Thern
Stage Equipment

Introduction to Stage Rigging Equipment

Counterweight rigging and motorized hoists for theatres, entertainment, and performance venues

ISO 9001 : 2015 CERTIFIED

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ISRE-0622

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This guide provides an introduction to stage rigging equipment used in theatre, performing arts spaces, houses of worship, museums and other venues. All Thern Stage Equipment is designed exclusively for the express purpose(s) listed in our product materials, and the safe and proper function of a rigging system relies on the selection, installation, operation, and maintenance of appropriate components. This guide does not instruct how to design rigging systems, professional integrators and consultants are required for proper system design.

Contact Thern, Inc, to learn about professional rigging design resources in your area. Beyond the products presented here, Thern, Inc, has an extensive engineering team ready to provide custom rigging solutions for your facility. Contact the ay factory 800-553-2204, or info@thernstage.com to discuss your application.

BRIEF HISTORY OF THERN STAGE EQUIPMENT

Founded in Winona, Minnesota by the mechanically inclined Royal G. Thern and his wife, Lucille, during the post World War II boom, Thern Incorporated began with a handful of basic winches and other miscellaneous tools. After the war, Royal and Lucille settled in the small, flourishing town of Winona on the banks of the Mississippi river where they created a corn sheller, lever operated chain hoist, cordwood saw frame and a differential chain hoist. These innovative products were the foundation for the lifting, pulling and positioning solutions the company manufactures today. More than seventy years later, Thern has built a solid reputation for manufacturing the most dependable, powerful and durable solutions for moving loads of all sizes. Our extensive selection of off-the-shelf models and ability to design custom solutions is why customers in markets around the world choose Thern winches and cranes.

Thern introduced the first major innovation for counterweight rigging in decades, the Brickhouse™ front loading arbor. Today, Thern offers a complete line of product solutions for every type of venue, from intimate theatres to large performing arts centers and concert halls.

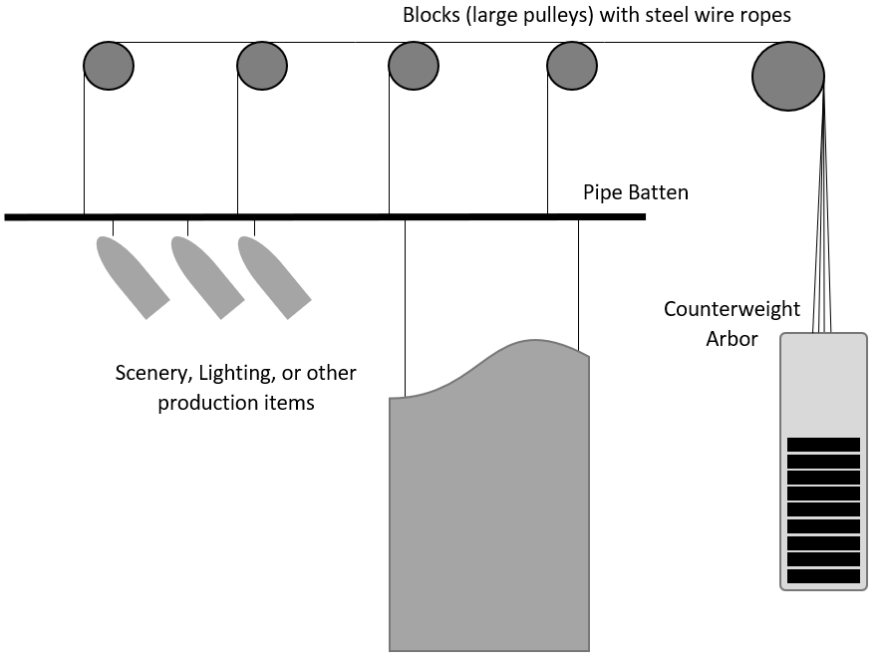
TABLE OF CONTENTS

WHAT IS THEATRE RIGGING?

1. Stage rigging is a simple method to raise and lower items using a series of pulleys and weights or motors to balance the load in equilibrium. Manual counterweight rigging uses a counterbalance arbor equal in weight to the objects (load) being raised or lowered. When balanced, almost any operator can move the line set while maintaining safe and complete control of the line set. As stage draperies, lighting, video, sound, or scenery change from production to production, so can the weight balance. Theatre rigging is customized to work properly within a facility's structural capabilities, and may also be designed to support the particular style of productions that will take place on stage. Counterweight rigging equipment must be professionally designed to ensure proper integration and operation of the equipment.

2. Motorized hoists may be used to increase lifting capacity or provide precise and repeatable positioning. Hoists can assist in the operation of counterweight line sets, as in a Counterweight Assist hoist, or completely replace manual rigging. Hoists can offer a greater scope of performance with increased capacities, speeds, and computer-controlled capabilities with sensors and multi-hoist functionality. Theaters require motorized hoists and control systems specifically designed for overhead rigging situations found in performance and entertainment venues.

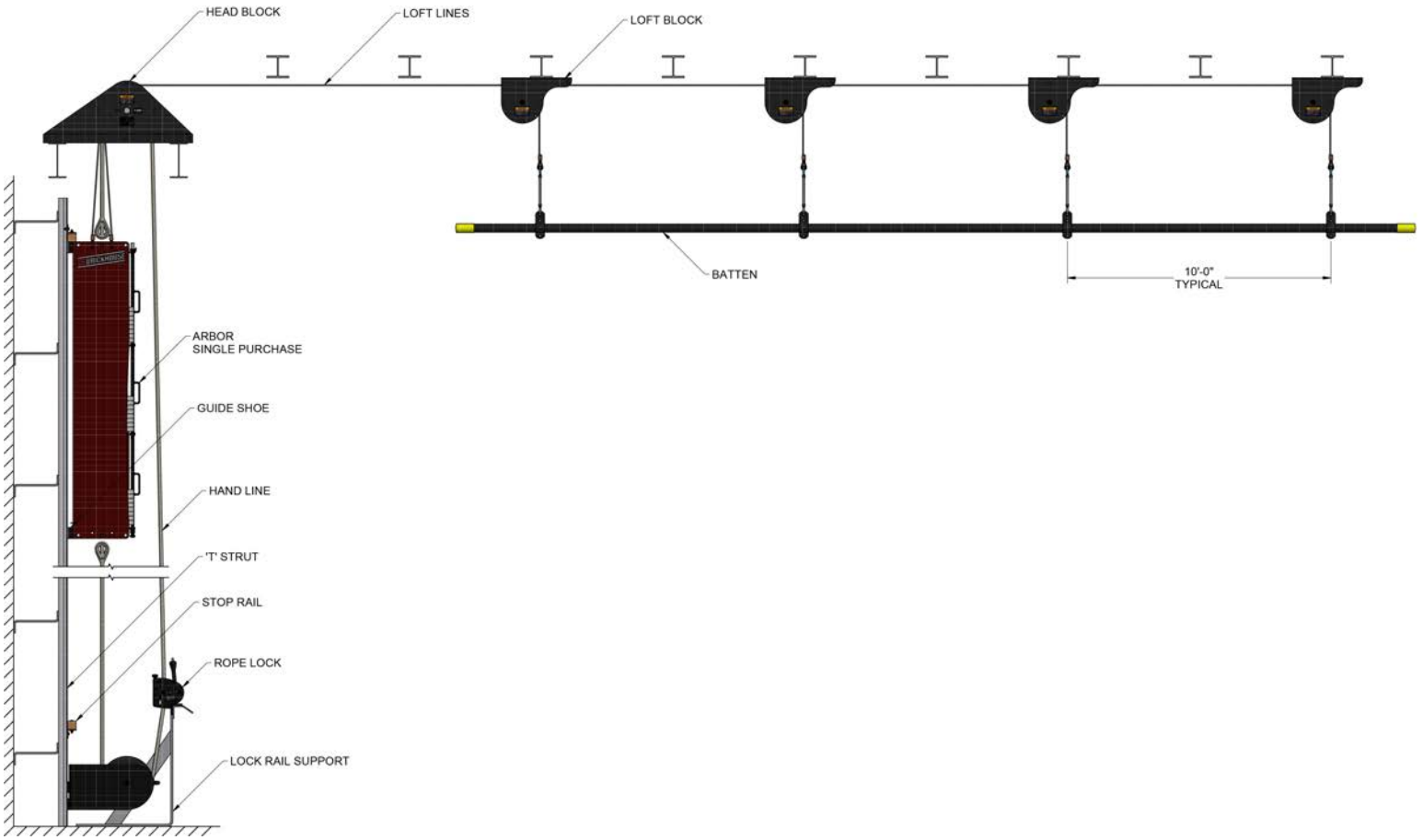
3. Stage rigging is based on large pulleys and counterweight.



The illustration above shows the elements of a typical stage rigging. The Arbor, at right, is loaded with weight equal to that of the production items hanging on the Batten. As the production items change, the weights can be added or removed from the Arbor to rebalance the system. Wire ropes are connected to the top of the Arbor and travel up and over large pulleys, called blocks. The large blocks are specifically designed for overhead lifting in theatre and provide high capacity and quiet operation. The specific arrangement of these blocks, how they connect to the building, and how they operate as a system are determined by a professional rigging designer.

Note: All rigging systems should be professionally inspected on a regular basis to ensure proper operation and maintenance. ANSI standards specify that stage rigging should be inspected on a regular basis, and more often in situations where rigging encounters heavy use. Contact Thern, Inc, to learn about resources in your area.

The schematic below shows the architecture of a typical counterweight rigging system. Each component is detailed below.



MANUAL COUNTERWEIGHT RIGGING

COUNTERWEIGHT COMPONENTS

Brickhouse Rope Lock

A Rope Lock is a lever-actuated rope binding device designed to bend a 5/8" to 1" rope and keep a balanced counterweight line set from moving up or down. Thern's rope lock uses a unique belaying style design that eliminates the wear other locks place on handline rope. Instead of a noisy and awkward rope ring, a spring-loaded plunger lock located at the end of the handle provides positive one-handed operation and self-locking features not found on other rope locks. Rope locks are designed to hold up to 50 lbs of force on the rope, and they must never be used to hold unbalanced line sets or deaccelerate loads.

Rope Lock & Lock Rail

Rope Locks are bolted in series, usually 6", 8", or 12" apart, to a solid steel bar, called a Lock Rail. Lock Rails are engineered to accept the complex forces of rigging systems. Lock Rails include numbers to identify line sets (1, 2, 3, 4, etc) and a labeling system to distinguish temporary or permanent uses for each line set (Electric #2, Stage border #1, "Act 2 Set", etc).

CLOSED POSITION

OPEN POSITION

Front-Loading Arbor

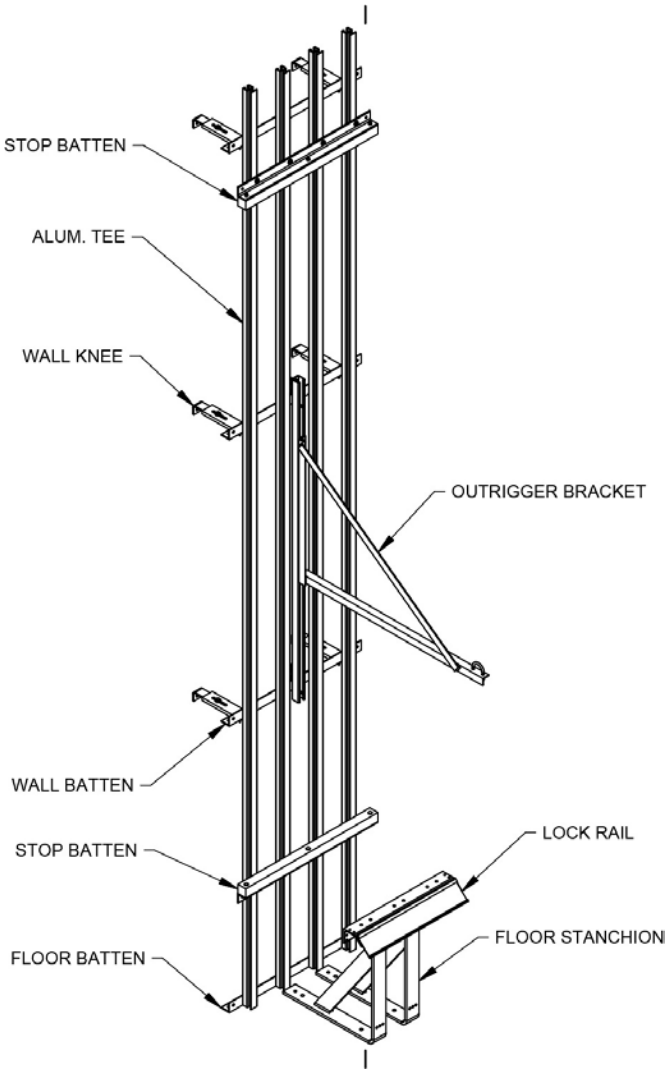
The Brickhouse™, Front Loading arbor is comprised of a welded steel box with shelves. Counterweight bricks are stacked inside the arbor to counterbalance the load. The bricks are held in place with a self-locking retainer bar. The weights rest on shelves that provide the ability to arrange weights to meet the needs of the facility. Arbors ride up and down a guide wall. Guide shoes bolted to the arbor fit between vertical rails on the guide wall to provide smooth continuous slots in which arbors can ride. Brickhouse Front Loading arbors are available in single purchase, double purchase, and gained arrangements (2 or 3 arbors wide) to meet the needs of most any rigging system design. Standard arbors can provide counterweight capacity from 200 pounds to over 3,000 pounds. Custom designs may allow tens of thousands of pounds of capacity.

Side-Loading (rod) Arbor

Side loaded rod arbors provide an economical carriage for counterweights to balance the load on a pipe batten. The arbor is constructed of two steel rods, a steel back bone, and bottom formed channels with punched holes. The arbors require a counterweight to be angled and slid sideways between the rods. Arbors include guides that are captured between guide rails. Arbors are also used in wire guided systems and for counterweighted fire curtains

Purchase Line (hand line)
A 5/8" to 1" diameter fiber rope is tied directly to the top of the counterweight arbor and runs over the center groove of the head block and back down through a rope lock. The rope continues through the Floor block (or Tension block) and ties off to the bottom of the same arbor, creating an endless loop. The rope provides the human interface between the operator and an individual line set. Most all purchase lines today are made from synthetic ¾" Multiline II, three-strand twisted rope of polyester stands and a polyolefin core for considerable strength, abrasion resistance, and a long lifespan.

Guide System
Thern's T-Strut guide system consists of a proprietary aluminum extrusion that captures the arbor between two vertical rails for smooth guiding and operation. An A-nut unistrut channel at the back of the T-strut guide provides fast and strong installation. A complete guide wall system includes T-strut guides, knee braces, horizontal wall battens, and arbor stops (with hardwood), as well as lock rails and outriggers. Other guides including J-bar and T-bar provide similar functionality



Detail of Thern t-strut guide wall rail

Wire Rope
Galvanized wire rope of 7x19 construction is preferred for stage rigging. Constructed of 7 bundles, 19 strands of wire in each bundle, it is also generically referred to as "7x19 GAC", for galvanized aircraft cable. Modern theatre rigging systems use wire rope in 1/8", 3/16" and 1/4" diameters. Larger diameters are used in systems requiring larger load capacities. In existing rigging systems greater than 30 years old, it is important to identify the type of wire rope used to determine lift capacity. Wire rope should be well maintained and professionally inspected regularly.

The most common sizes of wire rope found in theatre rigging are:

1/8" (0.125"; 3.175mm) 2000 lbs breaking strength
3/16" (0.1875"; 4.7625mm) 4200 lbs breaking strength
¼" (0.250"; 6.35mm) 7000 lbs breaking strength

Wire rope terminations are made in the field as a step critical to quality installation. Terminations and rigging connections should be performed by trained personnel under the supervision of an ETCP Certified rigger. Copper compression swage fittings are recommended.

Head Block

12IN Underhung Head Block Single Purchase- HB12-D8N25SP

Head blocks are mounted to the head beam (a steel beam designed for the complex loading that rigging places on a facility) high above the arbor The Head Block gathers all of the wire rope lift lines over one multi-groove sheave and directs the ropes down toward the arbor. The block contains a larger center groove sized for 3/4" or 1" purchase line to allow the operator to raise and lower the arbor. Thern Head Blocks use tappered roller bearings to provide exceptionally smooth and quite performance. Thern offers upright and underhung Head Blocks, in both single and double purchase, and in 8", 12" an 16" diameters. Custom groove arrangements are also available.

Loft Block

8IN Throat Cut Loft Block

Loft Blocks are used in a series to direct wire rope lift lines between the pipe batten and the Head Block. Thern Loft Blocks are available in single or multi-groove sheaves, in upright and underhung configurations, with optional idlers. When compared to idlers, multi-groove sheaves offer several benefits including smoother and quieter operation and increased load ratings. Standard options include 6", 8", and 12" diameter sheaves grooved for standard 3/16"and 1/4" wire rope. 3/4" fiber rope grooves and custom groove sizes available. Thern Loft Blocks use precision ball berings.

6IN Upright Loft Block LB6-R2N19

6IN Upright Loft Block LB6-R2N19

Idler family

Idlers

Underhung loft blocks require a method to support the lift lines as they travel between the Head block and loft blocks. Idlers provide this support by reducing wire rope sag and noise. Idlers are never to support a suspended load off the floor, they only support the wire rope itself. Thern's standard 2" Nylatron idler is groove for 2 to 9 lines and provides quiet operation and long life.

8IN Mule Block
MB8T-X3N25

Mule Block

Mule Blocks are horizontally mounted blocks to divert wire rope around obstructions and redirect lift lines between the head block and loft blocks Various mounting configurations are available based on the load applied to the Mule block. Thern Mule Blocks are available in 8" and 12" diameters from 1 to 9 grooves. Custom groove arrangments are available. Contact our factory for more information.

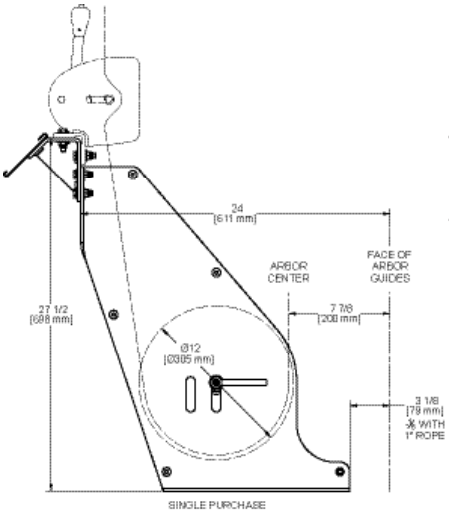
Batten

Stage battens are made from 1 ½" Schedule 40 black pipe with internal splices to create a continuous length of round pipe suitable for clamping lighting instruments and hanging other stage equipment. Batten capacities are defined by the specific application and use, and are also a function of the distance between lift lines, 10'-0" being a common maximum. For unusually heavy loads, found in orchestra shell ceilings or stage electrics, or when the distance between lift lines exceeds ten feet, a dual-pipe batten (also called a truss-style batten) is used. Truss battens increase batten stiffness and offer more connection points for scenery and lighting, and resist rotation under torsional loads, making them ideal for dedicated stage electrics.

12IN Nylaton Floor Block
FB12-W1N75

Floor Block

Floor Blocks, sometimes called tension blocks, are located at the bottom of a counterweight rigging system. Floor Blocks divert the purchase line from the bottom of the arbor back up through the rope lock. Thern standard single purchase floor blocks use a 12" Nylatron sheave (12" steel available) to achieve optimal alignment and reduced system friction. Blocks can be grooved for ¾" and 1" purchase line, and UHMW guide shoes provide several inches of travel within the guide wall. Thern Floor Blocks weigh at least 42 pounds to place proper tension on the purchase line and use non-lined shoes for optimal binding.



Combination Floor Block

The combination Floor Block/Rope Lock units are useful for wire-guide systems and for counterweight operation that cannot be part of a lock rail, such as lattice track counter weighted Grand Drapes.

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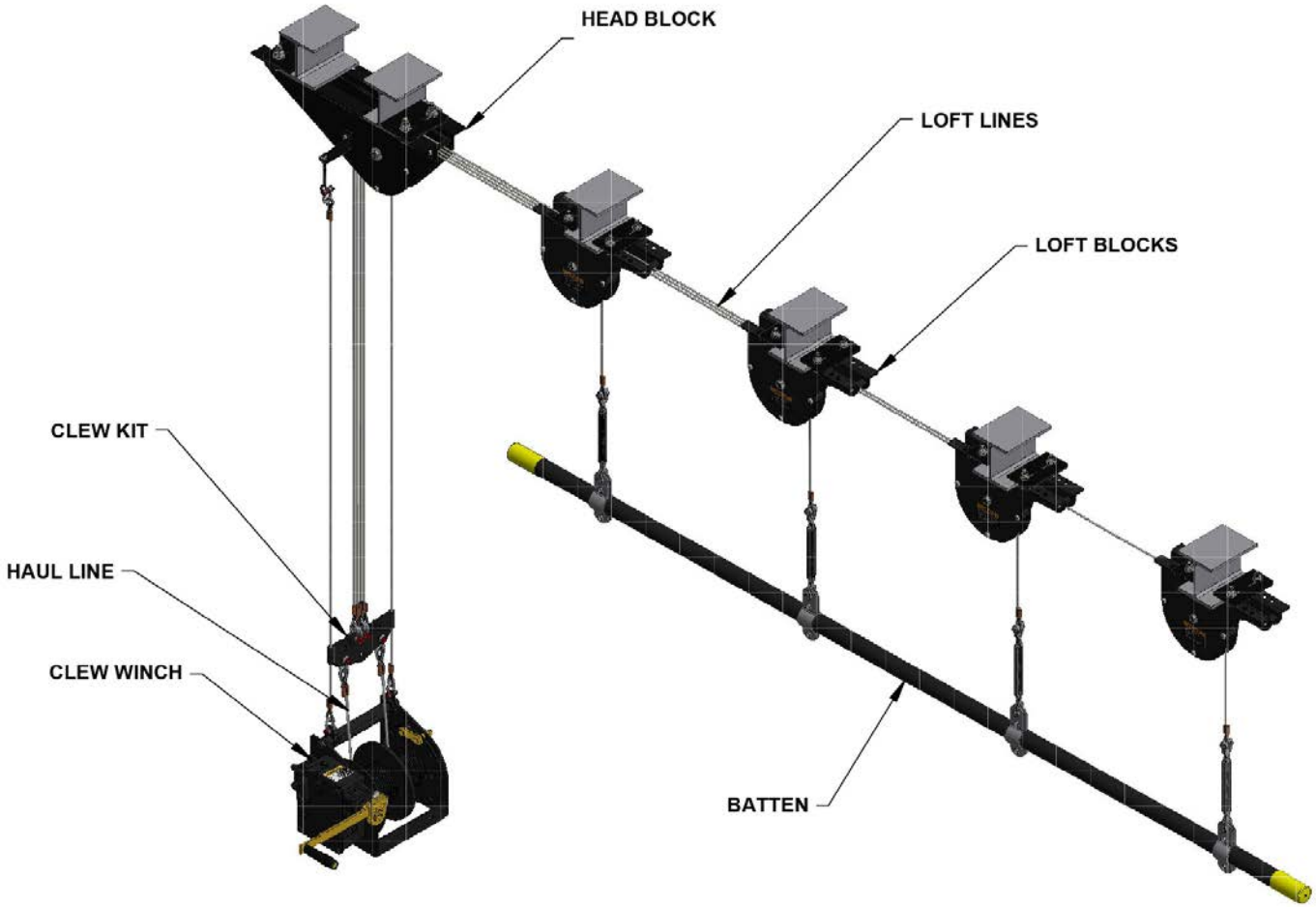
HOIST RIGGING SYSTEMS & SOLUTIONS

Entertainment hoists are defined by several factors including their lift speed, lift capacity, number of lift lines required, input power requirements, and control capabilities.

Fixed Speed vs Variable Speed
Most stage hoists are fixed speed machines designed to lift and lower scenery, lighting, audio, and stage drapery at speeds between 12 to 20 feet per minute (fpm) with simple up/down pushbutton operation. Hoists may also have several preset positions depending on the application. Touch-screen controls and programmable positioning can be added for greater capabilities.

Variable speed hoists provide increased performance when faster lifting speeds are required, or where scenery and other loads must move in sequence with a stage production. Speeds of 180 fpm, and faster, are available with variable speed machines. Cost increases with increased hoist speed and capabilities.

Manual Clew Winch



Clew Winches are used to lift multi-line loads where counterweight rigging is not practical and motorized hoist are cost prohibitive. The figure above notes the clew kit that includes the clew plate, which is a guided steel bracket that connects the pulling force of one set of haul line cables to a set of many lift lines. The haul lines pull down on the guided Clew Plate that in turn pulls lift lines and raises the batten. Each clew winch includes a constantly engaged internal brake that ensures the load cannot descend unless the operator manually cranks the load down through a passive drive-through brake. An integrated lockout pin provides an additional safety to hold the load, while a padlock provides security against unauthorized operation. A manual clew winch is typically operated by a manual hand crank that winds haul lines onto a drum to safely lifts loads. Additionally, a 300 RPM (max) heavy-duty drill and socket can be used on our manual clew winch as an economical way to ease operation. Manual Clew winches are available in 1,100 lbs and 2,500 lbs capacity and meet standard, ANSI E 1.4-3 (2020) Manually Operated Hoist Rigging Systems.

1,100 lbs Dual Drum Manual Winch CW11-2M

Motorized clew winches operate in the same manner with the added convenience of motorized control. Pushbutton controls provide secure keyed access with one set of up/down positions, and the clew winch can be installed in more remote locations where operator access is limited Whether manual, or motorized, clew winches are a highly versatile, compact, and economical solution to safe stage rigging.

2,500 lbs Manual Winch CW25-1M

Counterweight assist hoist CWA-2

Counterweight Assist Hoist

Counterweight Assist Hoist (CWA) replaces the floor block, rope lock and hand operating line of a counterweight line set with a hoist and set of controls. The hoist pulls large roller chain through the machine to raise and lower an arbor. There are many advantages to this. The overall line set capacity equals the lifting capacity of the hoist, 1,500 lbs, plus the gross weight of the arbor and counter weight. The ability of this hoist to handle 1,500 lbs of imbalance allows for a 0 to 3,000 lb load shift, depending on the arbor and fixed loading conditions. This significantly increases the safety of counterweight rigging, particularly when heavy loads are common. With a minimum spacing of 8-inches, a CWA hoist is ideal for new installations or as a retrofit to existing rigging systems.

2,500 lbs Sign Drum Motorized Winch CW25-2PC

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Pile Wind Hoist

Pile wind hoists, sometimes referred to as a "yo-yo" hoists, is a compact lifting machine for up to 9 lift lines (3/16" or ¼" wire rope). Each line is wound between two steel plates spaced the same distance apart as the wire rope's diameter. This mimics a yo-yo, where rope piles on top of itself. With a capacity up to 2,100 lbs, pile wind hoists are suitable in a wide range of lifting situations and mounting configurations, especially for zero-fleet angle applications.

Line Shaft

Line shaft hoists consist of a series of two or more wire rope drums that are mechanical coupled with drive shafting and universal joints. Line shaft hoists are mounted directly above the load to raise and lower it while eliminating any diagonal forces or other complex resultant forces on the building structure. Line shaft hoists can fit within existing rigging in renovations with a variety of motor orientations available, and also provide reliable lifting in new facilities.

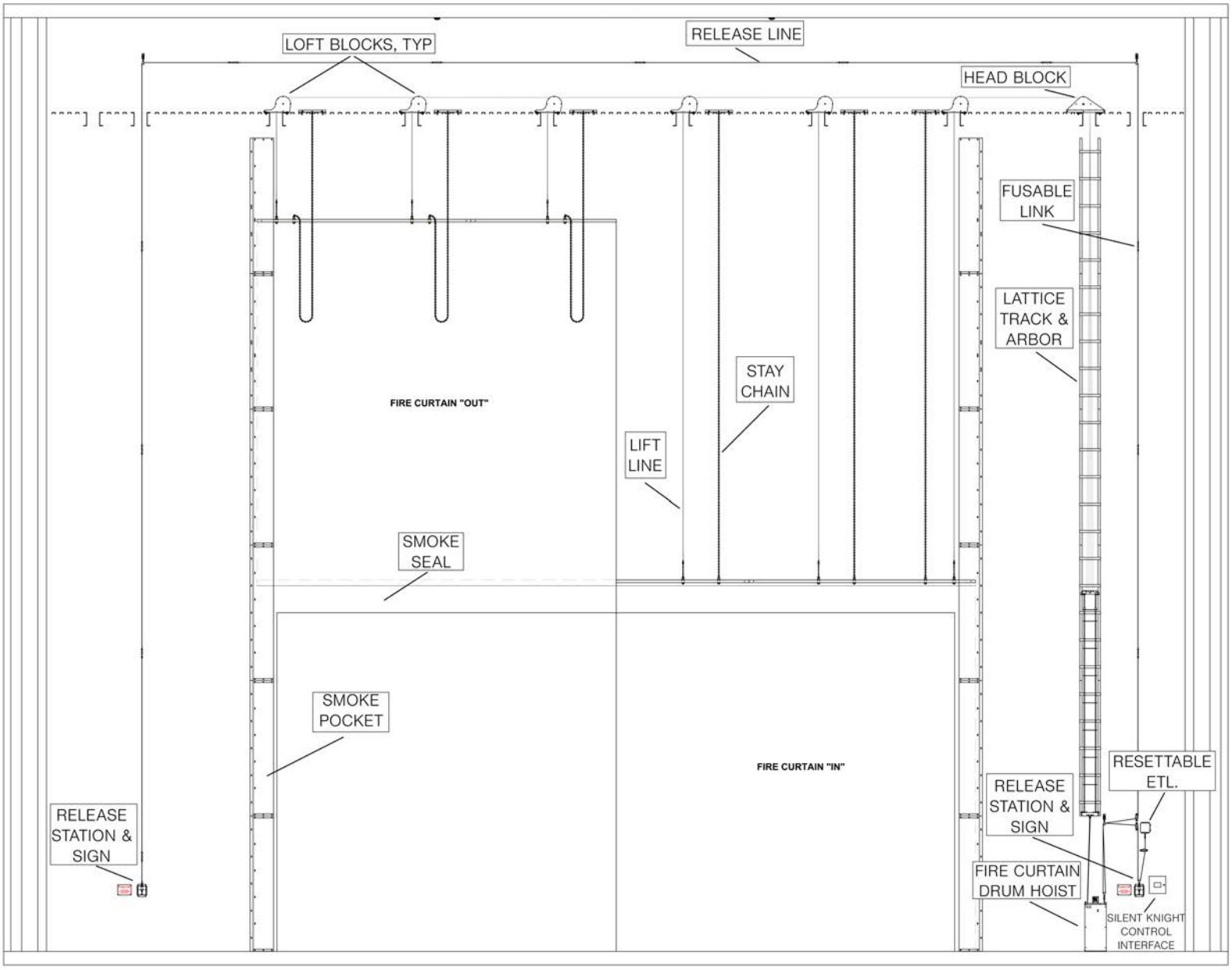
Roll Drop

A roll drop is a lifting machine that rotates a horizontal roll drum to spool on or off a continuous seamless fabric drop. The operation closely resembles a motorized window roller shade. Thern's roll drop can accommodate fabric up to 46 feet wide, and capacity varies from 50 lbs to 500 lbs depending on the overall length of the roll drum. Roll drops are ideal where cycloramas, sky drops, painted back drops, and acoustic curtains must be rolled up for storage, and where vertical fly space is limited. Plastic projection screens are not recommended for roll drop machines.

Self-Climbing Truss

A Self-Climbing Truss is a line shaft hoist mounted inside of an aluminum truss, and is manufactured to custom lengths for each project. With lifting gross capacity, including self weight, of 3,920 lbs, self-climbing trusses are ideal where hoist machinery cannot be mounted to a grid or other overhead building structures. And like line shaft hoists, self-climbing hoists eliminate diagonal forces or other complex resultant forces on the building structure. The hoist winds wire rope around a series of drums to lift the truss and hoist and any items mounted to the truss including lighting, audio, scenery, or drapery. The size and versatility of self-climbing hoists make them ideally suited for front-of-house lighting positions above the audience, multi-use facilities, convention centers, museums and houses of worship.

FIRE CURTAINS - OPERATION & EQUIPMENT



FIRE CURTAIN SYSTEM

Fire Curtains, or proscenium curtains, provide fire suppression between the stage and audience seating area in the event of a fire. The design, installation, operation, maintenance and testing of Fire Curtains is detailed in: International Building Code (IBC), National Fire Protection Association (NFPA) Life Safety Code 101, and ANSI E1.22 Fire Curtain Safety Systems. These codes require fire curtains to close completely in the event of a fire, and must provide a fire and smoke containment seal between the stage and audience chamber for up to 30 minutes. Manual counterweighted fire curtains are common in older installations, while most fire curtains today must be motorized.

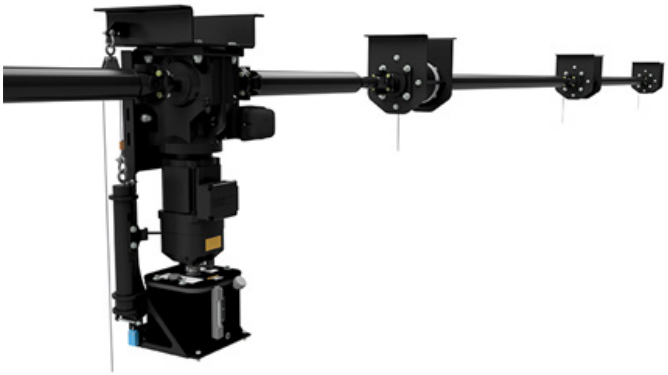
Thern, Inc, offers Fire Curtain hoists along with the components necessary for complete installations and maintenance. They include: lattice track and arbors, battens, safety chain, smoke seals, smoke pockets, release stations with resettable electro-thermal link (ETL) w/ Monitor, and a fire alarm interface.

Fire Vent Closure

A Fire Vent Closure winch is a compact manual winch designed to securely close smoke vents. The winch permits proper testing and resetting of smoke doors as required. With an integrated ETL (electro-mechanical link), and adjustable brake, the winch pulls smoke vent doors closed and holds them in position until released by the testing arm or the link.

Fire Curtain Drum Hoist

A Fire Curtain drum hoist is designed to safely raise and lower a fire curtain to provide separation between the stage and audience seating chamber. Thern's Fire Curtain hoist is designed for 5/16" wire rope and includes a compact design, 16 ¾" wide, 19 ¼" deep, and 48" tall, with versatile mounting configurations. The integrated hydraulic-controlled lowering mechanism provides arresting control in emergencies and conforms to ANSI E1.22 "Entertainment Technology Fire Safety Curtain Systems" and NFPA 80 requirements.



Fire Curtain Line Shaft Hoist

A Fire Curtain line shaft hoist uses a single motor with common shafting to drive one drum for each lift line. This allows for greater load capacities without introducing horizontal loads to the building structure. The integrated hydraulic controller provides automatic lowering for emergencies and conforms to ANSI E1.22 "Entertainment Technology Fire Safety Curtain Systems" and NFPA 80 requirements.

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MISCELLANEOUS RIGGING ITEMS

GUIDE SHOES

Guide Shoes connect arbors and floor blocks to the guide wall. UHMW (ultra-high molecular weight) polyethylene guides with steel backing plates provide smooth quiet and reliable operation. Our Brickhouse Front Loading Arbor includes a spring-loaded locking pin that automatically locks the backing plate in place for quick installation. Install the securing bolt and it is done.

Roller guides are also available for new installations or as an upgrade in renovations.

BLOCK CLIPS

Block clips mount loft blocks and head blocks to structural beam. Clips are sized according to the thickness of the I-Beam, or other structural steel, the block is mounted to. A complete line of clips is available at thernstage.com.

BATTEN END CAPS

Batten end caps are required in most installations to help demarkate the end of pipe battens. When vinyl caps are not used, the end-most 6" of battens can be painted with yellow, high visability paint.

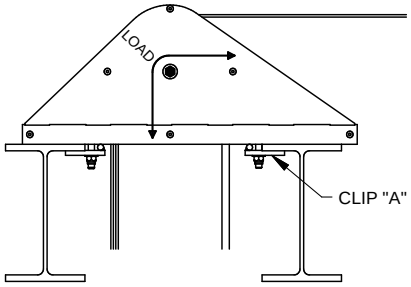
CABLE CRADLES

Cable cradles provide safe auxilary lifting for stage lighting cables without straining the electrical conductors. Large multi-conductor lighting cable is draped over the cradle and fastened in place with a batten clamp and U-bolts. Cable cradles are rigged in several different ways depending on the needs of each rigging system.

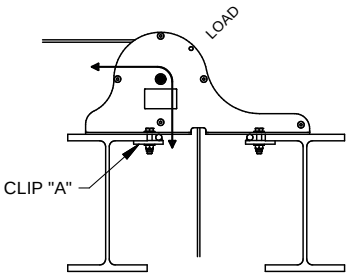
TECHINCAL DATA & RESOURCES (APPENDIX)

Block Mounting Guide

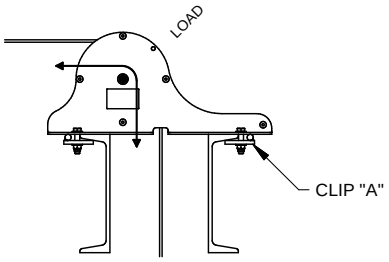
Depicted below are some examples of how Head Blocks and Loft Blocks can be connected to the structure of a theatre. Upright blocks set on top of the I-Beams or on top of a steel grid (grid wells), while Underhung blocks mount below I-Beams. Block Clips connect each block to the structural steel for quick and secure installation. Clip "A" noted in each image must be butted up against the I-beam flange for proper mounting. Block mounting bolts should be professionally inspected on a regualr basis



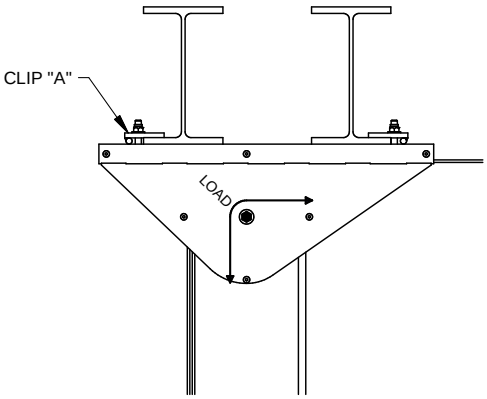
HEAD BLOCK MOUNTING
FROM TWO BEAMS

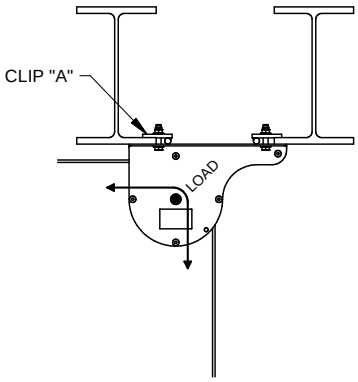


LOFT BLOCK MOUNTING
FROM TWO BEAMS

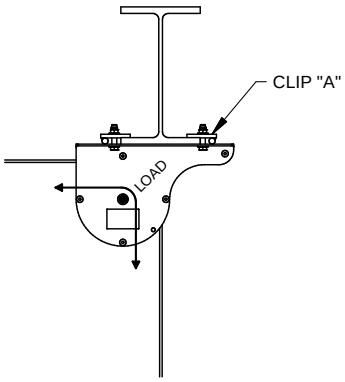


LOFT BLOCK MOUNTING
FROM CHANNELS





LOFT BLOCK MOUNTING
FROM ONE BEAM



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NOTES:

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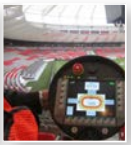
BC Place Stadium
Reduction System


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