoist.

2.15 Load, Anticipated: The sum of the static load and any factors that can be anticipated to increase the static load any time the load system is suspended.

E2.15 *These factors include:*

1. *Dynamic forces induced by starting, stopping, increasing or decreasing the speed of the lifting operation.*
2. *Forces induced by worker(s) falling into a fall protection system that would increase the load above the calculated load.*
3. *Forces induced by temporary loads.*
4. *Load shifting that may occur during the lifting operation.*
5. *Load increases caused by personnel working or performing on the load system.*

2.16 Load, Calculated: The estimated or theoretical total load, derived using the formulas and/or estimating techniques standard in the entertainment rigging industry.

E2.16 *The total load needs to include the static load and any other loads that move, such as curtains, personnel, and other moving loads.*

2.17 Load, Design The maximum allowable load as determined by a qualified person.

2.18 Load, Dynamic: The component of the total force that varies over time.

E2.18 *In lifting operations there are always dynamic forces present with the acceleration and deceleration of the load.*

2.19 Load Hazard Zone (LHZ): The area underneath the load system where death or serious injury may occur as the result of a load system or a rigging failure.

2.20 Load, Static: A force or combination of forces that remains constant.

E 2.20 *A suspended stationary load system has a static load associated with it caused by the force of gravity.*

2.21 Load, Verified: A force that has been confirmed by the use of a calibrated load measurement system.

E2.21 *The sum of the verified loads in a load system must equal the sum of the component loads of the load system.*

2.22 Overload: A load greater than the design load.

2.23 Parked: A load system is considered parked when power is removed from the hoist(s).

2.24 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 the hazards.

2.25 Person, Designated: A person selected or assigned by the employer or by the employer's representative as being competent to perform specific duties.

2.26 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.

2.27 Production Rigger: The person designated by the hoist user to ensure the proper installation of the rigging system and hoists.

2.28 Risk: The possibility of loss or injury.

E2.28 *The magnitude of risk can be assessed by multiplying the probability of harm, by the severity of that harm, by the frequency of the event occurring.*

2.29 Risk, Residual: Risk remaining after risk reduction procedures have been implemented.

2.30 Risk, Tolerable: Risk that is accepted for a similar task and hazard combination in general industry.

2.31 Support Structure: The load bearing elements designed to resist the allowable load imposed on the anchorage.

E2.31 *The support structure can be permanent such as roof support trusses in a building, or temporary such as an outdoor aluminum roof structure.*

2.32 System, Flown: Describes all the systems and components that must be considered when using a hoist system. See figure 1 & 4, section 12.

E2.32 *All components from the anchorage down through the load system must be able to safely resist the forces imposed by the lifting system. The term "flown system" describes all these components taken as a whole.*

2.33 System, Lifting: The group of hoists used to raise and lower the load system. See figure 1, section 12.

2.34 System, Load: The objects attached to the hoist(s), either directly or indirectly, causing a load to be applied to the hoist(s). See figure 1-3, section 12.

2.35 System, Rigging: The system of wire rope, shackles and any other equipment used to connect hoist(s) to a support structure. See figure 1, section 12.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

3 SYSTEM REQUIREMENTS

3.1 General

In order to comply with this standard, the flown system including the hoists shall meet the following requirements:

E3.1 *Over the years, contributing factors to failures involving hoists in the entertainment industry have included all parts of the flown system, ranging from anchorage failure at the support structure down through failures in the load systems. For this reason, the standard must address minimum requirements for all components of the flown system and the anchorage to which it is attached.*

3.1.1 All components shall be used in a fashion approved by the manufacturer or in writing by a qualified person.

3.1.2 The system design shall be such that the intentional operation of one or more hoists shall overload neither the anchorage nor any rigging, hoist or load system component.

3.1.3 The system design shall be such that the inadvertent operation of one or more hoists will be terminated, either by the operator or automatically by the control system, prior to overloading the anchorage or any rigging, hoist or load system component.

3.1.4 Dynamic loads associated with starting and stopping the hoist shall be considered when evaluating the anchorage or any rigging or load system component for overloading.

3.1.5 On a multiple hoist system, all applicable load distribution scenarios for the planned operations shall be evaluated and accounted for. This information shall be given in writing to the hoist user by the production rigger.

3.2 Anchorage

The anchorage point on the structure shall have a design load equal to or greater than the sum of the anticipated loads attached to it.

3.3 Rigging System

All rigging system components shall have a design load equal to or greater than the maximum anticipated load to which they are to be subjected.

3.4 Lifting System

In order to comply with this standard, all lifting system components shall meet the following requirements:

3.4.1 Hoists shall comply with the requirements of ANSI E1.6-2-200X.

3.4.2 Hoists shall be clearly marked with capacity, electrical requirements and speed information such that the operator can verify that the correct hoist(s) are installed prior to any lifting operation.

3.4.3 The capacities of hoists shall be equal to or greater than their anticipated loads.

E3.4.3 *Caution should be taken that the increased hoist capacity does not overload the anchorage, any rigging system component or load system component.*

3.4.4 There shall be a straight path between the hoist's upper and lower attachment points, except in situations where necessary redirection of the chain has been designed by a qualified person (such as in ground support towers).

3.4.5 The load chain shall not be twisted, knotted or choked.

3.4.6 When a swivel hook is used on the load chain, the hook shall be allowed to swivel to prevent twisting of the load chain.

3.4.7 The hoist body shall be prevented from freely rotating under load.

3.4.8 The attachment means to the load shall be properly seated in the hook and shall be of a design that prevents unintentional disengagement (rollout). The latch or tip of the hook shall not be allowed to support any part of the load.

3.4.9 If chain containers are used the following conditions shall be met:

3.4.9.1 The hoist owner shall provide hoist user with written installation instructions and capacity data.

3.4.9.2 The hoist user shall comply with the chain container installation instructions and capacity data supplied by the hoist owner.

3.4.9.3 The loose end of the chain shall be of adequate length, and properly positioned to feed into the chain container.

3.4.10 The power supply shall be adequate for the power requirements of the lifting system.

3.4.11 All power and control cables shall be secured to prevent damage during any lifting operation.

3.4.12 A means shall be provided to quickly remove power from hoists. It shall be readily accessible in case of an emergency.

3.4.13 If maintenance is required on a hoist, the user shall remove the hoist from service until the hoist owner or their designated person has performed the required service.

3.5 Load System

In order to comply with this standard, all load system components shall meet the following requirements:

3.5.1 Hoists should be rigged such that the load system can travel the full distance allowed by the hoists.

3.5.1.1 If the provisions of 3.5.1 cannot be met, precautions shall be taken to prevent the load system from striking any obstruction in the path of travel.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

4 AREAS OF RESPONSIBILITY

4.1 Hoist Owner

The hoist owner is responsible for all maintenance or repair of the hoist.

4.1.1 The owner shall provide documentation of the most recent periodic inspection when requested by interested parties.

E4.1.1 *Refer to BSR E1.6-2 section 5.2.3 for periodic inspection requirements and section 8.2 for documentation requirements.*

4.2 Hoist User

The hoist user shall ensure the hoists are selected and used in accordance with the provisions laid out in this standard. In addition, the user shall provide all necessary documentation and equipment required to comply with this section.

4.2.1 Any visual inspections required on site shall be carried out by a designated person selected by the hoist user.

4.2.2 If load verification techniques are employed during lifting operations, such as load cells or dynamometers, the hoist user shall be responsible for implementing the system, including verifying proper working condition and calibration.

4.3 Production Rigger

The production rigger is responsible for overseeing the installation of the hoists.

4.3.1 The production rigger is responsible for calculating and estimating both the calculated loads and anticipated loads with respect to any hoists attached to the rigging system. When required by this standard, the production rigger shall make this information available, in writing, to the hoist user and all other interested parties.

4.4 Hoist Operator

The hoist operator shall operate the lifting system in accordance with the provisions of this standard and any other applicable standards or regulations.

4.4.1 The operator shall be designated by the hoist user and trained in the proper operation of the lifting system, including any multiple hoist control systems used in that lifting system.

4.4.2 The operator shall be familiarized with the control system sufficiently to react immediately in case of a malfunction.

4.4.3 The operator shall prevent overloads during operation.

4.4.4 The operator should avoid unintentional slack chain situations.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

5 RISK REDUCTION PROCESS

In order to ensure hoist use in the entertainment industry is no more dangerous than hoisting operations in general industry, a risk reduction process shall be performed prior to all lifting operations.

This process requires that all hazards associated with the lifting operation be identified. The risks associated with these hazards shall then be evaluated and reduced to a tolerable level.

E5 *Hoist use in general industry is typically one hoist lifting one load system. In the entertainment industry there are typically multiple hoists attached to a single load system. The potential for elevated risk is present in typical entertainment industry hoist use, making the risk reduction critical to keeping residual risk at a tolerable level.*

5.1 Requirement for a Designated Person

The hoist user shall designate a competent person to perform a risk assessment prior to any lifting operation.

5.2 Requirement for a Qualified Person

Certain hazards or combination of hazards produce risks that require a qualified person to evaluate and reduce the risks. If the person making the assessment recognizes that the situation warrants a qualified person to complete the risk reduction process, the competent person shall notify the hoist user of this requirement.

5.3 Assessment

All hazards associated with the lifting operation shall be identified.

5.4 Reduction

For each identified hazard, the risk shall be reduced to a tolerable level.

5.5 Evaluation

Once risk reduction procedures have been selected, a system evaluation shall be undertaken to determine that the residual risk has been reduced to a tolerable risk level.

5.6 Implementation

Once the risk reduction procedures have been selected and an evaluation completed, the procedures shall be implemented prior to the lifting operation.

5.6.1 If specific risk reduction procedures are required for hoist operation, these procedures shall be communicated to the hoist operator.

STANDARD REQUIREMENTS	EXPLANATORY INFORMATION (Not part of the requirements of E1.6-3)
6 HAZARD ASSESSMENT	
The hazard assessment shall identify all possible hazards, and consider, but not be limited to, the hazards listed below.	
6.1 Personnel Hazards	
6.1.1 Authorized persons in the LHZ.	***E6.1.1*** *The presence of any person in the LHZ increases risk, however certain rigging tasks require that persons be present in the LHZ. Authorized persons who are properly trained to perform these tasks may help limit the risk since these persons are able to recognize and properly respond to hazards in this environment.*
6.1.2 Persons in the LHZ with the load system parked.	***E6.1.2*** *Risk is elevated when there are persons present in the LHZ who may not have the ability to recognize or be aware of hazards in this environment.*
6.1.3 Persons in the LHZ while the load system is moved.	***E6.1.3*** *The risk associated with persons in the LHZ is increased due to the potential hazards associated with a moving load system and the persons' proximity to these potential hazards.*
6.1.4 Persons using a parked structure as a work platform.	***E6.1.4*** *Risk is increased when persons rely on an elevated structure for support.*
6.1.5 Persons using a moving structure as work platform.	***E6.1.5*** *When persons are relying upon the structure for support, the risk of injury increases due to the unstable nature of a moving structure.*
6.2 Multiple Hoist Lifting Operation Hazards	***E6.2*** *More hoists in a lifting system increases the risk of failure.*
6.2.1 Unmatched phasing in the hoists or controllers.	
6.2.2 Mislabeled hoists.	
6.2.3 Mismatched controller assignments.	
6.2.4 Multiple operators controlling the movement of one load system.	***E6.2.4*** *Audio and visual coordination amongst operators is imperative to reduce the increased risk from this type of operation.*
6.2.5 The use of multiple controllers to control one load system.	***E6.2.5*** *The use of multiple controllers may increase the risk because the failure of one controller would only affect a portion of the hoists in the load system.*

6.2.6 Hazards due to induction motor speed variations.

E6.2.6 *Hoist speed varies due to internal friction and or varying loads.*

6.2.7 Low supply voltage hazards.

E6.2.7 *Low voltage can cause unreliable hoist operation.*

6.2.8 Excessive voltage drop in control/power cables.

E6.2.8 *Low voltage can cause unreliable hoist operation.*

6.2.9 Variations in time to energize or de-energize relays controlling individual hoists.

E6.2.9 *This can cause unaccounted for load shifting.*

6.2.10 Ambient noise levels from unrelated activity or the operation of the hoists.

E6.2.10 *Any noise can reduce the ability to respond to required signals during the hoisting operation.*

6.2.11 The reduced ability for the operator to visually monitor the entire multiple hoist lifting operation.

E6.2.11 *As the load system becomes larger and more complex the risk of an accident increases due to the reduced ability to visually monitor all portions of the system.*

6.2.12 Overloading caused by load shifting hazards associated with load systems that are indeterminate structures.

E6.2.12 *Rigid indeterminate structures can be very dangerous because they can have extremely rapid load shifting. The severity of the load shifting increases with the rigidity of the structure. In many cases a qualified person will need to be involved in the risk reduction process.*

6.2.13 The inadvertent operation of any hoist in the rigging system.

6.3 Compound Flown System Hazards

6.3.1 Load shifting in one load system caused by the other load system.

6.3.2 An unexpected hoist shutdown in either the upper or lower rigging system.

6.3.3 The inadvertent operation of any hoist in the rigging system.

6.3.4 A structural failure in the upper rigging system.

E6.3.4 *In general, these systems are not as robust as directly connecting to building roof structures. Miscalculation or misapplication of loads to these temporary structures can more easily cause structural failures.*

6.4 Variable Speed Hoist Application Hazards

6.4.1 High speed hoist operation.

E6.4.1 *Risk increases as hoist speed increases.*

6.4.2 Dynamic forces generated by abruptly stopping hoists running at high speeds.

E6.4.2 *Engaging the emergency stop feature of a hoist controller is one example of how this may occur.*

6.5 Hoist Capacity Hazards

6.5.1 Hoist capacity greater than rigging system component capacity.

6.5.1.1 The reduction of the risk associated with this condition shall prevent the overloading of the rigging system throughout the lifting operation.

6.5.2 Hoist capacity greater than anchorage capacity.

E6.5.2 *This is specifically disallowed by OSHA section 1926.554(a)(2) to prevent overloading the anchorage.*

6.5.2.1 The reduction of the risk associated with this condition shall prevent the overloading of the anchorage throughout the lifting operation.

6.6 Hazards Associated With Occasional Forces

6.6.1 Fall arrest forces introduced into the load path of the lifting system.

6.6.2 Dynamic forces associated by starting or stopping.

6.7 Environmental Hazards

6.7.1 Environmental hazards that would create an increase in forces on the system.

E6.7.1 *Accumulation of rain, ice, or snow loads on the system. Wind and seismic loads.*

6.7.2 Electrical hazards caused by moisture.

E6.7.2 *Thermal condensation.*

6.7.3 Environmental hazards that would degrade the system.

E6.7.3 *Galvanic, ultraviolet light, ozone, corrosion or heat degradation on the system.*

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

7 RISK REDUCTION TECHNIQUES

Hazards shall be identified and eliminated, or the risks associated with them minimized in the planning process whenever possible. If hazards cannot be eliminated as part of the planning process, the risks associated with them shall be reduced to tolerable levels in the field.

The methods used to develop procedures for reducing risks may include, but not be limited to, the risk reduction factors listed below.

7.1 Load Calculation

Load calculation shall be permitted as a risk reduction technique for overload conditions of the hoist, rigging system or anchorage only in conditions where: (a) the weights of all the elements of the load system are known and accounted for, (b) an accurate method is used for the distribution of the load system weight to the lifting system hoists and (c) any load shifting during the lifting operation will not be of sufficient magnitude to cause an overload condition.

E7.1 *In cases where the hoist capacity is greater than the anchorage, the risk can be reduced by calculating that the maximum anticipated load is less than the capacity of the anchorage. Load calculation of an indeterminate structure can be affected by the rigidity of the load system, rigging system, and support structure. These calculations require sophisticated structural analysis in order to accurately consider such factors. In some cases, certain factors may not be available for consideration, such as the support structure rigidity for a touring set erected in various venues. Appropriate measures should be taken to ensure that each hoist receives loads not exceeding its calculated load and/or the design shall include sufficient conservatism to accommodate an associated amount of load shifting.*

7.2 Load Verification

Load verification shall be permitted as a risk reduction technique for overload conditions of the anchorage or any rigging, hoist or load system component by the operator continuously monitoring and taking corrective action before an overload occurs.

E7.2 *During lifting operations, load verification techniques are only effective as a risk reduction technique to the extent that the operator can monitor all hoist loads and stop operation before the anchorage or any rigging, hoist or load system component becomes overloaded.*
Since in most cases the operator will not be able to see the display and visually monitor the load system during the move, an audible alarm or extra personnel may be required.

For the use of load limiting control devices that verify hoist loads and control the hoist operation, see Section 7.5.5. For overload warning devices, see section 7.7.3.

7.3 Load Reduction

It shall be permissible to reduce risk by reducing the load.

E7.3 *In many cases simply removing portions of the load system will reduce the forces in the entire system to an acceptable level.*

7.4 Controlling Personnel Access to LHZ or Load System

7.4.1 Restrict or eliminate access to suspended loads.

7.4.2 Restrict or eliminate access to the LHZ.

7.4.3 Provide a means for emergency evacuation from suspended loads.

7.4.4 Provide a means for emergency evacuation from LHZ.

7.5 Reducing Load Shifting Effects

7.5.1 Elimination of indeterminate structures where possible.

7.5.2 Reduction of load system rigidity.

7.5.2.1 Introduce hinges to increase the system flexibility.

7.5.2.2 Employ dampers to reduce the speed of load shifting.

7.5.2.3 Use flexible construction materials or structures.

E7.5.2.3 *The use of aluminum instead of steel, fabric instead of plywood, or smaller, more flexible, truss or pipe instead of large trussing where possible will reduce the effects of load shifting.*

7.5.3 Lower the lifting speed to reduce the speed of load shifting.

7.5.4 The application of measures in 7.5.2 or 7.5.3, or a combination of both, shall provide sufficient reaction time for the operator to prevent the overload of the anchorage or any rigging, hoist or load system component.

7.5.5 Class 3 multiple hoist control systems complying with BSR E 1.6-4 may be used instead of complying to the requirements of 7.5.4 as long as the system used will control or stop the movement of the load system prior to overloading the anchorage or any rigging, hoist, or load system.

E7.5.5 *These devices may have a time delay; therefore an appropriate factor must be used to compensate for that delay. Load limiting hoist control techniques are only effective as a risk reduction technique to the extent that the control system can monitor all hoist loads and control or stop operation before overloading the anchorage or any rigging, hoist or load system component.*

7.5.6 A network control system comprised of multiple interconnected controllers and complying with BSR E 1.6-4 Class 3, Automated Multiple Hoist Control Systems shall be permissible to reduce risk when using multiple controllers to control one load system. At a minimum the network control system used shall provide an automatic power disconnection to all hoists in the load system when an unexpected shutdown or inadvertent operation of any interconnected hoist occurs.

7.6 Inspections

In order to use inspection as a risk reduction technique a competent person shall evaluate the effectiveness of the inspection to reduce specific risks. The inspections and risks being reduced shall be documented.

7.7 Other Actions

7.7.1 Add redundant suspension as required.

E7.7.1 *An indeterminate hoist system can provide redundancy, but this must be weighed against load shifting risks and must consider rigidity of the load and rigging systems.*

7.7.2 Lowering the maximum working load of the hoist and associated rigging system below the design load.

7.7.3 Employ overload warning devices.

7.7.4 Use of fall protection.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

8 INSPECTIONS PRIOR TO USE

Prior to operation under load the following items shall be checked by a person designated by the hoist user.

8.1 Lifting System

8.1.1 Hoists shall be inspected for proper capacity and speed as per 3.4.3 and 3.4.4.

8.1.2 Chain shall be inspected for compliance with the requirements of 3.4.5, 3.4.6 and 3.4.10.3.

8.1.3 Hooks shall be checked for proper seating as required by 3.4.9.

8.1.4 Chain containers shall be inspected for worn or distorted fittings; snags, cuts, fraying or other fabric damage; and the presence of foreign matter.

8.1.5 Chain containers shall be checked for proper installation and capacity required by 3.4.10.

8.1.6 Power and control cables shall be checked for proper attachment as required by 3.4.12.

8.2 Load System

8.2.1 Confirm that the load system can travel the full distance allowed by the hoist(s) as recommended by 3.5.1. If confirmation of full travel is not possible, then confirm that the requirements of 3.5.1.1 are fulfilled.

8.2.2 The load system shall be inspected to ensure proper assembly and attachment to the hoist(s).

8.3 Other

Review the load distribution scenarios as required by 3.1.5

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

9 OPERATING PRECAUTIONS

Prior to operation under load the following precautions shall be taken by the hoist operator.

9.1 Lifting System

9.1.1 There shall be no power applied to the hoist while the operator is away from the operating controls

9.1.2 The functionality of all applicable controls on the hoist controller shall be checked.

9.1.3 Before moving a parked load each hoist shall be bumped in the direction of travel to ensure correct operation. In cases where the bumping process will cause a disturbance to a production, appropriate risk reduction techniques shall be employed in lieu of bumping the hoists.

9.1.4 When bumping three phase hoists, check that the direction of movement corresponds to the directional indicator on the controller. If not, take the appropriate corrective action.

9.1.5 During hoist down operation when the chain is slack, the operator should be in close enough proximity to the hoist to be able to prevent chain jams.

9.1.6 Confirm all fixed speed hoists in a lifting system are operating at the same speed as per the requirements of 3.4.4.

9.2 Load System

Center the load system under the hoist(s).

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION
(Not part of the requirements of E1.6-3)

10 OPERATION

10.1 General Operating Practices

While performing any lifting operation, the operator shall adhere to the following general operating practices.

10.1.1 Only operate hoist in an orientation approved by the manufacturer as required by 3.1.1.

10.1.2 Focus full attention on the lifting operation.

10.1.3 Respond to signals from designated persons only, except that the operator shall respond to a stop signal from anyone.

10.1.4 Bump hoists to engage the load system, but avoid unnecessary bumping and quick reversals of direction. Avoid quick repetitive bumping - Wait a few seconds between bumps.

10.1.5 When a load approaching the rated capacity of the hoist is moved, check brake action by lifting the load system off the ground a few inches and stopping. Continue only after the brake action is verified.

10.1.6 Check the balance of load system to prevent tipping.

10.1.7 Only move the load system when all personnel are clear, unless the appropriate risk reduction actions have been taken.

10.1.8 During long moves, periodically stop to check the level of the piece being moved.

10.1.9 Stop the lifting operation if something unexpected happens. Determine the problem and a safe solution before moving the load system in any direction.

10.1.10 Lifting of personnel shall only be undertaken by a person designated by the hoist user. This designated person shall follow written instructions provided by the qualified person responsible for the design of this system.

10.1.11 Only lift loads at or below the rated capacity of the hoist.

10.1.12 Monitor the load system visually or by other means throughout the entire move.

10.2 Specific Operating Practices

In addition to the above general operating practices, any specific practices identified by the risk reduction process shall be implemented.

10.3 Engineered Lifting Operations

During the risk reduction process, if a qualified person is deemed necessary, any risk reducing factors identified shall be implemented. The operator shall follow written instructions provided by the qualified person.

STANDARD REQUIREMENTS	EXPLANATORY INFORMATION (Not part of the requirements of E1.6-3)

11 TRANSPORTATION AND HANDLING

11.1 Transportation Considerations.

11.1.1 The hoist shall be supported in transit to minimize the likelihood of damage.

E11.1.1 *Manufacturers guidelines, when available, should be followed when transporting the equipment.*

11.1.2 If the hoist is equipped with mechanical limit switches, consult with hoist manufacturer on transporting with the limit switch engaged.

11.2 Handling Considerations

11.2.1 The hoist shall not be lifted or moved by the electrical cables**.**

11.2.2 Disconnect power to hoist prior to handling.

11.2.3 Handle hoist per the manufacturer's written instructions.

11.2.4 Dropped or damaged hoists shall be removed from service and shall be inspected by a person designated by the hoist user prior to returning to operational status.

11.2.5 Any hoist failing an inspection shall be removed from service, tagged and returned to the owner.

12 FIGURES

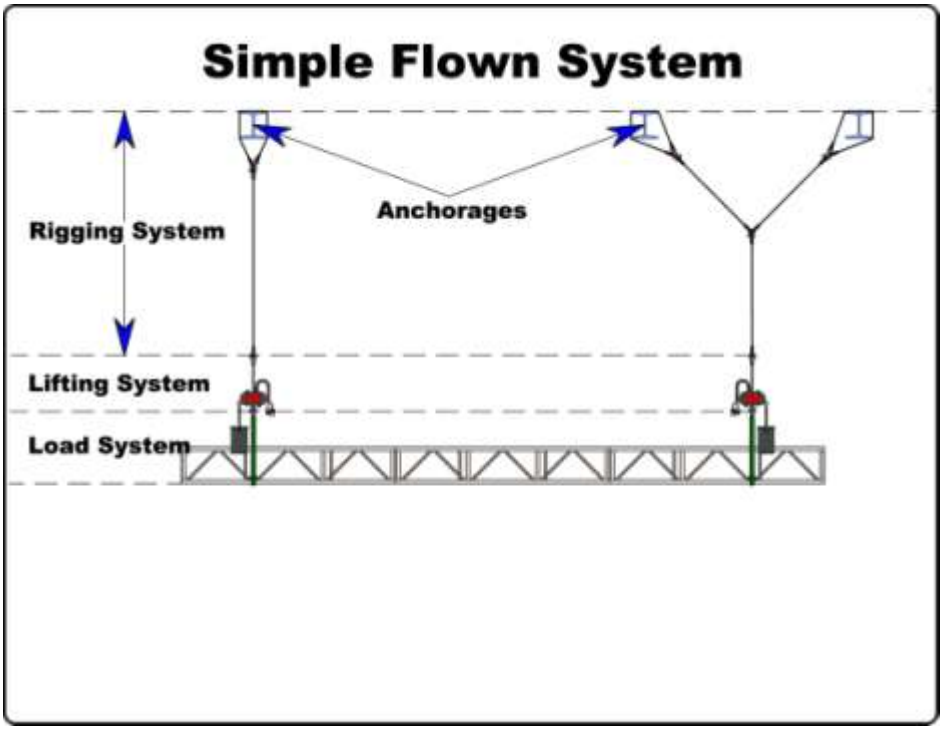


figure 1

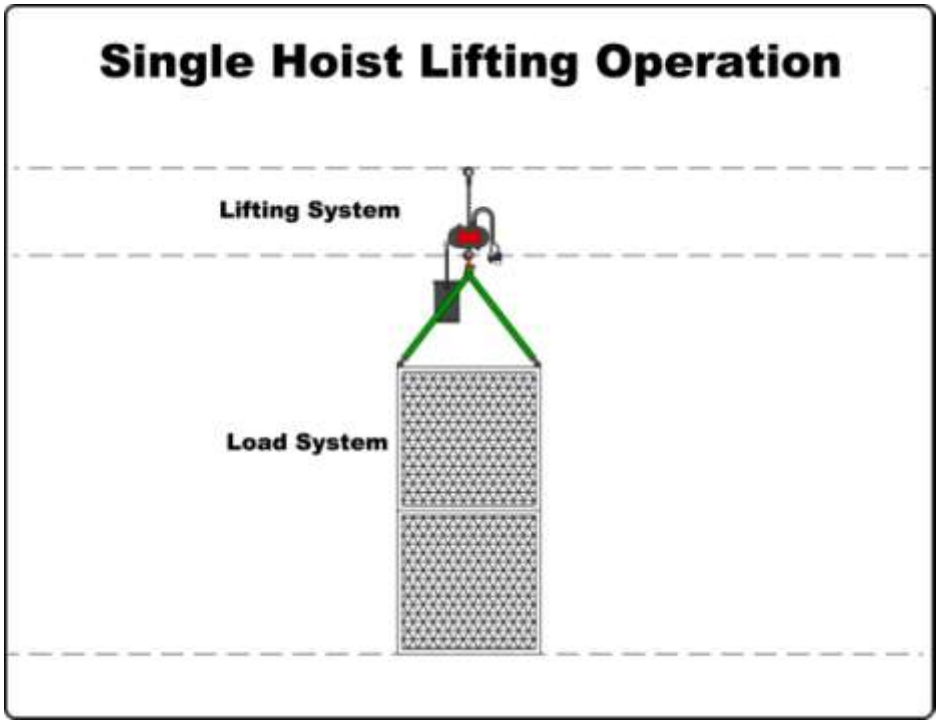
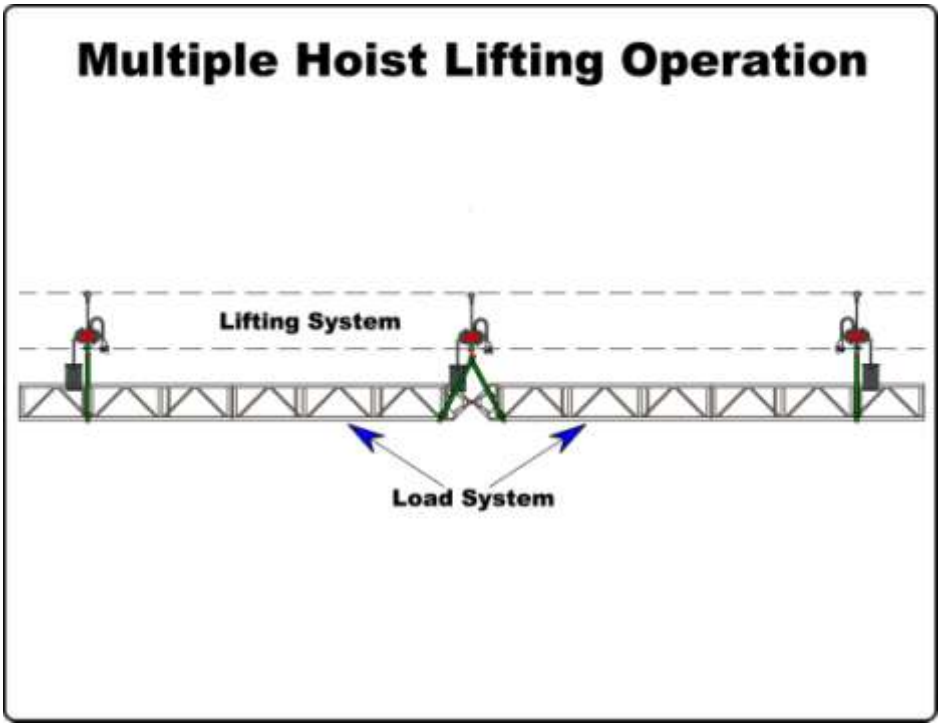


figure 2



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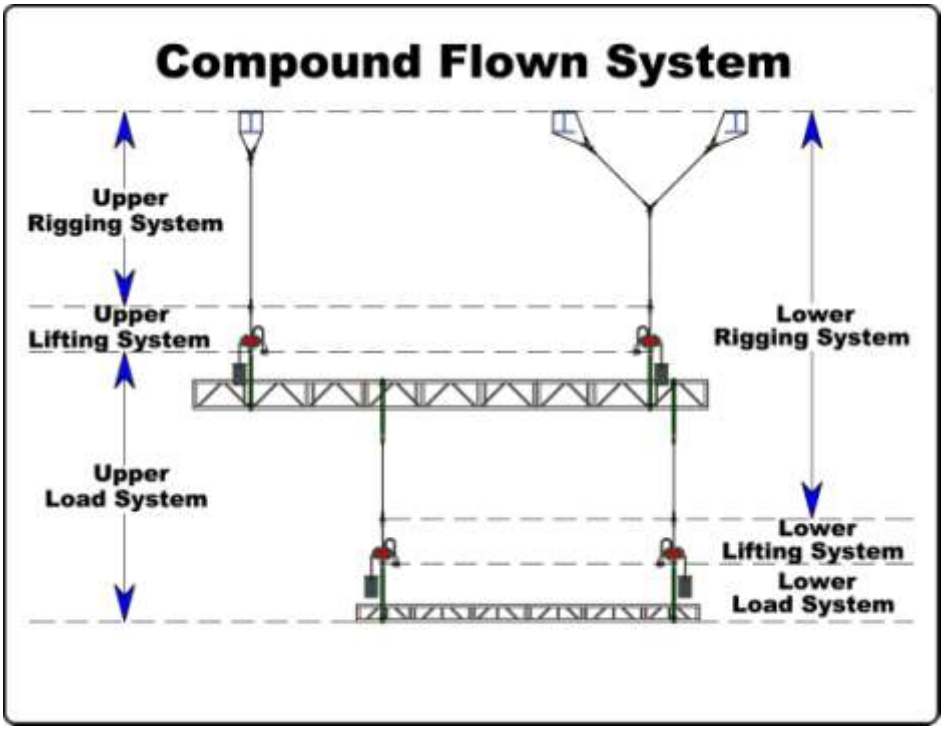

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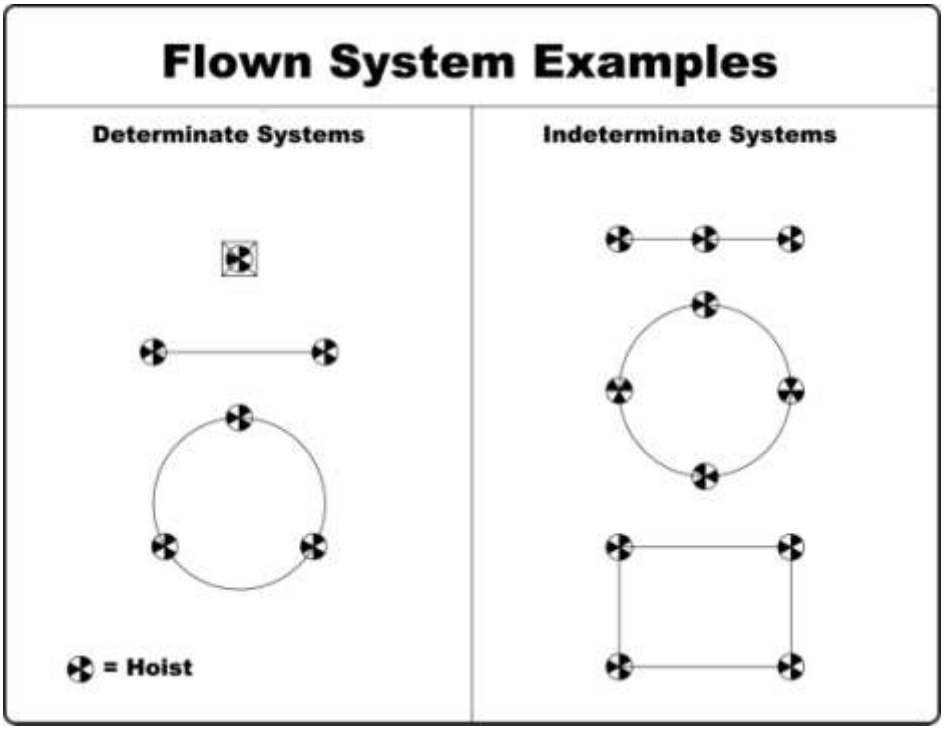
Flown System Examples
Determinate Systems
Indeterminate Systems
= Hoist

figure 5