



## **COUNTERWEIGHT RIGGING SYSTEM SAFETY INSPECTIONS**

**By Erik Viker**

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# COUNTERWEIGHT RIGGING SYSTEM

## SAFETY INSPECTIONS

by Erik Viker

The theatre workplace all too often features inadequate training, rushed work timelines, older and unsafe facilities, and jury-rigged equipment. Essential routine maintenance often gets overlooked or postponed until “when we have time,” which often means “indefinitely.” Although counterweight rigging systems seldom need major repair or total replacement, they can be dangerous if improperly maintained. Most veteran technical directors recognize the benefits of regular rigging system safety inspections, but this practice is often neglected by less experienced practitioners who sometimes treat counterweight systems as *architecture* rather than *equipment*. This article provides an overview of the counterweight rigging system safety inspection process and explores why it should be a regular part of theatre facility maintenance.

Although regular in-house inspection of all rigging components is a necessary practice, here are several reasons for periodically arranging a professional counterweight system inspection:

- We usually lack the time or staff available to complete the thorough inspection we want to do.
- We sometimes see what we expect to see when working on familiar equipment.
- Very few staff technicians can match the years of experience offered by professional rigging safety inspectors.
- A “second opinion” is always in order, especially since rigging mishaps can be catastrophic.

Several expert rigging safety inspectors were interviewed for this article and asked to discuss approaches to counterweight rigging system safety. These professionals agree that the inspection process is not a “do-it-yourself” operation, and that merely reading even detailed information about safety inspections does not qualify theatre technicians for the job. Reviews of industry and government literature on the subject reveal no official certification or required training for counterweight rigging inspectors in the United States, but expert practitioners strongly advise that extensive experience is the most important training and preparation necessary for the work. A lengthy,

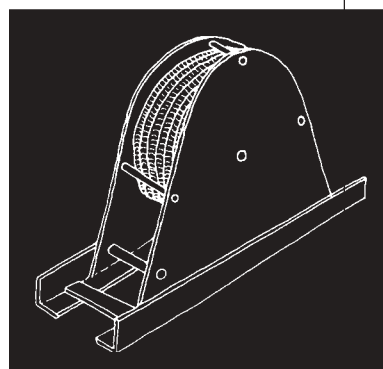
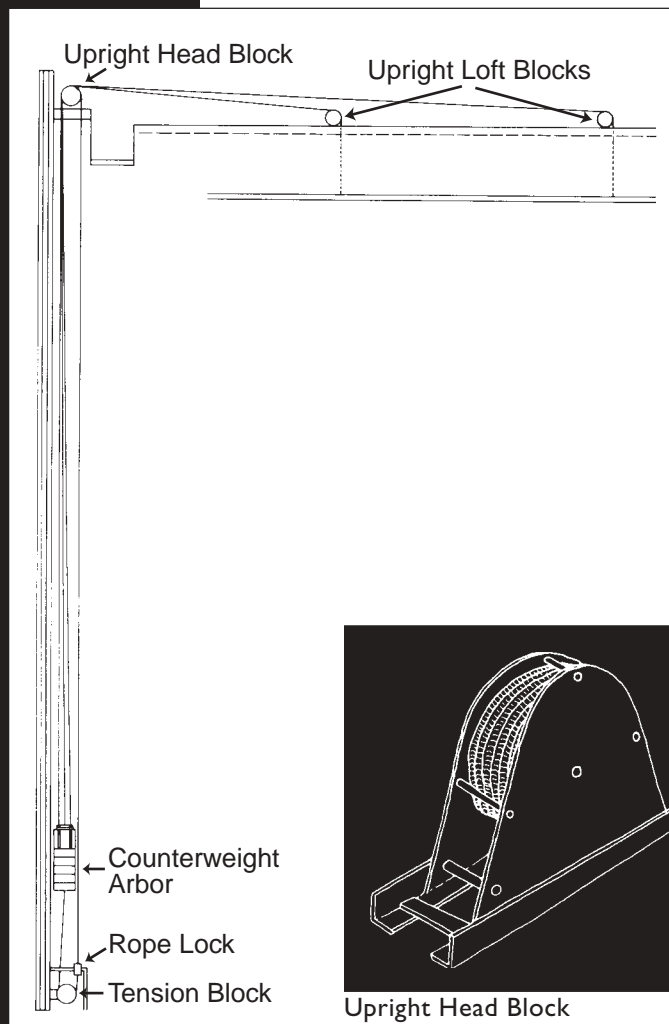
successful career as a rigging system installer and operator may begin to prepare a theatre technician for the safety inspection process.

## INSPECTION PROCEDURES AND EQUIPMENT

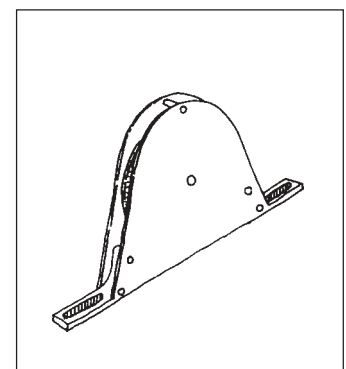
A counterweight rigging system is relatively easy to operate but this simplicity can be deceiving. A typical system includes such diverse elements as Schedule 40 pipe and other steel components, wire rope, copper swaging sleeves and other termination hardware, rope hand lines, several types of sheaves and other machined equipment. A professional rigging inspector is thoroughly versed in identifying signs of structural stress or imminent failure in materials used for rigging system construction. Professional inspections include extensive examination of everything in service from arbor to batten, often paying special attention to mechanical components such as loft and head blocks that are sometimes treated as “maintenance free” by rigging system operators. Rigging inspector Thomas Pettus feels that every sheave should be manipulated by hand during a full system inspection to assess bearing wear. Pettus also notes that some sheave component manufacturers are more reputable than others, and inspectors consider product quality

when making recommendations for component replacement. Hardware used for fastening blocks to the building’s structural steel must also be inspected, as vibration and system operation movement can loosen clamping nuts and bolts over time. Arbor framing, arbor spreader plates, T-track or wire guides, and tension blocks must be inspected, along with all hand line ropes and hand line terminations. Inspection of the operating rail equipment should include rope locks and the hardware fastening the rail to the building. In his book, *Stage Rigging Handbook*, Jay Glerum summarizes the importance of rigorous inspection when he reminds us that a counterweight lineset may fail if only one small component of the system fails (Glerum, 117).

A complete rigging inspection can take anywhere from several hours to two full days, depending on the size of the fly system, the number of linesets and building design factors.



Upright Head Block



Upright Loft Block

Expert inspectors have extensive knowledge of structural materials properties, including what steel under stress actually looks like. Experts use standard measurement and hand tools, with a voltmeter occasionally employed to check for errant electrical current in motorized components. Binoculars and mirrors may be used for viewing hard-to-reach areas of the system. Careful inspection of steel hardware and other components sometimes requires a magnifying glass. To guarantee accuracy, measurement equipment such as torque wrenches and “go-no go” gauges for Nicopress sleeves must be carefully calibrated and in perfect working order.

A complete rigging inspection can take anywhere from several hours to two full days, depending on the size of the fly system, the number of linesets and building design factors. Inspectors often find it difficult to estimate the time needed to thoroughly inspect a lineset system until they have seen the facility.

### SAFETY INSPECTION COSTS

A professional safety inspection of a counterweight rigging system may cost between \$350 and \$850. If the system’s complexity requires a two-day assessment period, the rate may go up by \$350 to \$500 for the second day. Inspection firms routinely charge a flat rate based on the type and complexity of the rigging system plus expenses which include travel, lodging and per diem. Quantity discounts for inspecting two or more facilities can be negotiated by universities and large performing arts complexes with several theatres. Inspectors say they also consider reduced rates for long-standing customers and in special cases where capable in-house assistance reduces the time needed to do a thorough inspection.

Although preventative safety measure expenses are sometimes offset by decreased insurance costs, regular documented safety inspections usually do not lead to an insurance premium discount for the venue (Lively). Apparently the risks inherent in rigging operation are factored into overall liability and do not themselves raise a “red flag” for insurance risk calculations. Of course, the decision to hire a professional inspector is not primarily a financial one, as the liability protection and safety benefits more than compensate venue operators for the inspection expense.

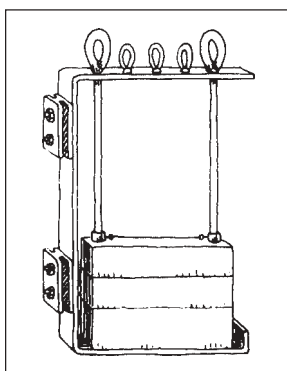
### RECOMMENDED FREQUENCY OF INSPECTION

How frequently a system is used will govern how often it should be inspected. One expert says most facilities could safely assume an annual inspection sufficient, but heavily used venues may need a follow-up two to four times a year. Constant-use roadhouses are one example of a facility requiring more frequent safety inspections. Glerum relates how large touring companies often move, add or remove linesets in roadhouses and sometimes either pay for follow-up inspections after their local run or have specialized staff do the job as part of load-out activities. Thomas Pettus suggests that with well-trained personnel on staff doing annual in-house inspections, a professional oversight inspection should be arranged every three years. Glerum agrees that safety inspection should be an ongoing process enacted daily by trained, observant operators using the system. Pettus believes that facilities such as high schools should consider more frequent inspections because they are likely to have less qualified personnel operating and maintaining their counterweight equipment, leading to increased wear and possible unseen damage or hardware misuse.

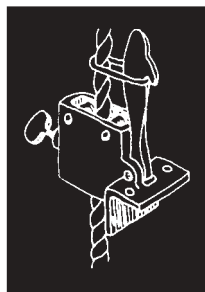
### COMMONLY OBSERVED PROBLEMS AND POSSIBLE SOLUTIONS

The most common problems reported by inspectors include improperly tightened wire rope clips on lift-line terminations or arbor connections and worn-out or incorrectly adjusted rope locks. Poorly aligned blocks resulting in fleet angles, where cable travel is not perpendicular to the sheave axis, can also damage cables and sheaves over time. In addition to regular visual inspection of these critical components by a trained technician, a facility’s minimum preventative maintenance measures should include checking wire rope clips and other system hardware with a torque wrench to ensure they are all tightened to correct torque amounts.

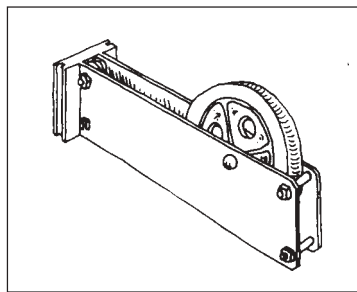
The misuse of spacer plates on counterweight arbors is another common concern often overlooked by operators, and inspectors often find anchor shackles incorrectly aligned under tension. Experts also report that accumulated dust in sheaves can affect bearing operation and ultimately lead to rapid wear on wire rope passing through the sheaves. Pettus notes that many movement-related problems, such as subtle



Counterweight Arbor



Rope Lock



Tension Block

**The most common problems reported by inspectors include improperly tightened wire rope clips on lift-line terminations or arbor connections and worn-out or incorrectly adjusted rope locks.**

ILLUSTRATIONS BY GEORGE CHIANG,  
FROM *BACKSTAGE HANDBOOK* BY PAUL CARTER

fleet angle misalignments, can be traced directly back to poor installation. He describes how older installations are sometimes less reputable because safety precautions and standards have improved over recent decades, but cautions that even modern installations are only as good as the quality of craftsmanship involved. Glerum describes one installation in which he discovered the contractor had used an improperly adjusted swaging tool and a slightly bent “go-no go gauge.” These oversights required a complete replacement of every wire rope termination in the new system. Inspectors relate finding poorly swaged terminations, improperly torqued wire rope clips and loose arbor rod end nuts in several newly installed systems. New systems installed by even experienced firms should be independently inspected before putting the counterweight rigging system into operation.

Experts interviewed agree that counterweight rigging operators often need standardized training, as “learning-by-doing” can sometimes lead to poor habits and unsafe practices. This training deficit is especially apparent in academic environments but is not exclusive to high schools and college theatres. Glerum advocates a program of venue-specific certification, in which the most experienced staff member carefully trains and supervises prospective operators in controlled circumstances before approving the new operators to load, unload, or run the system in rehearsals or performances. Even supervisory personnel can benefit from regular refresher training to keep their observation and operation skills sharp. Lack of training can also lead to gradual accumulative errors and sudden mishaps. Examples of accumulative mistakes made by untrained or careless operators include regular use of out-of-weight linesets and the collision of arbors with the upper and lower stops during operation. These errors place unnecessary wear on the system and may lead to serious problems over time. Sudden mishaps of even a moderately serious nature, such as runaway linesets crashing up or down, will add invisible stress to a system and can be avoided with thorough training of everyone loading, unloading and operating the fly system.

Most counterweight rigging system problems can be traced to three contributing factors:

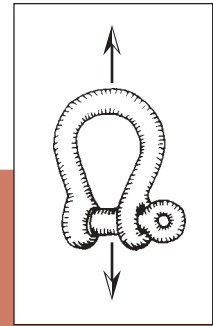
- Normal wear-and-tear
- Poor maintenance
- Operator error

Regularly scheduled safety inspections will help conscientious venue operators catch the effects of normal accumulated equipment and material wear before danger results.

The sheer number of sheaves, lift lines, and hand lines in even a modest system can be daunting, yet all these components may need replacement over time. Theatre work schedules often do not encourage routine maintenance, and inspection experts relate many tales of venue operators who conveniently assume counterweight rigging systems are hassle-free. Jay Glerum sardonically comments how random hardware items appearing beneath tension blocks are not “gifts from the Bolt Fairy” and should be immediately identi-

## ...inspectors often find anchor shackles incorrectly aligned under tension.

(Note correct alignment in drawing.)



Shackle

fied and replaced. He notes this cavalier attitude toward loose hardware is unfortunately all too commonly encountered during safety inspections. Although the need for diligence should seem obvious, many venue operators need motivation to find the time for routine, documented in-house inspection and maintenance.

### IN-HOUSE INSPECTIONS

Glerum advises that many problems can be avoided when operators pay attention to the system every time it is in use, as immediate investigation of unusual noises, vibrations or rough operation may prevent later malfunctions or injuries. The value of trained personnel looking over system components during daily operation should never be underestimated, but an annual in-house inspection by the most experienced rigging professional on staff is also recommended. Annual in-house inspections should include the following minimum steps for every lineset:

- Inspect batten pipes for bending.
- Check the chains or alternate fastening between the batten and the lift line termination.
- Check the wire rope termination hardware, paying special attention to torque on any wire rope clips in use.
- Ensure any nuts and bolts used for rigging attachments are adequately rated for the job.
- Examine each wire rope from the batten through the length of travel to the arbor top.
- Inspect the wire rope termination and attachment hardware between the wire rope and the arbor itself.
- Follow path of travel for all wire ropes to check for friction or obstructions.
- Inspect every head block and loft block for wear and damage.
- For double-purchase systems, inspect arbor blocks for wear and damage.
- Check tension blocks for wear and damage, and inspect tension block fastening components for bending
- Assess arbor wire guides or track guides for obstructions and wear.
- Check hand lines for stretching and signs of wear.
- Check knots or splices fastening hand lines to arbors.
- Assess rope locks for wear and adequate tension, and make sure all rope lock and operating rail hardware is properly tightened.

## Most counterweight rigging system problems can be traced to three contributing factors:

- Normal wear-and-tear
- Poor maintenance
- Operator error

### MAINTENANCE AND INSPECTION LOG

Long after system installation is completed, dedication to in-house maintenance quality helps avoid problems that might otherwise surface at routine inspections. As summarized by 52-year rigging veteran Thomas Pettus, “A well-maintained system can last for a hundred years, but if it’s not taken care of you might as well throw everything in the garbage in twenty years.” In addition to regular inspections, thorough records of routine maintenance, documentation of problems and records of corrective action are critical to the safe operation of a counterweight rigging system. Glerum strongly advises that every venue operator keep a written log of all maintenance and inspections done on the equipment.

The counterweight rigging system inspection log can be as simple as a 3-ring binder permanently tethered to the operating rail. Separate pages in the log should document the maintenance history of each lineset, with spaces available for the following information:

- Venue name
- Technical supervisor responsible for maintenance
- Lineset number
- Dedicated use (if applicable; electric, RP screen, etc.)
- Lineset weight capacity
- Date of last in-house inspection
- Date of last professional inspection
- Dates of routine maintenance activity
- Problems noted and dates of corrective action

Ideally, an up-to-date copy of the maintenance log should be also kept elsewhere, preferably in the theatre technical supervisor’s office. For convenience, this version of the log may also include a section for maintenance and inspection of chain motors, block-and-fall assemblies and other rigging equipment in stock. Responsibility for keeping rigging system maintenance records should be assigned to a capable senior staff person to ensure maintenance is never neglected. Theatre operators should take cues from the construction industry, where executive management has responsibility for setting and monitoring strict safety policies, with authority and responsi-

<b>COUNTERWEIGHT RIGGING SYSTEM MAINTENANCE / INSPECTION LOG</b>
<b>VENUE:</b>
<b>Technical Supervisor:</b>
<b>LINE SET #:</b>
Dedicated Use:
Capacity:

	PROBLEMS NOTED	CORRECTIVE ACTION	SIGNATURE AND DATE
<input type="checkbox"/> ROUTINE MAINTENANCE <input type="checkbox"/> SAFETY INSPECTION			
<input type="checkbox"/> ROUTINE MAINTENANCE <input type="checkbox"/> SAFETY INSPECTION			
<input type="checkbox"/> ROUTINE MAINTENANCE <input type="checkbox"/> SAFETY INSPECTION			
<input type="checkbox"/> ROUTINE MAINTENANCE <input type="checkbox"/> SAFETY INSPECTION			

Sample Inspection Log Form. Add pages as needed to continue line set log record.

bility for enacting safety procedures clearly defined for all staff (Rosnagel, Higgins, and MacDonald, 454). Maintaining a counterweight rigging system should be taken as seriously as are procedures for ensuring safety from fire hazards.

## CONCLUSION

Even in the busiest theatre, a counterweight rigging system is not an acceptable place to ignore the line between “good” and “probably good enough.” Regular professional safety inspections should be a carefully scheduled part of a well-managed program including in-house inspections, training and maintenance. The extra effort and expenses incurred will be rewarded by increased workplace safety, liability protection, peace of mind and that sense of “good practice” that should be part of making theatre happen. ❖

*Erik Viker is assistant professor of theatre and technical director at Susquehanna University.*

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