How to make hoists safe before OSHA knocks

To get the job done, you have to know your hoisting equipment: what's safe, how to keep it safe, and how to use it safely. It takes a sound safety program to come up with the right approach—before OSHA spells it out in new standards.

As we go to press, uncertainty about OSHA requirements has been a "way of life" for industrial users of overhead hoists. So far, OSHA standards have had little to say about this "bread-and-butter" materials handling equipment, used in plants across the country.

"Overhead hoists", as a category, are briefly treated in construction standards (Subsection 1926.554 of 29 CFR Part 1926). Elsewhere, in the standard for double-girder, top running cranes (Subsection 1910.179 of 29 CFR Part 1910) OSHA says that a "hoist" may be part of a crane, and exerts a force for lifting and lowering. But, a Department of Labor interpretation has ruled that "overhead hoists" are not covered by 1910.179, OSHA's only industrial crane standard.

And now there's a growing urgency about hoist safety, in that the employer's responsibility could soon become much more specific. It's no secret that OSHA wants to adopt comprehensive safety standards for overhead hoists. They may do it within six months. So the question is: Will you be ready for the OSHA standards?

To get ready for OSHA, you have to know your hoisting equipment: what's safe, how to keep it safe, and how to use it safely. That kind of information is basic to an effective safety program.

In the past, that kind of information has also been built into most OSHA standards. And, fortunately, much information about hoists is now available in a national consensus standard: ANSI B30.16—1973 safety standard for Overhead Hoists.

The B30.16 safety standard covers all power-operated and manually-operated hoists for lifting service. It includes electric and air-powered hoists that lift with chain or wire rope. It also includes manually-operated hoists that are actuated by a hand chain and that lift with a chain.

Excluded are manually-operated ratchet-lever devices. The standard says they are not "overhead hoists." However, the Hoist Manufacturers Institute has specifications for two types of manually lever-operated chain hoists.

Also excluded from B30.16 are hoists designed for use in adverse environments. And there is no mention of worm-geared hand-operated chain hoists. So this standard does require some further clarification of details.

B30.16 can help you

Experts tell us that they hope, and expect, that the OSHA hoist standard, when adopted, will be "consistent" with the consensus standard, B30.16. So you can use B30.16 as a general safety guide.

You should be aware that B30.16 identifies mandatory rules by the use of the word "shall". Advisory rules are "shoulds", or are simply stated as recommendations.

In the past, when OSHA had to quickly adopt a number of national consensus standards, they avoided picking up the "should" material in these standards. But, today, with the pressure off, it is possible that OSHA will give more serious consideration to the ideas behind the "should" material.

Also, OSHA might omit some design and construction details over which the employer-user would have no control. This would be consistent with OSHA's aim to stress "performance-type standards" rather than "specification-type standards."

Of course, there are some other good sources for help, in getting ready for OSHA's new hoist standard. For example, you can get literature from the Hoist Manufacturers Institute. This organization, with representatives on the B30 committee, helped to prepare the B30.16 standard and concurs with its provisions.

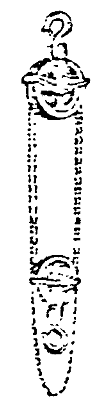
HMI can provide basic hoist specifications to help you promote

CTL005957

Where expertise can help you: hoists covered by B30.16 safety standard

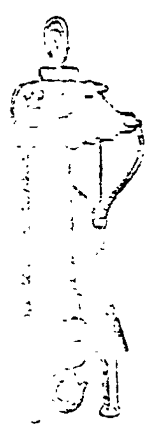
Hand-operated hoists

Spur geared chain hoist

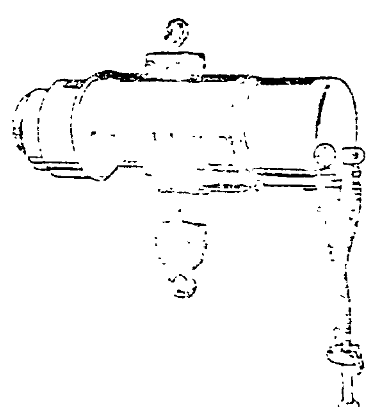


Differential chain hoist

Air-powered hoists

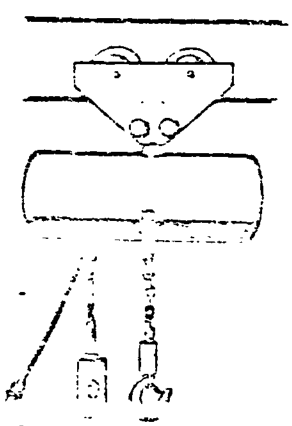


Chain hoist

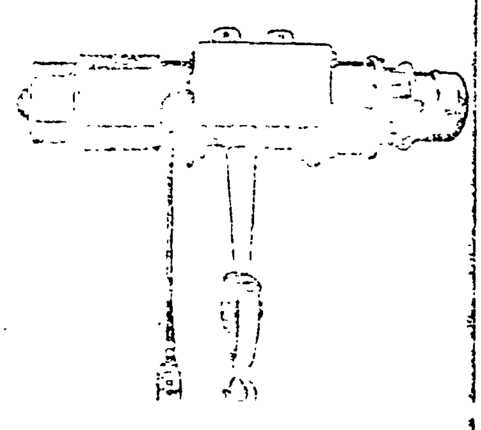


Wire-rope hoist

Electric-powered hoists



Chain hoist



Wire-rope hoist

safety and select the types and classes best suited to your applications. For example, HMI specifications include those for electric wire-rope and chain hoists, and for hand-operated chain hoists. Also, HMI can provide "Do's and Don'ts" for safe operation of hoists, and the HMI consensus on the National Electric Code.

Even though overhead hoists are not yet specifically covered by OSHA, for industrial applications, electric hoists must meet applicable parts of the National Electrical Code. So HMI has published a consensus on what it takes to make an electric chain or wire-rope hoist meet the NEC. Also, the 1975 NEC, just published, contains practical guidelines in Section 610 and could be adopted by OSHA.

If you have monorail applications, you will also want to contact ASME for a copy of ANSI B30.11—1973, Monorail Systems and Underhung Cranes—as well as a copy of B30.16, Overhead Hoists. The B30.11 standard says that manual or powered hoist units must comply with B30.16 safety requirements.

Not to be overlooked are the variety of safety devices that are now available as standard or optional features of overhead hoists.

And hoist manufacturers can provide checklists, manuals, and recommendations for inspection and maintenance. They can also tell you about testing and repair services.

By following this approach, using B30.16 as your basic guide, you can soon develop an effective program for hoist safety. But you have to understand what *is* safe equipment, what must be done to keep it safe, and how to operate it safely. So here are the highlights—not all the details, but the basic elements in hoist safety.

CTL005958

What's 'safety right' in the equipment

It bears repeating that equipment safety is the key to a sound safety program for overhead hoists. First, your equipment must be "safety right" for the job. Then people must be trained to keep it safe, and to use it safely, as OSHA will soon spell out.

So how do you start? First, by considering what's available in safety features, and by matching hoists to applications.

Over the years, a surprising variety of safety features have been built into overhead hoists or made available as options and accessories. Much of this has been written into HMI equipment specifications as well as the ANSI B30.16 safety standard for overhead hoists.

In addition, users should, of course, consider the special safety characteristics that are inherent in various types of hoists. Such characteristics may suggest which type is best for a given application.

But, above all, a user must try to properly evaluate his specific application requirements, before attempting to "match a hoist to the job."

For example, it may not be enough to know that a hoist has the load-lifting capacity, headroom, lift, and speed that a job requires. You should also consider the severity of the duty-cycle, including the special demands of infrequent heavy work-periods, when likely.

New safety concept

This concept is to match the "duty-service class of application," in two ways: (1) with the "duty-service class of hoists, and (2) with the "duty-service class of inspection."

For example, the Hoist Manufacturers Institute has already defined "duty-service classes" for electric wire-rope hoists and their applications, in the HMI 100-74 specification (expected soon).

And the B30 committee is expected to soon re-classify hoist-inspection requirements on a more rational basis, considering the severity of hoist service.

Such a re-classification of inspection requirements—redefining the "frequent" and "periodic" inspections—could specify what is appropriate for "normal", "heavy", and "severe" hoist service.

Someday, possibly soon, this concept may find its way into OSHA standards, as a practical safety guideline for the hoist user.

But, whether or not OSHA adopts it, the concept can help you to avoid over-specifying or under-specifying a hoist or its inspection requirements. It can help you to protect the operator from equipment failure, and to protect the equipment from excessive wear. It can also help you to avoid over-sized equipment, and to minimize your investment—without excessive inspection, testing, or maintenance.

Safety features available

When you buy a hoist, today, you get a "package" of safety devices. Among the possible safety features are: warning labels for operators, enclosed blocks, upper and lower travel limits, chain containers, load-weighing or indicating devices, load-limiting devices, thermal overload switches, latch-type hooks. The list could go on and on.

Some safety devices protect the operator from obvious mistakes, such as getting fingers into moving parts, lifting loads too high, or running the wire rope out and reversing it on the drum.

The latch on a safety hook can boost safety two ways. It secures a sling load. It also serves as a gauge, showing whether the hook has been sprung and has excessive throat distortion.

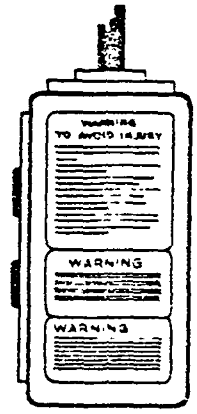
B30.16 states that latch-type hooks shall be used on hand-operated chain hoists unless the latch "increases the hazard." Latch-type hooks are now called for on electric and air-powered hoists, but exceptions may be allowed in the future.

Numerous safety devices can indicate or limit overloads. These may be standard equipment—more often are optional, or available as accessories. Thermal overload switches react to exceptional duty-service conditions that overheat a hoist motor. For example, these devices will shut down a hoist because of excessive running time and too frequent stops and starts—conditions hard on motors, brakes, and controls.

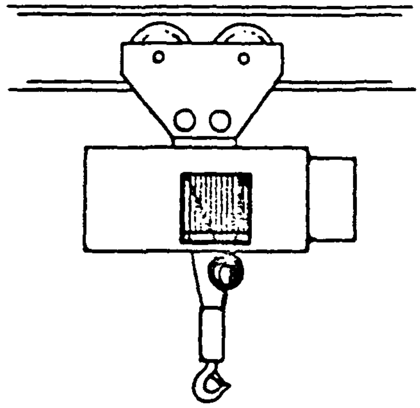
Many safety features protect the operator indirectly. These protect hoists from damage or excessive wear that, if undetected, could lead

CTL005959

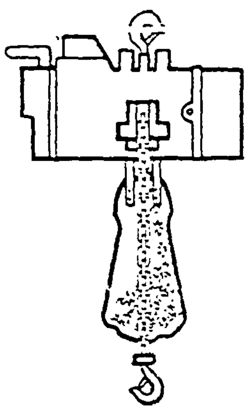
Six equipment features to boost hoist safety



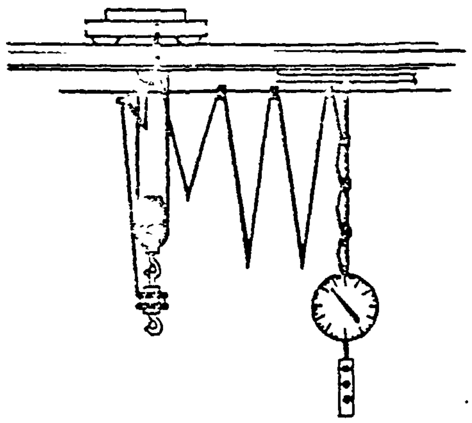
1 WARNING LABELS—These call attention of operator to major safety precautions.



2 UPPER LIMIT CONTROLS—Prevent load-hook from exceeding upper limit of travel.

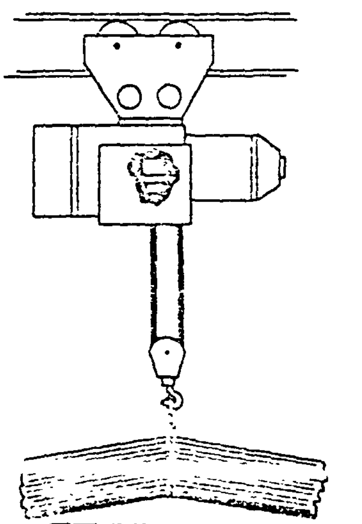


3 SLACK CHAIN CONTAINERS—Store slack chain so it won't hang in the way.

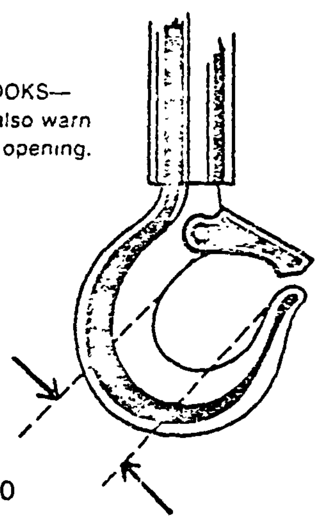


4 LOAD-INDICATING DEVICES—Sense the load and show its magnitude.

5 LOAD-LIMITING DEVICES—Sense an excessive load and prevent lifting it.



6 SAFETY-LATCH HOOKS—Retain slings. Can also warn of excessive throat opening.



CTL005960

to accidents,sooner or later.

One inherent characteristic of many hand-operated hoists is that they are relatively light and often moved from place to place. Basically, these hoists are designed for occasional and light lifting jobs.

Inherent hoist characteristics

The lever-operated types are highly portable. They often are used by maintenance people, and may be used for "pulling" jobs.

Because of the variety of possible applications for hand-operated hoists, there is some risk of accidental overloading or abuse. So the equipment manufacturers offer overload protection devices.

One example of an overload-indicating device, on a lever-operated ratchet hoist, is a special handle. This deflects up to 30 deg to warn of excessive loads.

One mechanical load-limiting device, on a hand-chain operated spur gear hoist, is a clutched hub on the hand wheel. When the pull on the hand chain is enough to overcome a given torque setting, representing an overload limit, the hand wheel will still turn. But this hub—on the hand wheel and the load wheel—won't turn. So the load wheel won't turn, either. In other words, the hoist will simply refuse to lift a severe overload.

No special load brake is needed on a differential hoist or a worm-geared hoist. The differential hoist has a single endless chain over a double sheave. The small difference, or "differential" of the two diameters of the double sheave sets up enough friction to keep a load suspended when there is no pull on the hand chain.

A worm-geared hoist needs no special load brake, because the load is supported by inherent "friction": the gear teeth cannot rotate the worm. In brief, a separate hand-chain operates a hand-chain wheel on the shaft of which is a worm gear. So a downward pull on either side of the hand chain rotates the power sheave and worm. This design offers greater mechanical advantage than that of the differential hoist, and provides accurate positioning.

Hoist users may be concerned that a typical differential hoist, as used in the past, has an open bottom block. The question is whether such a design could be in conflict with safety specifications.

B30.16 specifies that components must be sufficiently guarded to minimize the possibility of operator injury, and prevent entry of foreign objects. And this point, about guarding, is reinforced by OSHA's general requirements for all machines, 1910.212(a): guarding must protect the operator from hazards such as those created by point of operation, ingoing nip points, rotating parts...

However, an expert believes that an open-design differential hoist—*as pictured in B30.16*—has been accepted "as is" for the usage intended: filling a recognized need for an economical chain fall, where there is minimum usage and minimum investment.

Obviously, the B30.16 standard needs clarification.

Spur-geared hoists have relatively high efficiency and are designed for production service where good hand-hoist speed and ease of operation are essential. A spur-geared hoist may be used with a push-type or geared trolley on a crane or monorail. When headroom is limited, the hoist and trolley may be built together, in a low-headroom unit that provides maximum lifting height.

It's worth noting that the B30.16 standard for electric and air-powered hoists specifies that bottom blocks be of the enclosed type. And, hoist makers consider that the vertical entry of wire rope into a block is adequate protection for a man's fingers. Especially, because it's safer to hold the block or hook

Powered-hoist characteristics

While air-powered hoists include a variety of air-cylinder hoists—single-acting, double-acting, and air-balanced types—the B30.16 standard covers only air-motor hoists.

B30.16 does not cover hoists for operation in adverse environments. But air-motor hoists can be safely used in hazardous areas where air power cuts the danger of shock, combustion, or explosion. They also can be used in corrosive or abrasive atmospheres, because the air keeps contaminants out.

Both piston and vane types can provide graduated control of speed varied by throttling the flow of air. And lightweight portable units are available.

The piston types provide precise speed control and would lower a load relatively slowly if the brake should fail. Vane types can be relatively high-speed units.

One advantage of air-motor hoists is that the motors will simply stall when overloaded. They have automatic load-limiting capability.

Another is that they do not overheat on repetitive operations.

Exhaust silencers can hold the noise level below 90 dBA.

Electric hoists are well-adapted to busy production-service.

The principal components are the motor, the gearing system, a drum and hoisting-cable or a load sprocket (or sheave) and chain, the motor brake and load brake, "up" and (if specified) "down" controls, and the operating con

Link chain, roller chain, or wire rope may be used in ligh

CTL005961

Matching electric wire-rope hoists to the job
HMI's new hoist duty-service classification

Hoist class	Duty-service classification	General area of application
H1	Infrequent or standby	Powerhouse and utilities. Infrequent handling. Hoists used primarily to install and service heavy equipment, where loads frequently approach hoist capacity, with periods of utilization being infrequent and widely scattered.
H2	Light	Light machine shop and fabricating industries, and service and maintenance work. Where loads and utilization are randomly distributed, with capacity loads infrequently handled, and where total running time of equipment does not exceed 10-15% of the work period.
H3	Standard	General machine shop, fabricating, assembly, storage and warehousing. Where loads and utilization are randomly distributed, with total running time of equipment not exceeding 15-25% of the work period.
H4	Heavy	High volume handling in steel warehousing, heavy machine shop and fabricating plants, mills and foundries. Manual or automatic cycling operations in heat treating and plating operations. Total running time of equipment normally approaches 25-50% of work period, with loads at or near rated capacity frequently handled.
H5	Severe	Bulk handling of material in combination with buckets, magnets or other heavy attachments. Equipment often cab operated. Duty cycles approaching continuous operation are frequently necessary. User must specify exact details of operation, including weight of attachments.

[illegible] TWO BASIC GROUPS: Three hoist clas[illegible] H2, H3—apply to the vast majority of hoist [illegible] the generalized application-descriptions [illegible]adequate for selection of these hoist classes. But [illegible]—H4 and H5—require a thorough analysis of the duty-cycle. In brief, HMI then recommends a form[illegible] selection procedure. This applies if hoist utilization can [illegible] generally described as "heavy" or "severe", or if load conditions cannot be broadly described as "randomly distributed."

hoists. Link chain is durable and can tolerate some side stress (not recommended practice). Roller chain permits smooth operation for spotting loads. Wire rope is commonly used on higher-capacity hoists, and is often used for high (long) lifts with heavy loads.

Load-indicating and load-limiting devices are available for electric hoists. The HMI specification for wire rope hoists defines an "overload device": an emergency device that will permit operation of the hoist within its rated capacity, and will prevent the lifting of freely-suspended loads that would cause permanent deformation of a properly maintained hoist or trolley.

One load-indicating system uses a hydraulic weight-sensor, between the lower hoist hook and a load hook. This device will transmit the load signal to a dial indicator.

There's a load-limiting system that has a switch between the hoist and the supporting structure. The switch is set for an appropriate load limit. An overload will then actuate the switch, and this will de-energize the hoist motor and apply the brakes.

Another load-limiting device is an electronic unit, easily wired-into the hoist. This device works without any connection to the wire rope or chain that holds the load. It works on the principle that the hoist motor draws a higher current to lift an increased load. When it senses an overload current, a relay is energized to open the "up" circuit and stop the hoist. But a time delay makes sure that the relay will not be actuated by the short period of surge currents at the start-up of the motor.

There's a mechanical load-limiting device that has been built-into electric wire-rope and chain hoists as standard equipment. This slip-clutch device is set to function within a pre-determined range above rated capacity. The device limits severe overloads, and, on a chain hoist, can prevent damage from a jammed chain.

Of course, a chain guide is also provided to prevent a chain from twisting on a load sheave.

Electric chain hoists are generally powered by reversible, intermittent (non-continuous) duty, enclosed motors. These provide higher starting torque and better heat dissipation than continuous-rated motors.

However, the new HMI specification for electric wire-rope hoists includes both intermittent and continuous-duty motors. The torque characteristics must be suitable for hoist or trolley service and capable of operation at loads, number of starts, and speeds specified.

Hoisting horsepower must, of course, be ample for the required hoisting speed: the velocity (fpm

How to select the right class in electric wire-rope hoists

HMI 100-74 provides a step-by-step procedure for selecting the class of electric wire-rope hoist that you need. [illegible] can generally be described as "heavy" or "severe", or when loading conditions cannot be broadly described as randomly distributed throughout the work period.

The procedure uses tabulated "Performance specifications for standard electric wire-rope hoists."

Performance specifications are organized by duty-service class of hoist. These specifications define each duty-service class in terms of data on rated bearing life, running time, and number of starts.

[illegible] bearing [illegible] hours [illegible] defined [illegible] minimum expected life [illegible] of bearings at a given [illegible] rated B10 life [illegible] load condition [illegible] mean [illegible] average load [illegible] and other components [illegible]

Other performance specifications [illegible] load condition K=0.65. Values for [illegible] distributed work period [illegible] heavy work periods, the maximum elapsed time, in min., for hoist utilization when operating 50% of the time and the maximum number of starts.

You can quickly make a tentative selection of a class of hoist by comparing these performance specifications with facts about your known duty-cycle.

The formal selection procedure requires that you calculate the "mean effective load" for your duty-cycle requirements while using an assumed hoist capacity.

To do this, you first convert all loads to a "load magnitude," expressed as a decimal fraction of the hoist rated capacity. Next, you cube each different load, and multiply by the load probability—a decimal fraction of the total running time with and without loads. This gives you a series of numbers to add. Finally, you take the cube root of the sum. The result is the mean effective load. This is the actual load condition "K" for your duty cycle.

Next you look at the rated bearing life specification for the hoist class that you have tentatively selected. Simple math can now be used to convert the rated bearing life in the specifications to an "actual bearing life" for your actual load condition, K.

The actual bearing life—for your actual load condition—is the rated life multiplied by the cube of a ratio: the specified K (0.65) divided by the actual K that you have calculated.

[illegible] than desired, you go to a higher-capacity hoist, or to a higher duty-service class.

...he rated load. And the speed must be ample for the workload, including the frequency and height of lifts.

HMI points the way

A great service has been performed by the Hoist Manufacturers Institute, in developing specification HMI 100-74 for electric wire-rope hoists (expected soon).

In this specification, leading manufacturers have defined five classes of duty-service applications ... which five classes of hoists are ...igned. The five classes: "infrequent or standby duty-service" for "H1" hoists, "light" for "H2" hoists, "standard" for "H3" hoists, "heavy" for "H4" hoists, and "severe" for "H5" hoists.

Hoist classes and application ...ses have been tabulated, along ... generalized descriptions, in a "...st duty-service, classification" ... So you can soon discuss ...able classes of hoists with the ...facturers.

...eral experience has proved ... this tabulation—for electric ...rope hoists only—can ade... identify the vast majority of ...ations in industry: "infrequent ...ndby," "light", and "stan-... —for hoist classes H1, H2, and ...

... "heavy" and "severe" duty-... applications require a thor-... analysis of the hoist duty-cycle ... you specify a class of hoist. ...he H4 or H5 hoist classes may ...ected.

...analytical procedure is clear-...ined in the appendix. It is ... six major factors that ... the life of mechanical and ... components and should ... hoist selection:

...d distribution is the proportion ... and partial loads to be ... including attachments. Ex-...earing life varies inversely ... cube of the load. A 5-ton hoist that handles a mean effective load of 2 1/2 tons will have a bearing life 8 times that of the same hoist used steadily at its rated capacity.

Operational time is the total running time of the hoist, per hour or per shift.

Work distribution is the operational-time distribution, uniformly distributed over the work period or concentrated in a short time span. This factor can have a material effect on electrical components, such as motors, brakes, and controls. Example: a hoist motor designed to operate 15 min. per hr cannot cope with 2 hr of steady operation and 6 hr of idle time.

Number of starts and stops has a direct affect on all electromechanical devices, including contactors, brakes, and solenoids. Motor heating is related to allowable running time and number of starts, rather than the mean effective load.

Repetitive long lowering generates heat in the electrical or mechanical means for controlling speed.

Environmental conditions, such as temperature extremes, moisture, dust, and corrosive fumes are not taken into account unless otherwise specified.

How all these factors affect the selection of wire-rope hoists has been evaluated in establishing the HMI "Hoist duty-service classification."

But, in addition, HMI 100-74 says that you need more than generalized descriptions of duty-service applications to select an H4 or H5 class of hoist, for "heavy" or "severe" service.

First, a thorough analysis of your hoist duty-cycle is a must. Then you can use the technical data in the HMI 100-74 appendix to arrive at the right class of hoist. This approach is recommended to avoid

How to know you have safe overhead hoists

1 Know your duty-cycle requirements

Lifting capacity, headroom
Speeds, hook travel
Work distribution, loads, running times, starts

2 Know available safety features and specifications

Product literature, checklists for features, inspection, maintenance
Manufacturers association specifications
National safety standards and OSHA status

3 Match your hoist to the job

The features you need, in the specific environment
The required capacity and duty-cycle capability
A safety program to keep it safe, use it safely

the possibility of inadequate or oversized equipment.

Equipment features in B30.16

In B30.16, you will find hoist markings, construction, and installation details for hand-chain and electric or air-powered hoists.

All of these hoists must have the rated load permanently marked on the hoist or block, and legible from the operating position.

Each control element on a powered hoist must indicate the direction of motion. And all these hoists must be permanently marked with identification details.

Warning labels must be where specified, in a readable position, to display basic information on safe operating procedures. The required information is spelled out.

Basic construction features

There are numerous similarities in construction requirements for all hoists covered by B30.16.

Basically, any properly installed hoist, properly used under normal operating conditions, must be able to cope with loads within the rated load.

Load bearing parts must be designed so that the static stress, for the rated load, will not exceed 25% of the average ultimate material strength, for hand-operated hoists, or 20% for electric or air-powered hoists. And elements provided to give a visible warning of severe overload must be so designed that the static stress for the rated load will not exceed 35% of the ultimate strength.

The supporting structure, including trolley, monorail, or crane, must have a load rating at least equal to that of the hoist.

The manufacturer's replacement parts must be interchangeable within the original hoist assembly. [illegible]tions must be approved by the manufacturer.

Components must be guarded to minimize entry of foreign objects. Also, to prevent the possibility of injury to the operator of a hand-operated hoist.

The noise generated by operation of an electric or air-powered hoist must be controlled, so that the noise level at the operator's station does not exceed 90dBA.

Load chain may be roller link or welded link type and must be accurately pitched to pass over load sprockets without binding. It must be proof-tested by the chain or hoist manufacturer with a load at least equivalent to one and one half times the rated load, divided by the number of parts supporting the load.

Load sprockets must have accurately formed pockets or teeth to allow proper engagement of the load chain. And they must be guarded to minimize entrances of foreign objects. Provision must be made to release the chain freely, to prevent jamming.

MORE ON HOIST SAFETY

This series to be continued in the November issue.

Bottom blocks must be guarded against jamming of rope or load chain. On electric and air-powered hoists, bottom blocks must be of enclosed type, and should also guard the pinch points between the ropes and sheaves.

The hand chain on hand chain powered hoists must be guarded so it won't disengage from the wheel. The chain must fit the wheel without binding. And it must withstand three times the pull required to lift the rated load.

The load hook must be free to rotate through 360 deg when supporting the rated load. And hooks must be retained in the housing so they can't work loose.

The hooks must have enough ductility to open noticeably before failure of the hook under overload. Latch-type hooks must be used, unless—on hand chain hoists—the use of the latch increases the hazard.

The braking must be so designed that it will automatically stop and hold loads up to 125% of rated load, when controls are released or actuating force is removed.

The braking system for electric and air-powered hoists must also limit the speed of a lowering load to 120% of rated lowering speed for the load. It must have ample thermal capacity for the required frequency of operation. And it must be adjustable to compensate for wear.

Travel restraints are specified for all types of hoists. The load chain on a hand-operated hoist must be restrained before it can be completely run out of the hoist. The restraint must withstand a lowering hand chain force of twice the pull to lift a rated load.

Electric and air-powered hoists must not let the load hook exceed an upper limit of travel. And they can't be installed where the loaded hook can be lowered beyond the rated hook travel, unless the hoist has a lower limit device.

B30.16 also covers specific features of electric and air-powered hoists. These features include electrical design, controls, hoist rope, rope drum, rope sheaves, slack chain storage, power supply and grounding, direction of motion, and power failure protection.

Equipment used with hoists can also affect a safety program. Related equipment: a host of slings and other below-the-hook devices.

A sound safety program also stresses proper inspection, testing, maintenance, and use of hoists.