

# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

This bulletin describes safety guidelines for rigging systems and flown scenery. Anyone responsible for rigging must understand the requirements of [Part 15](#) of the Occupational Health and Safety Regulation before proceeding with any rigging work.

## OVERVIEW

*Rigging* in a performance setting generally refers to the process and operation of suspending and securing equipment, lighting, audio, or scenic elements overhead above people. It involves specialized rigging systems, including trusses, motors, and cables, to safely hoist and support objects in the air (i.e., loads). Rigging is crucial for creating dynamic, visually appealing setups that enhance the overall production value of events and facilitate the seamless execution of artistic and technical elements. See ANSI ES1.18-2022, Event Safety – Rigging.

## HAZARDS AND RISKS

The use of rigging presents significant hazards and risks that can lead to injuries and other incidents if control measures aren't in place. Rigging incidents rarely happen but when they do the consequences can be serious.

### Workers at risk

Workers at risk include anyone working in rigging operations and anyone below during active rigging or while rigging loads are suspended in the air.

This includes:

- Riggers and operators
- Performers, artists, and crew (e.g., technicians, stagehands, contractors) working under the load
- Event staff such as security and ushers
- The audience

### Typical hazards

Here are some examples of hazards related to rigging systems and flown scenery:

- Improper use or handling of tools and equipment or the rigging systems loads
- Improper installation and maintenance of rigging systems and associated equipment (i.e., not to safe design specifications)
- Obstructed views and lack of communication

- Lack of training and supervision, particularly for new and young workers
- Fatigue or other factors leading to reduced cognitive performance
- Other workplace elements such as sets, moving objects (e.g., scenery or cases), stage floors, and equipment

### Potential outcomes and injuries

Here are some examples of potential outcomes and injuries:

- Falling loads, scenery, equipment or objects causing crushing or contact injuries
- Strains and sprains (i.e., musculoskeletal injuries) from overexertion or repetitive motions
- Struck by or caught between objects causing crushing or contact injuries
- Falls from working at heights and slips, trips, and falls from level surfaces



# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

### RESPONSIBILITIES

Responsibilities are key for maintaining safe workplaces and performances. Duties are described in Part 2, Division 4, sections 21–27 of the *Workers Compensation Act* and Part 15 of the OHS Regulation. In addition to those duties, individuals and productions should be aware of the following responsibilities.

#### Producer/producer's representative (e.g., GM, PM)

- Provide all necessary tools, equipment, administrative requirements, and manufacturer specifications so the rigging system can be installed, operated, and maintained safely.
- Provide safety notifications to all affected individuals, including riggers, crew members, contractors, workers, and the audience.
- Ensure the rigging system meets safety specifications when installed and during maintenance and operation.

#### Supervisor

- Ensure the safety of workers under their supervision. This includes following requirements for personal protective equipment (PPE).
- Inform other departments of any known and reasonably foreseeable hazards.
- Ensure the rigging system is installed to safety specifications.
- Ensure the working load limit is not exceeded.
- Ensure the rigging system is regularly maintained.
- Ensure all riggers, crew, and other workers are qualified and fit for duty.
- Ensure all movement of flown equipment during a show has been adequately rehearsed, and all crew and performers are familiar with the roles and procedures for safe operation.
- Understand and communicate emergency procedures.

#### Owner of rigging system

- Ensure the system is used and operated as intended within the safety specifications.
- Ensure that there are regular inspections and preventative maintenance based on the rigging-system requirements.

#### Rigger installing rigging system

- Install the rigging system as per safety specifications provided by the producer.
- Ensure the working load limit is sufficiently posted and not exceeded.

#### Operator of rigging system

- Ensure that you are familiar with all of the safety procedures and standards for the equipment and rigging systems being used.
- Understand all potential hazards during operation.
- Don't exceed the working load limits.
- Ensure hazards and safety requirements are communicated when loads are being flown or overhead rigging is in progress.
- Maintain effective communication with ground riggers.
- Make sure moving loads are visible to the operator at all times. If it is not possible for the operator to have a direct line of sight to the moving load, then a spotter should be used, with clear communication to the operator.
- Don't operate the rigging system if there is a safety concern.
- Understand and be able to implement emergency procedures.



# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

### Ground rigger

- Understand the hazards associated with rigging systems and the applicable loads.
- Maintain visibility and communication to rigging operators and essential components of rigging systems and loads.
- Ensure others in the area know when the rigging system will be in use and the hazards that will be present.
- Understand and be able to implement emergency procedures.

### Anyone working below overhead rigging

Performers, riggers, crew (e.g., technicians, stagehands, contractors), and other workers should follow these guidelines:

- Follow all safety rules and requirements. Report hazards and incidents immediately.
- Understand and follow safety warnings from production, riggers, and operators.
- Maintain situational awareness, and communicate hazards.
- Wear any required PPE, such as steel-toe boots and a hard hat, when working in a load hazard zone during load-in or load-out, and as appropriate during the normal operation of the event / performance.

## GENERAL RIGGING PRINCIPLES

*Rigging* is the attaching, supporting, or flying of scenery, drapery, lighting, or audio, visual, and sound equipment through hardware such as fibre or wire ropes, chains, slings, attachments, and fittings or connectors. The following principles apply to rigging:

- Select and operate work equipment for overhead loads to ensure they are safely held in place.
- Use appropriate design factors and stay within Working Load Limits (WLL). If a system has a WLL designated by a licensed engineer, or a manufacturer's rating specifically for loads over people, those limits should be observed.
 

Otherwise, the following safety margins should be observed:

  - When considering Overhead Load Rigging, people will be under a suspended load, which means a higher degree of safety must be observed. This can be achieved by either:
    - a secondary suspension system (aka "a safety") capable of holding the full load at a minimum design factor of 5:1, or
    - by increasing the design factor of the main suspension system.
      - If the load will be moving over people, then a 10:1 design factor is required.
      - If the overhead load will be suspended over people, but not moved, then a 10:1 design factor is recommended, but some Riggers do use, and some other jurisdictions do allow for, an 8:1 design factor, with due caution.
- When determining the forces that act upon rigging equipment (i.e., the load) when loads are moving, static and dynamic loads (including acceleration and deceleration) must be accounted for.



# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

- When selecting rigging system components with ratings, caution is needed. The WLL ratings may be for regular lifting, and not for use over people. Best practice is to determine the minimum breaking strength, and divide by the recommended design factor. If the minimum breaking strength cannot be determined, reduce the listed WLL by an appropriate amount to determine an effective WLL (e.g. if the component is for lifting at 5:1, and not specifically for use over people, then convert from 5:1 to 10:1 by reducing the listed WLL by one-half).
  - Other loads such as weather (e.g., wind, rain, snow) must be accounted for outdoors, along with roof systems.
  - When installing rigging systems, take into account the load-bearing capacity of the building structure and the connection points to the building. Both of these must be able to safely bear the entire load transferred by the rigging system, with the same strength-to-load ratio.
  - Make sure all connections are positive (i.e., form fitting or form locking) to prevent them from loosening or coming undone. Connections must be clearly visible for inspection.
  - Avoid single-point-failure modes. Where necessary, use safeties. Make sure safeties are snug (i.e., they allow for no drop) to minimize shock loads. If slack is required for equipment operation, keep safeties to the minimum possible distance (e.g., 20 cm or 8 in. for lighting fixtures).
  - Interlocking components must be compatible and move freely as designed by the specification and the manufacturer's instructions.
  - Use edge protection when bending flexible components around a sharp corner.
- In addition, ensure that all elements are:
- Dimensionally stable (i.e., they don't have undue stretch under load)
  - Composed of temperature-resistant material (e.g., steel or aluminum) to ensure they will not melt or break in a fire or extreme temperatures
  - Resistant to expected conditions of use (e.g., weather, corrosion, aging)
  - Manufactured to applicable standards and have the required certification listing (e.g., ANSI or CSA)
  - Inspected before use and those elements found defective are taken out of service.

## DEFINITIONS

- **Counterweight** — Objects or weights (e.g., sand bags or metal plates) used to balance, or counter, a load.
- **Flown scenery** — Scenery that is shifted by using a rigging system to raise or lower it over the stage.
- **Fouling** — Unintentionally entangling flown scenery, or an incorrectly loaded component of a rigging system.
- **Load** — Objects such as framed scenery, lighting equipment, audio equipment, projectors, soft goods, or banners that are suspended in air by a rigging system.
- **Load hazard zone** — The area underneath a load system where injuries or death may result if there is a load system or rigging failure.
- **Overhead load** — A load positioned and held by a rigging system above the audience, performers, or crew.
- **Preventive maintenance** — Regular inspections to identify and correct equipment issues to prevent workplace incidents.
- **Qualified person** — A worker who is knowledgeable of the work, the hazards involved, and the means to control the hazards, by reason of education, training, experience, or a combination of these three things. For performing arts and live-event productions, a qualified person is generally a live performance technical director, rigging technician, or professional engineer.



# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

- **Soft goods** — Scenery made of fabric (e.g., a border, leg, or backdrop).
- **Trim** — The set height of a load.
- **Working load limit (WLL)** — The maximum load that each component of a rigging system is rated

for, as specified by the manufacturer or owner of the rigging system. System capacity is determined by its weakest component.

## RIGGING SYSTEMS

A *rigging system* is the equipment used for raising and lowering loads such as scenery, drapery, lighting, or audio, visual, and sound equipment. This section includes guidelines for the installation, removal, operation, inspection, and maintenance of rigging systems.

### Installation and removal

During load-in and load-out, particularly for overhead work, follow these guidelines:

- Minimize the number of people on the stage and in areas of increased risk of injury (e.g., moving equipment or objects and overhead work).
- Danger zones (e.g., areas where there is a risk of falling objects or other hazards) must be delineated and communicated through verbal warnings, signage, traffic cones, barriers, stanchions, caution tape, or a combination of these.
- All workers in the danger zone must wear PPE, including hard hats.
- No one should stand under a suspended load or in the danger zone, except for qualified individuals who are hooking, unhooking, or guiding a load, or who are engaged in the initial attachment or detachment of the load to a component or structure.
- Minimize loud noises and distractions to allow for effective communication between riggers and working crews.

### Operation

During operation of rigging systems, follow these guidelines:

- Ensure all riggings systems and equipment are inspected before use and are used in accordance with the manufacturers' instructions and safety specifications (including load limits).

- Ensure that only qualified persons operate rigging systems and equipment.
- New and young workers must have the required training and supervision.

### Maintenance and inspections

Implement preventive maintenance to identify and remedy hazards or defects to the rigging system and equipment before an incident occurs. Follow these guidelines:

- A qualified person must inspect all of the rigging system after installation and then inspect and maintain it annually, in accordance with the manufacturer's instructions.
- The qualified person should be satisfied that the rigging system is in safe operating condition and that the parts and functions will remain in safe operating condition until the next scheduled inspection.
- An inspection and maintenance log must be kept. All entries should be signed by the inspector and verified by the owner or designate.

Maintenance methods and frequency for a rigging system should be determined by the owner or by a qualified contractor on behalf of the owner, in accordance with the:

- Manufacturer's or supplier's instructions
- Current condition of the system or equipment
- Frequency of use
- OHS Regulation and the *Workers Compensation Act*



# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

Rigging system maintenance must be in accordance with manufacturers' instructions. Maintenance generally includes the following:

- A thorough inspection of all parts and functions of the system, performed by a qualified person at least once a year. Inspect items that receive frequent use or considerable wear more often.
- Cleaning, lubricating, and adjusting all parts of the rigging system at regular intervals.
- Repairing or replacing parts that are worn, defective, damaged, or broken. Defective parts must be marked and removed from service until they are repaired by a qualified person.

**Note:** If a part of a rigging system is replaced for any reason, the replacement part should be at least equivalent to the original part as supplied by the manufacturer or as specified in the design submission.

## OVERHEAD LOADS

- A qualified person should complete the construction and assembly of individual pieces of loads and flown scenery. The qualified person should inspect the assembled scenery before it is flown.
- Ensure that the number and placement of the attachment points on flown scenery is adequate to prevent any undue stress on or sagging within the scenery.
- When scenery or equipment is distributed along a structural member (e.g., a box truss, I-beam, or pipe), the structural member must be of sufficient strength and shape to hold the load without failure or excessive deflection, in accordance with the manufacturer's specifications.
- When the height or placement of a load requires counterweights to be added to the rigging system before the load is fully suspended, that load is considered "out of weight." It is important to secure the counterweight until the final position is reached and the load is in balance. Whenever possible, use a chain motor to secure and control out-of-weight systems.
- Before flying a load with moving components that may foul with other loads nearby or change the balance of the load in the air, secure the moving components to prevent any unplanned movement.
- For soft goods, securely fasten the bottom pipe or chain in a pipe or chain pocket to prevent the pipe or chain from falling out of the pocket. Ensure the spacing and strength of ties is adequate for the weight of the loads.
- Place attachment points on overhead loads to ensure the structural integrity of the load.
- Ensure that all ropes, chains, bolts, clamps, and other elements of the rigging systems and applicable loads are appropriate sizes and strengths for the working load (including static, dynamic, and adverse weather). Mark all components with a load rating, either attached to or engraved on the component. In the case of rope, the load rating should be included in accompanying documentation.
- Secure in position all turnbuckles, trim chains, and other devices for adjusting the trim of flown scenery.
- Safely terminate and secure any ropes, chains, or other lines on which scenery is flown or other loads are attached.
- Manufacturers' instructions and rigging plots must be followed and easily available.



# Overhead Load Rigging

## ACTSAFE SAFETY BULLETIN #7

### RELATED RESOURCES

For more information, refer to the following resources:

- [ANSI ES1.18-2022, Event Safety -- Rigging](#) (ANSI Standard)
- [Hoisting and Rigging Safety Manual](#) (Infrastructure Health & Safety Association)
- [Materials Handling fact sheets](#) (Canadian Centre for Occupational Health and Safety)
- [OHS Regulation Part 11: Fall Protection](#) (Government of BC)
- [OHS Regulation Part 15: Rigging Systems and Fall Arrest](#) (Government of BC)
- [OHSA Safety Guidelines for the Live Performance Industry – Rigging Systems and Fall Arrest](#) (Government of Ontario)

### Entertainment Services and Technology Association (ESTA) technical standards

ESTA provides several standards related to rigging systems and performance safety. These include the following:

- ESTA: ANSI E1.47-2020, Entertainment Technology — Recommended Guidelines for Entertainment Rigging System Inspections
- ESTA: ANSI-E1.1-2018, Entertainment Technology — Construction and Use of Wire Rope Ladders
- ESTA: ANSI E1.4-1-2016, Entertainment Technology — Manual Counterweight Rigging Systems
- ESTA: ANSI E1.2-2012, Entertainment Technology — Design, Manufacture and Use of Aluminum Trusses and Towers
- ESTA: ANSI E1.22-2022, Entertainment Technology — Fire Safety Curtain Systems

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