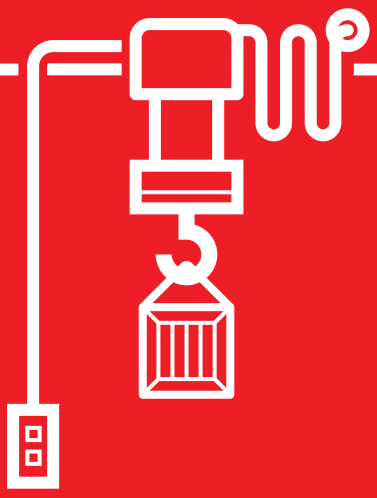

OVERHEAD

CRANE AND HOIST SERVICE

A GUIDE TO UPGRADES AND MODERNIZATIONS

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INTRODUCTION

Welcome and thank you for downloading our Guide to Overhead Crane Upgrades and Modernizations!

The service life of an overhead crane system can span decades if it was properly engineered, installed, and maintained throughout its lifetime. However, it can be frustrating to feel like you're stuck with an expensive piece of equipment that has become unreliable, unsafe, and outdated as your production needs have changed or your business has grown.

Fortunately, engineering advancements and modern technologies can extend the life of an overhead crane that no longer works efficiently or doesn't meet the production or safety requirements for which it is currently operating under.

Newer technologies now allow for:

- Automated drives to control the speed and motion of the crane
- Remote monitoring and diagnostic information for components
- Collision avoidance and anti-sway technologies
- Upgraded electrification systems and remote radio controllers

If you think your crane is currently exceeding its capacity and service classification, or you know your production needs will be changing in the future, then this e-book is for you. Our goal is to help you understand why it might be time to upgrade or modernize your existing crane equipment, what new technologies and systems are available to you, what's required to upgrade your crane's capacity, and what to expect when a company comes on-site to install or modify your overhead crane equipment.

We thank you for your time and we're here to help if you have any additional questions about overhead crane service, installation, repairs, or upgrades and modernizations. Please don't hesitate to contact us at **800-664-3380 or visit www.mazzellacompanies.com/contact.**

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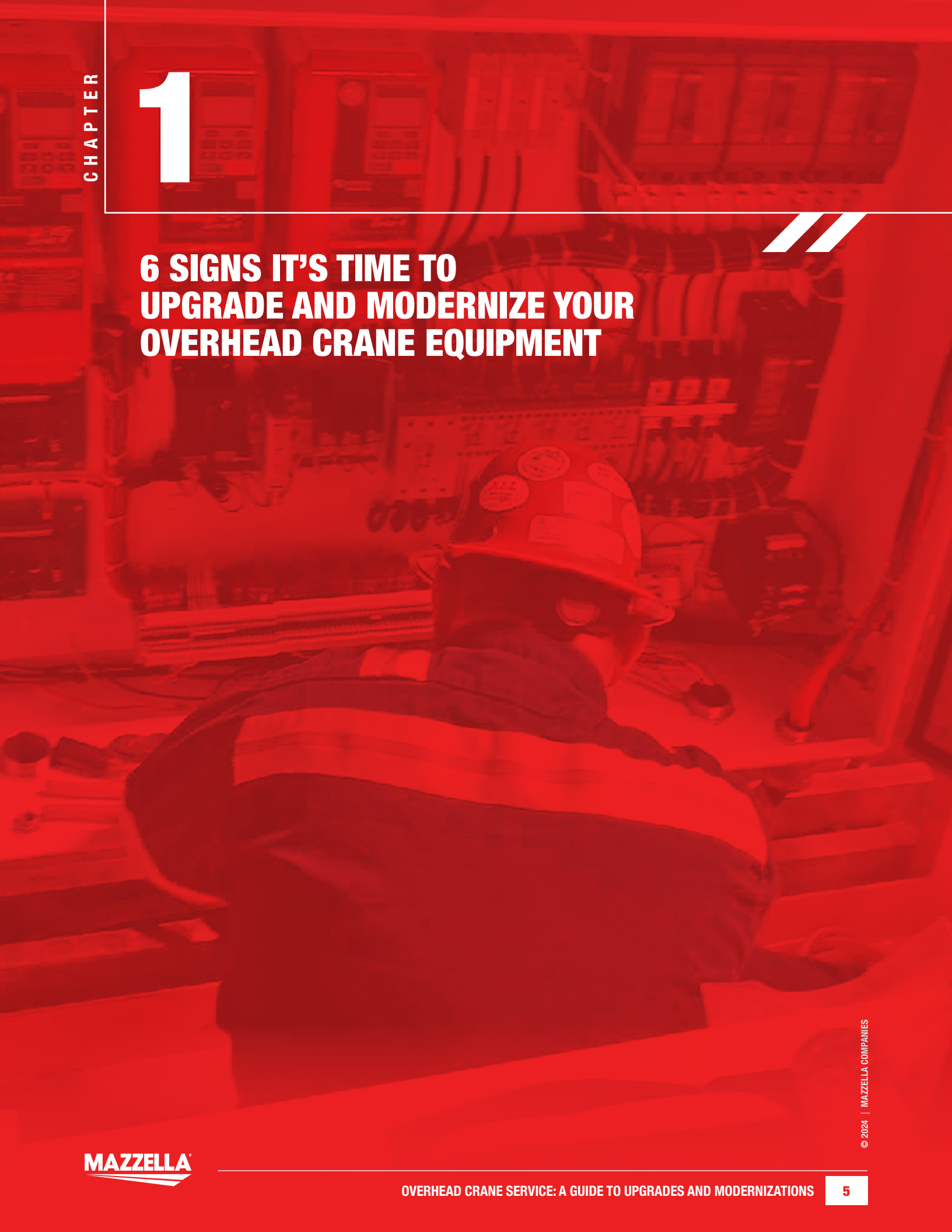
6 SIGNS IT'S TIME TO UPGRADE AND MODERNIZE YOUR OVERHEAD CRANE EQUIPMENT



6 SIGNS IT'S TIME TO UPGRADE AND MODERNIZE YOUR OVERHEAD CRANE EQUIPMENT

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Fortunately, engineering advancements and modern technologies can extend the life of an overhead crane that no longer works efficiently, or doesn't meet the production requirements for which it is currently operating under. Custom-engineered solutions can improve the production of your crane equipment with more efficient hoists and drives, updates to electrification and drive control systems, and so much more.

WHY UPGRADE OR MODERNIZE YOUR OVERHEAD CRANE?

The major benefit of installing an overhead crane system is the lifespan that you can get once you've invested in the equipment. While the components of the crane can wear down over time and may need to be repaired or replaced, the structure of the crane itself typically has a longer lifespan than the other components. This allows you to upgrade or modernize the individual crane components as newer and more efficient technologies become available, all while continuing to utilize the main runway and girder structures in place.

So, why would you need to upgrade your overhead crane system? Let's explore some reasons that would provide the opportunity to modernize your overhead crane's components.

6 SIGNS IT'S TIME TO UPGRADE AND MODERNIZE YOUR OVERHEAD CRANE EQUIPMENT:

1. Your production or lifting requirements have changed
2. You're experiencing excessive wear or frequent repair of crane components
3. An inspection uncovered issues with the crane's equipment
4. Replacement parts are becoming difficult to find
5. You want to improve the safety and efficiency of your overhead lifts
6. You're considering purchasing a replacement overhead crane system

1 YOUR PRODUCTION OR LIFTING REQUIREMENTS HAVE CHANGED

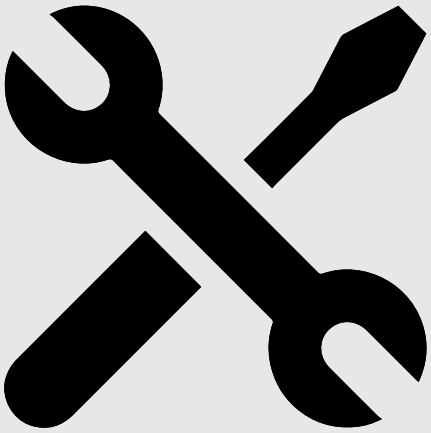
Let's say you've been reliably using your overhead crane system for years with no problems — but now your production needs have changed due to any of the following conditions:

- **Another production shift was added to the schedule**
- **You're lifting different or heavier materials**
- **You require faster speeds to perform the lifts**
- **You need more precise controls**
- **You're making more lifts per shift or using the crane more frequently**

When you originally designed your overhead crane system, each individual component including the controls, hoist, end trucks, trolley, and drive systems were specified to a specific duty cycle or crane service classification. If you now need the crane to make more frequent or heavier lifts, this can put a strain on your crane equipment if the new production demands exceed the duty cycle or service classification of the existing crane components. Over time, this leads to premature wear, or even failure of your crane components if they aren't properly inspected, serviced, and maintained.

Consider your crane's braking system. If over time, you have to keep replacing the brakes on your crane because the load it's lifting is now heavier than what the brakes were originally specified for, this puts more strain on the brakes to slow down and stop the crane's motion. This added strain begins to prematurely wear the brakes — requiring more frequent service and increases in maintenance costs. These increased costs add up over time and in the long-run, end up costing more than it would have to simply upgrade and replace the entire brake system with something more substantial.

2 YOU'RE EXPERIENCING EXCESSIVE WEAR OR FREQUENT REPAIR OF CRANE COMPONENTS



Overhead crane components that receive a lot of use may be showing signs of excessive wear, or you may be experiencing more frequent shutdowns for service or repairs. The cost of frequent repairs can add up over time versus the cost of a new replacement component — like in the brake system example we used earlier.

> ***Not only do you need to consider the cost of the service call and replacement parts, but the true costs related to shutting down your production when your crane equipment goes down.***

You have to factor in the cost of the equipment downtime, lost production costs, and lost production time for your workers. In certain manufacturing environments, the cost of downtime can be tens of thousands of dollars an hour!

Older cranes can require more maintenance and repairs. While you may find that your crane system is still structurally sound, you may want to consider modernizing or upgrading any specific components that need to be serviced or replaced frequently.

Think of it like this — if you had a work truck that constantly needed new shocks, at some point, you would decide it's more cost-effective to install a heavier-duty set of shocks and springs that will hold up to the demands of your daily driving and hauling needs.

If you find that you're replacing or repairing the same crane parts again and again, it may make sense to schedule a consultation with a professional crane technician to come in and inspect your crane equipment and make a recommendation on replacing or upgrading your equipment.

3 AN INSPECTION UNCOVERED ISSUES WITH THE CRANE'S EQUIPMENT

OSHA, ASME, and CMAA have specific guidelines for the frequency of inspections for overhead cranes. Establishing a regular inspection schedule can help to keep your crane and hoist equipment operating at top efficiency, help keep the operator and other personnel safe, and help reduce costly downtime and extend the life of the equipment.

Regular inspections also help identify signs of wear and irregularities with the whole crane system as well as with the individual components. If during the course of an inspection, you find that individual components are wearing faster than normal, you may be able to replace these with components that are stronger, have greater performance, and require less maintenance. That's the benefit of replacing a 15 to 20 year-old part with a new and modern design.

You may also find that an industry sanctioning body like OSHA, ASME, HMI, or CMAA have released an updated version of one of their standards. When it comes to wear and fatigue tolerances for individual crane components, what may have been acceptable in the past may no longer be in compliance with current safety and design standards or best practices. Modernizing your overhead crane using components that meet or exceed the latest industry standards will help ensure that you're in compliance and help keep your employees safe.

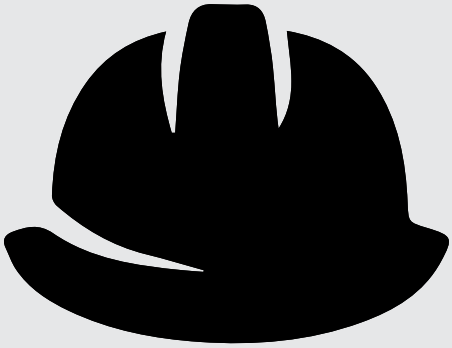
4 REPLACEMENT PARTS ARE BECOMING DIFFICULT TO FIND

As cranes age, it can become more and more difficult to find replacement parts for their individual components. The OE manufacturer may no longer be in business, may no longer have a distribution network, or the parts themselves may be obsolete. It can be difficult to source direct replacement parts for older cranes — and if you're able to find the parts, they may have extremely long lead times, and come at a steep price.

Some crane service companies can reverse engineer or rebuild parts for older crane systems, but this can also lead to higher costs and longer lead times as these are most often custom-designed and one-off builds.

Under certain circumstances, the easiest and most cost-effective solution is to upgrade or modernize your crane's broken or worn-down parts. Not only do you get the benefit of a brand new component and modern design, but you know that if it needs to be serviced or replaced down the road it will be easier and more economical to find replacement parts.

5 YOU WANT TO IMPROVE THE SAFETY AND EFFICIENCY OF YOUR OVERHEAD LIFTS



Today, most businesses with an older crane are replacing and modernizing their crane's control systems and replacing the operator cab with push button pendant or remote radio controls.

While not as popular today, open or enclosed operator cabs were standard on most crane systems. The operator sat in a cab that was attached to the bridge of the crane and relied on other personnel on the floor to provide signals and direction to help them lift, lower, and maneuver the crane's hook to safely move a load through a facility. By moving the operator to the ground, you can reduce the number of personnel required to move and operate the crane — and in most instances, the operator can load, move, and unload the crane without assistance.

The most important reason that companies are converting to pendant or radio controls? Safety. The operator has a much clearer vantage point from the ground to identify and react to obstacles, personnel, and hazards while the crane moves through the bay.

6 YOU'RE CONSIDERING PURCHASING A REPLACEMENT OVERHEAD CRANE SYSTEM

If your overhead crane system has become a maintenance headache or is no longer a reliable piece of equipment, it can be easy to cave-in to the idea of buying a completely new crane system. While the idea of a brand new system can be attractive, it may not be a cost-effective solution. You can still modernize one or multiple component systems on an overhead crane at a fraction of the cost of a completely new overhead crane.

> ***If the cost of your crane upgrade or modernization exceeds 65% of the cost of an overhead crane, then it may make more financial sense to go with a completely new replacement system.***

If your crane equipment is older, you should consider the return on your original investment. You've most likely paid off, or are close to paying off, the cost of the initial investment. Like we mentioned earlier—very rarely do you find that the actual structural components of the crane need to be replaced.

Also, an overhead crane upgrade or modernization can be scheduled in phases to spread out the cost of the upgrades, as well as cause less disruption and downtime that can affect your business' production and manufacturing output. Consider how long your production could be down if you had to replace the entire structural, mechanical, and electrical pieces of your crane system.

Most crane upgrades consist of upgrades or modernization to the crane's electrical or mechanical systems. Due to the cost and transportation of the material, the crane's support structure (including the runways, supports, and girders) can be the single most expensive component of an overhead crane system.

We typically recommend that you price out the cost of modernizing or upgrading your overhead crane and weigh that versus the cost of an upgrade. **If the cost of your crane upgrade or modernization exceeds 65% of the cost of an overhead crane, then it may make more financial sense to go with a completely new replacement system.**

WHAT PARTS OF AN OVERHEAD CRANE SYSTEM CAN BE UPGRADED?

Overhead crane modernization can be as simple as replacing one component, or replacing multiple component systems. A lot of crane owners will take an “a-la-carte” approach and invest in the upgrade and replacement of multiple components of an aging crane system.

In this section, we’ll discuss the different components of an overhead crane that can be upgraded and also discuss their benefits to the efficiency and capabilities of the crane system.

CRANE CONTROL SYSTEMS

For newer style cranes, there is an added safety bonus when converting from pendant to radio controls. Radio controls operate wirelessly using a transmitter and receiver and don't require the operator to be tethered to the crane like a pendant system does. This allows the operator to work away from the load, and also away from other obstacles or trip hazards as the crane moves down the bay.

Modern-style radio controls also offer diagnostics and monitoring (off-site or on-site). Crane operators and production personnel can now use mobile devices, tablets, workstation computers, or an operator's "belly box" to view real-time diagnostic data, including:

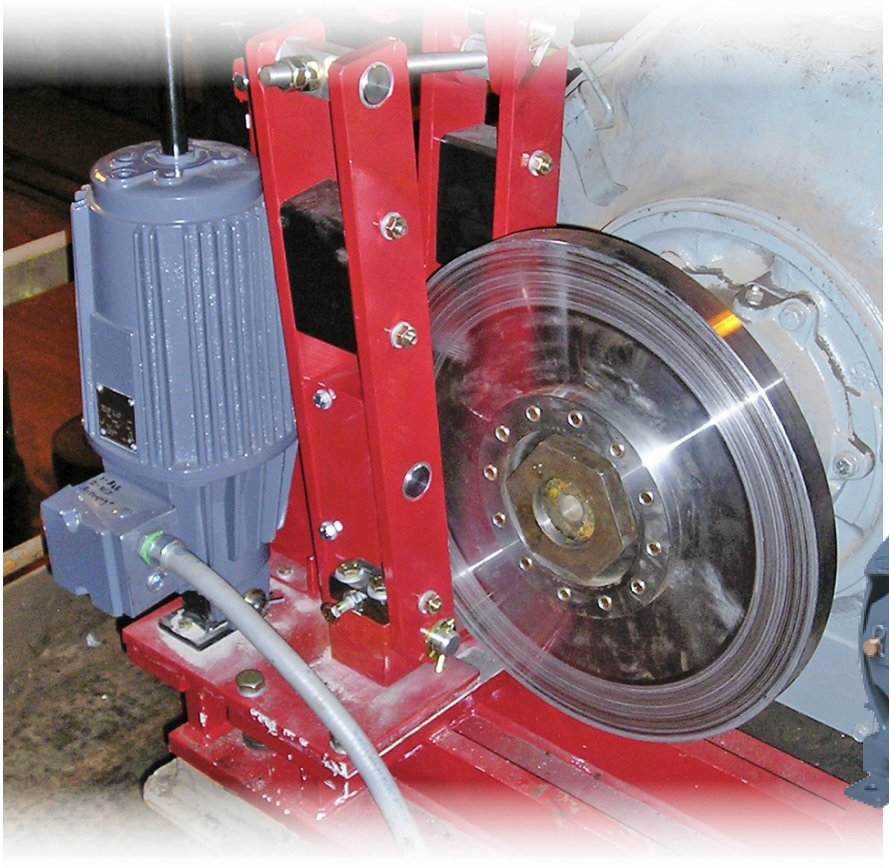
- **Fault codes**
- **Number of lifts and cycles that the drives have made**
- **Capacity of lifts**
- **Maintenance requirements for certain components**
- **AMP draw and voltage**

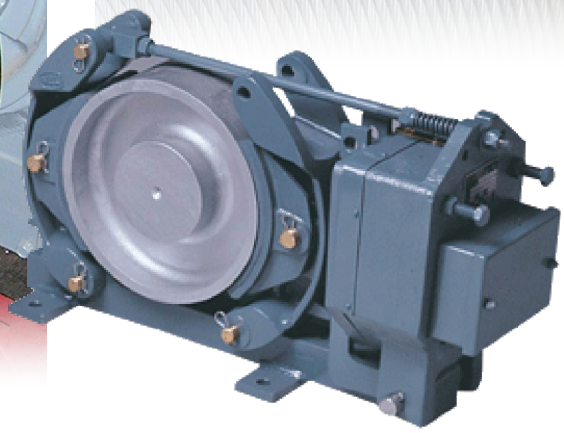
For many years, the drive controls on overhead cranes were commonly single-speed, two-speed, or fixed-speed designs. These types of drives can be rough on the brakes, gear boxes, couplers, and girders on the crane because the starting and stopping of the crane can be abrupt.

With the introduction of variable frequency drives, microprocessors now control all the components of the drive system, and provide smoother acceleration and deceleration curves. This allows for smooth starts, smooth transitions, and smooth stopping. This greatly reduces the strain on the gear boxes, couplers, girders, and the brakes because the microprocessor controls and slows down the motor, while the brakes mostly act as a control to keep the crane from moving. Also, by eliminating the abrupt starting and stopping of the crane, you get far less load swing because the crane moves in a controlled manner — making it safer for everyone on the floor.

BRAKE SYSTEMS

Like many other components of an overhead crane, it can be difficult to source replacement parts for a crane's brake system.





Overhead cranes with older brake systems also miss out on the benefits of newer technologies like wear sensors and auto-adjust features. Auto-adjust features make sure the brake is always in proper adjustment, and don't require maintenance or service personnel to manually and repeatedly adjust the brakes. This results in equal wear on the brake pads and less wear and tear on the moving components.

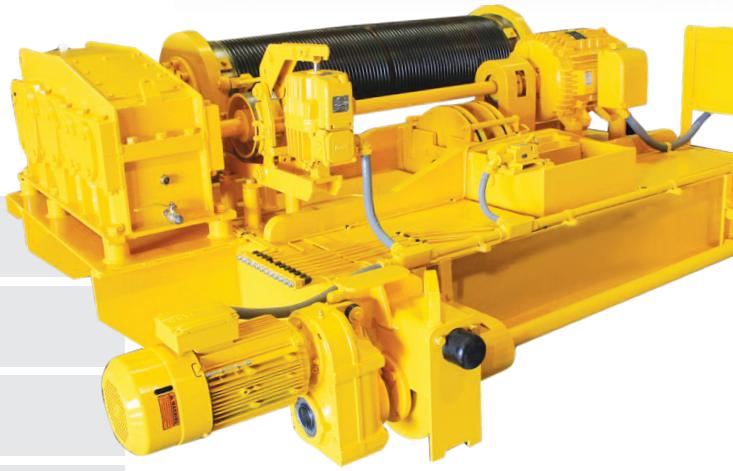
If you choose to upgrade your crane's brake system at the same time that you add variable frequency drive controls, you can greatly reduce the wear and tear and maintenance on your brake system. Having a microprocessor control the motor and slow the crane's motion versus using the brakes to slow down the crane, can prolong the life of the brake system.

HOIST, TROLLEY, AND GEAR BOX

Most often, an overhead crane's hoist is considered an age-related replacement. If you've been using the same hoist for a while and the gear box has become worn, it may be time to swap out to a newer model.

Over time, it can become harder and harder to get replacement parts for the hoists and gear boxes. Even a model that's 10-15 years old may have parts that are now obsolete or hard to track down. Sourcing these hoist components can become expensive as the price may jump up if the parts are hard to come by. It can also lead to costly production downtime if there are long lead times on getting the parts you need replaced or reverse-engineered.

A change in production needs can also require you to replace the hoist on your overhead crane. If you're adding a new production shift, or starting to make heavier or more frequent lifts during the course of a day, you may need to upgrade to a hoist that meets the proper duty and service specifications. This ensures that your new hoist is designed and built to withstand the rigors of the job you'll be performing.



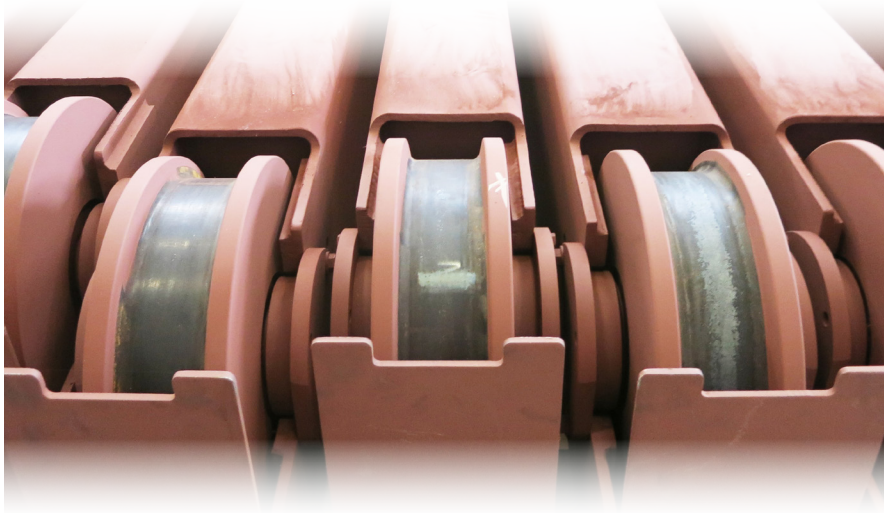
HMI / ASME has five duty cycle classifications for electric hoists that take the following into consideration:

- **Average operating time per day**
- **Load spectrum**
- **Starts per hour**
- **Operating periods**
- **Equipment life**

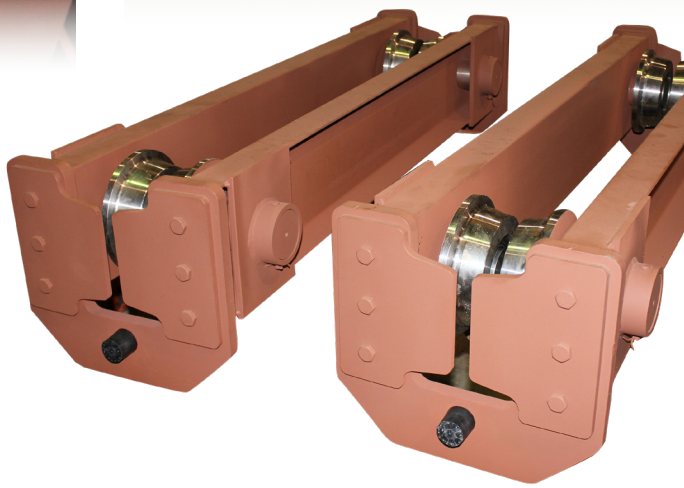
Gear boxes also have the longest lead time for replacement gears and internal components. Most styles of overhead crane gear boxes aren't commercially available, so individual components are repaired or replaced. There also aren't a lot of repair or rebuild kits readily available — especially for the heavy-duty and higher end boxes. Manufacturing or reverse-engineering of these gears and components can take a long time due to machining and heat-treating of the components for strength and durability.

END TRUCKS AND WHEELS

One of the most common problems with overhead cranes is uneven and excessive wear to the end truck wheels. The wheels on an overhead crane will naturally wear down due to normal use and may require more frequent maintenance, replacement, and adjustment than other components. However, a crane that is out of alignment or is moving loads outside of the capacities and service classes that it was designed for, will put extra stresses on the end truck and wheels as it moves down the runway.



You can upgrade to wheels made of a harder material that is best suited for the application and for the hardness of the rail itself. A wheel that is harder than the hardness of the rail will begin to cause excessive wear to the rail or beam itself, so make sure that the wheels were made specifically for the rail they're running on.



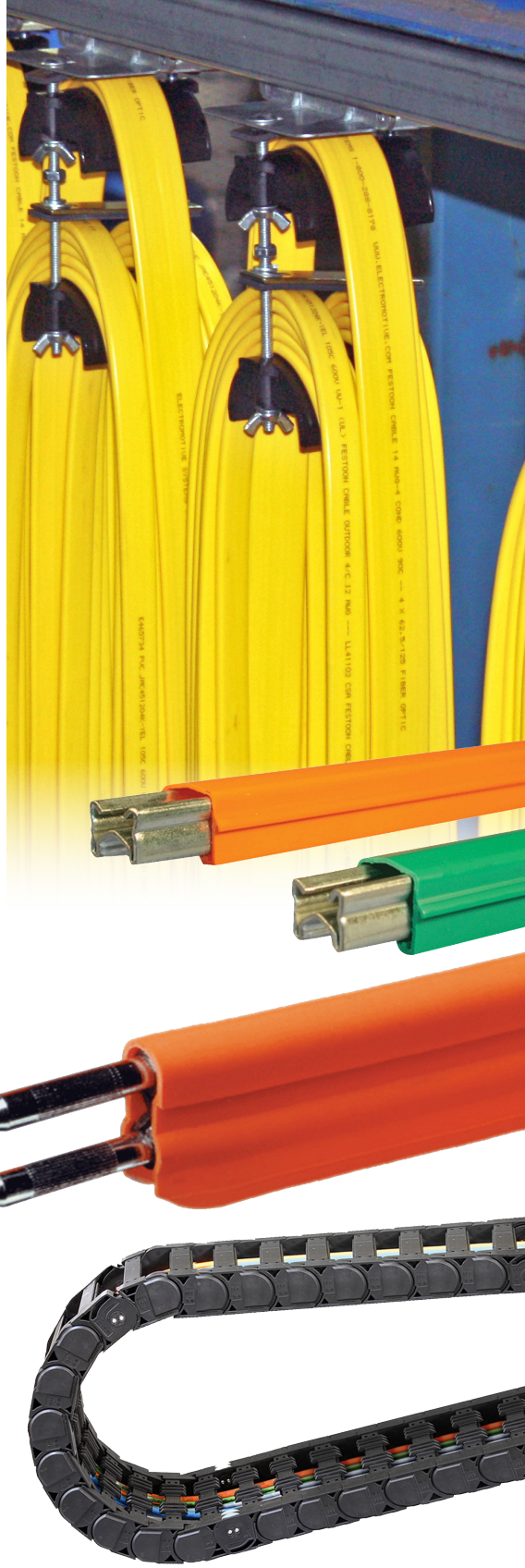
The majority of crane wheels are made from high-carbon steel, but can also be made of polyurethane, alloys, cast steel, and medium-carbon steel. Carbon steels will increase the hardness of the wheel, and heat-treating can also be used to increase the hardness as well.

As wheels and end trucks age, it can become more difficult to get older style bearings or cast wheel replacements — your best bet may be to upgrade the entire end truck itself. You can also choose to modernize your crane's end trucks or wheels when you upgrade the drives, couplings, controls, or electrification. Often times you can immediately increase the efficiency and performance of your crane by upgrading and combining multiple systems — especially as it relates to the drives and controls.

ELECTRIFICATION SYSTEMS

An overhead crane's electrical system can cause more downtime than anything else. Loose or broken wires, shorts in the electrical connections, and blown fuses all require service calls that will result in equipment and production downtime.

You should also be aware that if you're currently running 3-bar conductors to power your crane system, the bridge and trolley wheel contact with their tracks is not permitted to be used as a reliable grounding and bonding connection, and you are not in compliance with NEC Article 610.61.



The original electrical systems on older cranes weren't really engineered or designed at all. In a lot of instances, uninsulated and bare copper wiring was run loose with the only goal being to provide power to the crane. Over time, your main control panel could look like a rats' nest of tangled and unmarked wires as a result of different service technicians digging through and trying to patch together a fix.

When you upgrade an older crane's electrification system, you get the added benefit of a higher efficiency system, which can translate into energy cost-savings. You may also save money when it comes time to file your taxes, as a new electrical system in your crane equipment could translate into an energy credit.

Upgrading to a newer electrical system comes with inherent safety features. All new wiring is insulated or shielded and it should be routed cleanly with clear markings or indicators during the installation process.

With the addition of a modernized electrical system, you also prolong the life and increase the efficiency and reliability of your other electrical components — including the control systems, drives, and other structural and mechanical devices of your overhead crane.

STRUCTURAL AND RUNWAY COMPONENTS

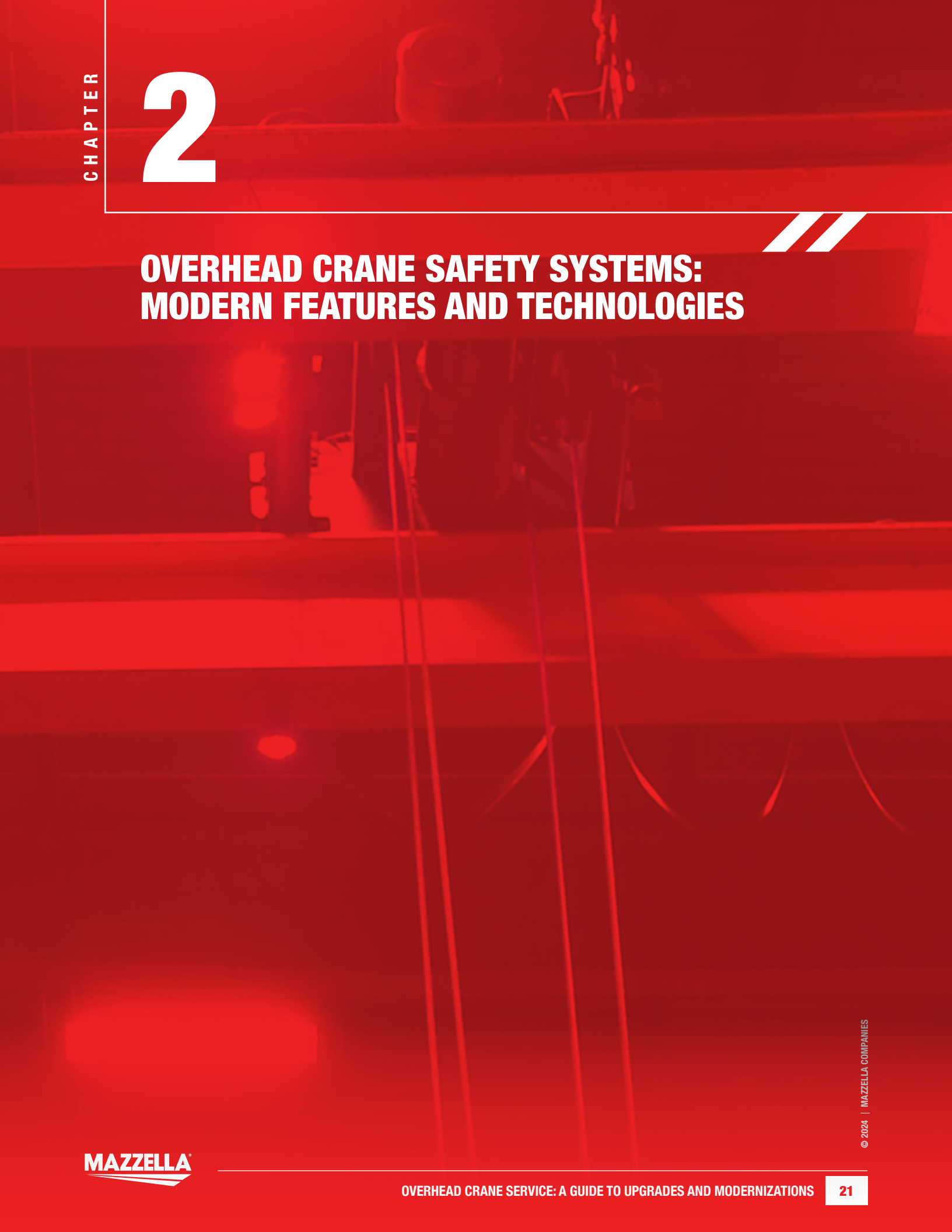
Structural components on an overhead crane can be replaced if necessary, but when designed and installed properly, can far exceed the life span of other crane and electrical components.

Replacing or upgrading the runways, girders, or tie-back supports can be one of the most expensive projects you may go through. A process like this requires an engineering team to come on-site to provide a structural survey and foundation assessment of your building and flooring. You should also have a reliability survey conducted on your overhead crane to see how much life is left in the components of the crane and of the structural support.

At this point, you'll have to do a thorough cost-benefit analysis of what it will cost to replace cracked, bent, warped, or corroded runway or bridge beams (plus any other components that have reached the end of their effective productiveness) vs. the cost of a new overhead crane system.

CHAPTER 2

OVERHEAD CRANE SAFETY SYSTEMS: MODERN FEATURES AND TECHNOLOGIES



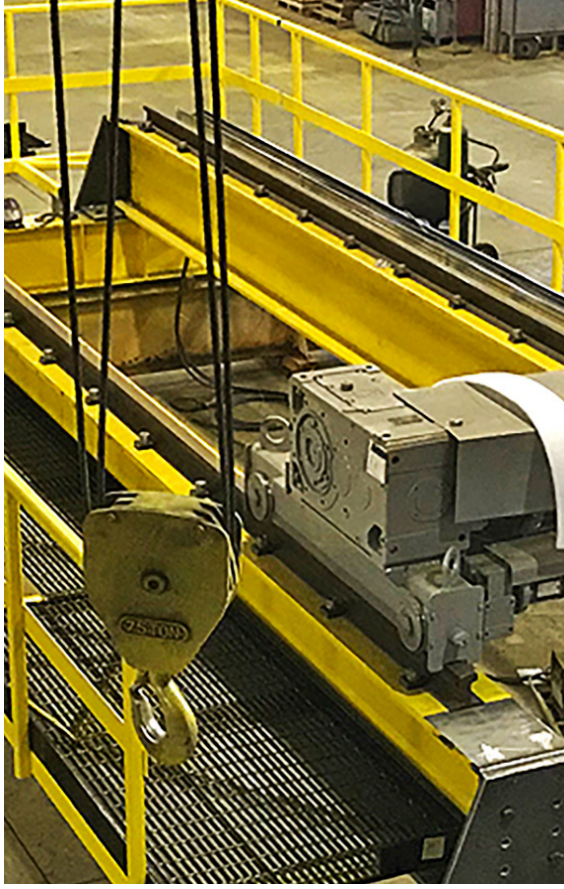
OVERHEAD CRANE SAFETY SYSTEMS: MODERN FEATURES AND TECHNOLOGIES

Whether you're considering upgrading or modernizing your older crane system, or you're designing the specifications for a new overhead crane system, your number one goal should be to improve the safety of the overhead crane equipment and production processes at your facility.

With modern technologies becoming more readily available and more affordable, the safety features available for overhead crane systems have never been better. Newer technologies now allow for:

- **Remote monitoring and diagnostic information for individual components**
- **Automated drives to control the speed and motion of the crane**
- **Radio controls**
- **Collision avoidance systems**
- **Overload sensors and read-outs**

Modernizations provide you with the option of transforming components of your existing crane equipment instead of a full replacement. In this article, we'll walk you through some of the modern technologies that are available to help improve the safety, performance, and reliability of your overhead crane equipment.

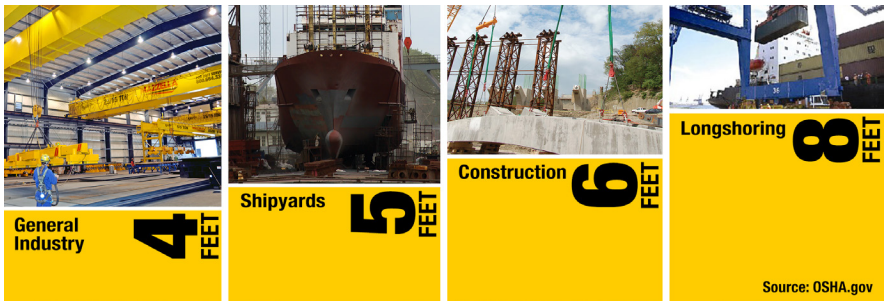


WHAT TYPE OF EQUIPMENT OR SYSTEMS ARE AVAILABLE FOR OVERHEAD CRANE SAFETY?

FALL RESTRAINT, LIFELINES, AND WALKWAYS

OSHA states that Fall Protection is the #1 most frequently cited violation and they've established industry specific requirements *(OSHA 1926.501 – Duty to Have Fall Protection)* to reduce the risk that comes with employees who are working at height.

You may be surprised to learn that you can be cited for failing to use fall protection equipment at working heights of as little as 4-8 feet. See below for industry-specific guidelines:



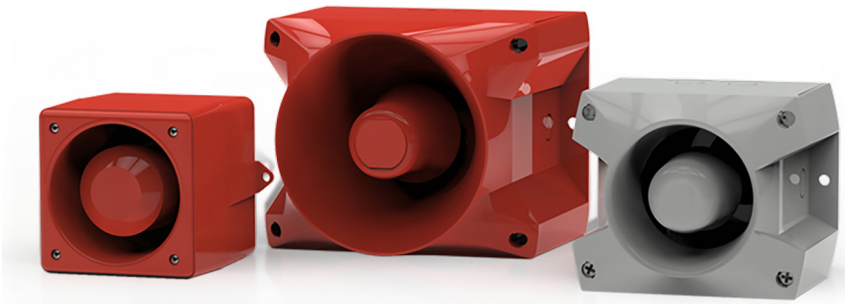
Fortunately, compliance in fall protection is increasing and reaching the board rooms of many corporate executives — in part, because enforcement of mandatory training in fall protection started in May of 2017. If employers are not providing training on fall protection to their employees that are working at height, they can be cited for it.

Many business owners are looking to add fall restraints and engineered lifeline systems to existing overhead crane equipment, and are having it included in the specifications for new crane equipment being installed in their facility. Any operator or maintenance personnel working at heights, or performing service or inspections from a lift, should have some form of fall protection — whether it's a lifeline system engineered into the design of the crane itself, or lanyards or harnesses available to them.

Crane walkways can also be designed for higher capacity cranes to provide maintenance personnel with a place to safely tie-off and service or inspect their crane. Walkways can also be designed with kick plates to prevent items or tools from falling off the edge onto workers below.

BUZZERS, HORNS, AND SIRENS

Per *OSHA 1910.179*, cranes equipped with radio controls or cab controls are required to have buzzers, horns, or sirens to provide an audible warning to other personnel while the crane or loads are in motion. These can be added in addition to a warning light for personnel on the ground who may not be able to see the crane's warning lights.

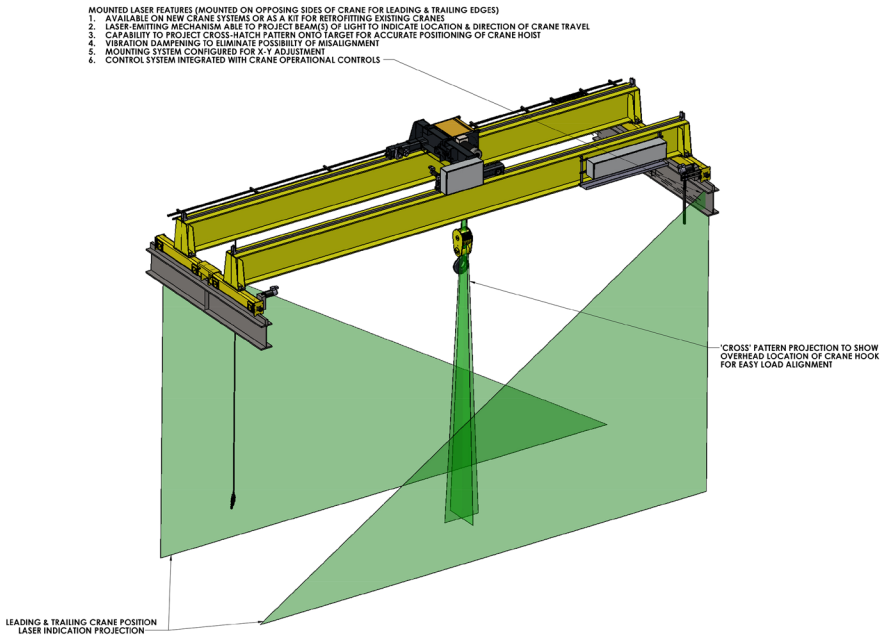


In addition to the OSHA requirements, you should familiarize yourself with your state and local codes for audible warning device requirements. Some states like Michigan and California require the use of audible warning devices for any crane in motion — regardless of what control method the crane is using.

WARNING LIGHTS AND INDICATOR LIGHTS

Warning lights and indicator lights can be built into the design of an overhead crane to provide personnel on the ground with an idea of where the crane bridge is overhead and where the hook will be. These lights are automatically on when the crane equipment is turned on and running — helping to reduce accidents and operator error.

OSHA 29 CFR 1910.179 requires the use of warning lights for any cab-operated overhead crane.



These bright red, blue, or white lights are mounted on the bridge or hoist of the crane and project directly onto the ground using lasers, LED lights, or a combination of both. The warning lights don't take the place of audible alarms, but provide an additional visual warning to pedestrian and motorized traffic in the immediate vicinity of the crane. These lights can illuminate an area of up to 20 feet from approaching hooks and crane equipment in operation.

Operators can also use these lights as a reference tool to help them position the hoist and hook to make their picks or position a load.

VARIABLE FREQUENCY DRIVES AND ANTI-SWAY TECHNOLOGIES

With the introduction of variable frequency drives, microprocessors control all the components of the drive system, and provide smoother acceleration and deceleration curves. This allows for smooth starts, smooth transitions, and smooth stopping — which greatly reduces the strain on the gear boxes, couplers, girders, and other essential crane components. This also prolongs the life of the brake system as the microprocessor controls and slows down the motor, while the brakes mostly act as a control to keep the crane from moving.

Also, by eliminating the abrupt starting and stopping of the crane, you get far less load swing because the crane moves in a controlled manner — making it safer for everyone on the floor.

Columbus McKinnon highlights some of the inherent safety features built into most VFD systems:

SAFE TORQUE OFF – A redundant hardware safety circuit that guarantees motor and brake power are removed when an E-STOP switch or safety controller opens the drive input, eliminating the need for external disconnects.

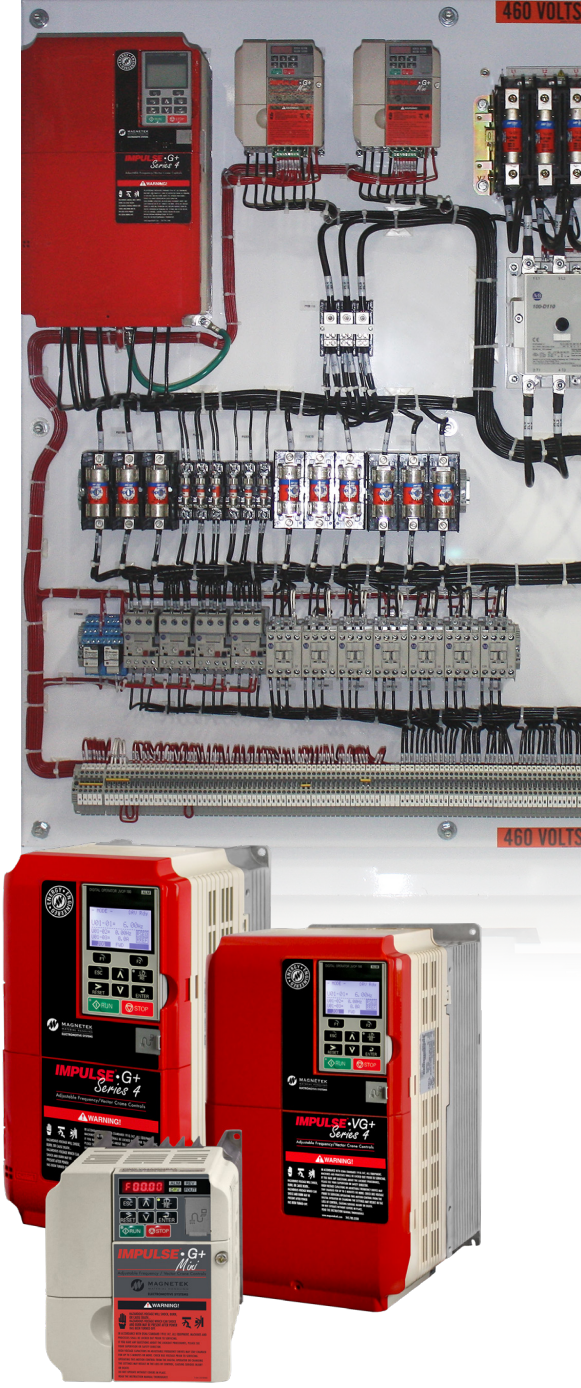
TORQUE PROVING – On some older systems, the motor is pre-torqued to guarantee that the load can be held before opening the brake.

LOAD CHECK – Continuously checks for hoist overloads and prevents the hoist from lifting when an overload condition is detected.

BRAKE CHECKS – Monitors the opening and closing of a brake to ensure that it is safe and healthy.

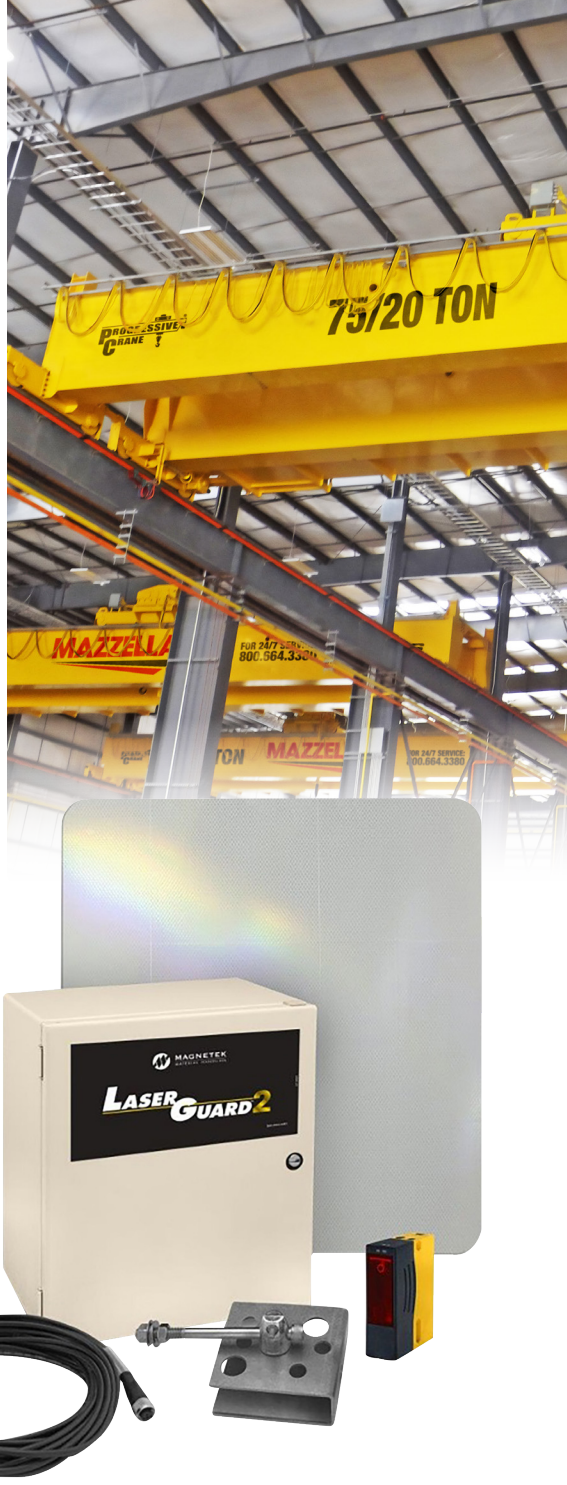
MICRO-SPEED – Allows the operator to make slow, precise movements.

ELECTRONIC PROGRAMMABLE LIMIT SWITCHES – Allows slow down and stop limits without physically geared limit switches.



COLLISION AVOIDANCE SYSTEMS

As the demand for workplace safety grows, collision avoidance systems have become popular as an automated way to control the motion of the crane to avoid accidents and collisions. Anti-collision technologies are becoming more common in facilities that are operating multiple cranes on one runway, have multiple runway systems in place, or have cranes operating in areas where there may be other obstacles or obstructions that can block the movement of the crane.



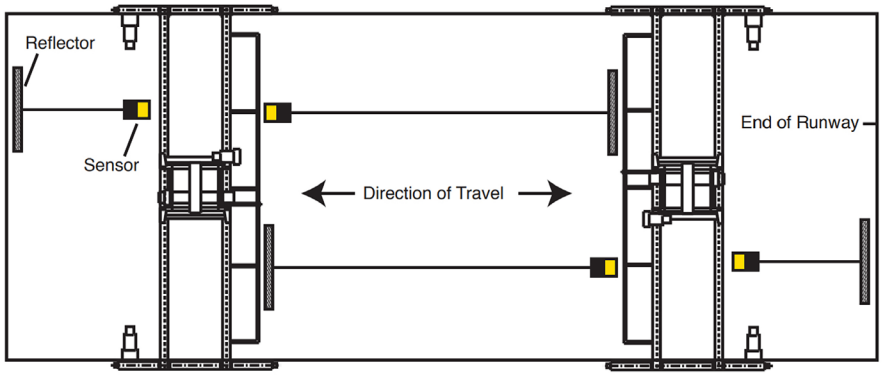
Collision avoidance systems use wired or wireless transmitters that emit radio waves, lasers, LED, or infrared light signals to transmit information to stationary receivers. These receivers process the signal from the transmitting device and use that information to determine the location of the trolley and bridge within the facility and identify obstacles or obstructions it could encounter. The system can then slow or stop the motion of the crane or trolley if it determines there is a possibility for a collision. This helps prevent unintentional contact of the crane or trolley with mechanical end stops and other crane or monorail equipment in operation.

Another benefit of collision avoidance systems is they can be used to help prevent overloading of a runway system that multiple cranes are operating on. Keeping cranes far enough apart, whether they're carrying a load or not, will help prevent undue stress and overloading on certain parts of the runway beams and supports.

SLOW DOWN AND STOP LIMIT SWITCHES

Limit switches can be used for a variety of motion controls on an overhead crane. Multiple limit switches can be used in sequence to slow down and stop the travel of an overhead crane's bridge, hoist, or hook block before it makes hard contact with something that could cause load swing.

As the crane approaches the end of its safe travel limit, an electrical or mechanical switch will trigger and begin to slow down the hoist motion or travel of the bridge. If the hoist or bridge continue to travel, they will activate a stop switch which will immediately stop the motion altogether before it hits an end stop.

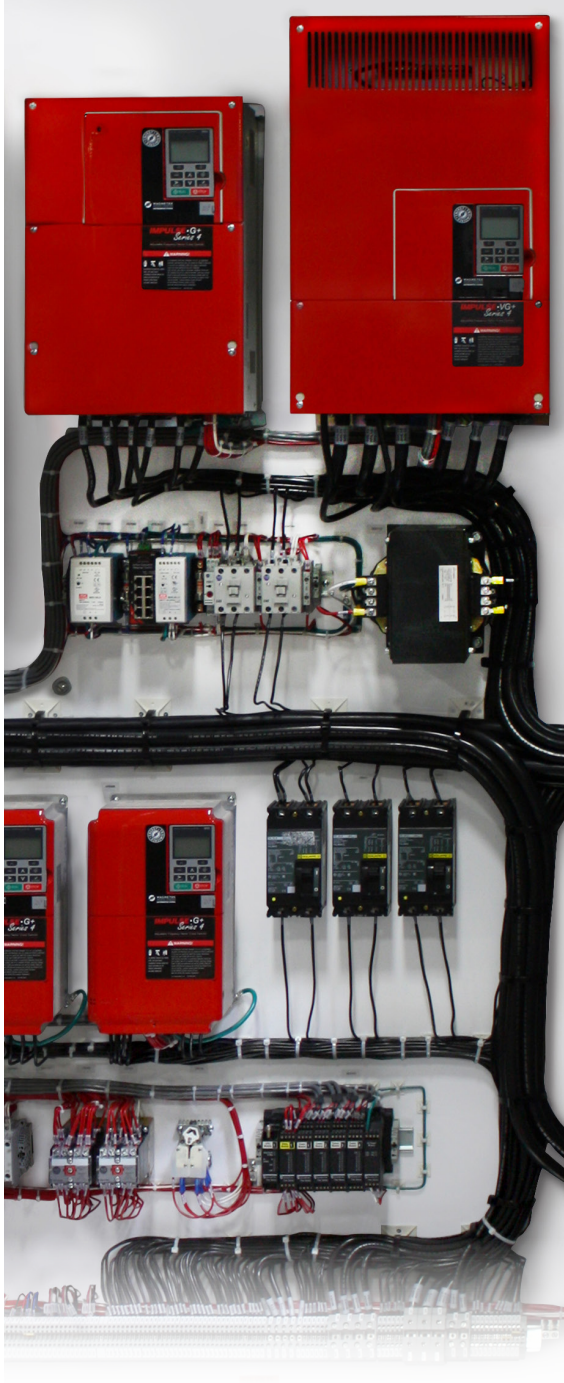


There can also be multiple limits set for the lifting and lowering motions of the hoist. When triggered, limit switches on a hoist can manage all of the following:

Slowing and stopping motions to reduce mechanical wear on the hoist

The speed and the height of the lifting or lowering motion to prevent load swing

Provide a final safeguard to prevent the hoist block from making contact with the floor or the drum, which can cause the load to swing violently and even break the wire rope



REMOTE RADIO CONTROLS

A wireless remote transmitter with a series of buttons or levers is either held by the operator or is clipped onto a harness or belt worn by the operator. The remote transmitter sends a radio signal to a receiver unit mounted on the crane. This unit transforms the signal into electrical energy and passes it on to the intermediate relay unit on the crane, and the appropriate contact is activated to then move the crane up and down the runway, move the hoist or trolley side to side, and raise or lower the hook.

The main advantage of using radio controls for an overhead crane is that it eliminates the dependence on being tethered to the crane itself — either via cab controls or pendant controls. Because the operator doesn't have to be near the load to lift, position, or lower it, radio controls can help protect them from hazards like:

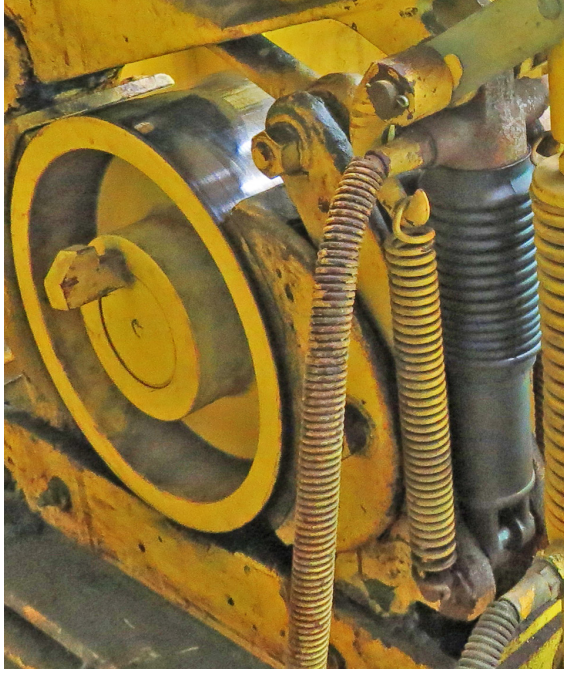
- **Vapor, smoke, or chemical exposure**
- **Radiation**
- **High heat or hot metals**
- **High voltage or electric shock**
- **High humidity**

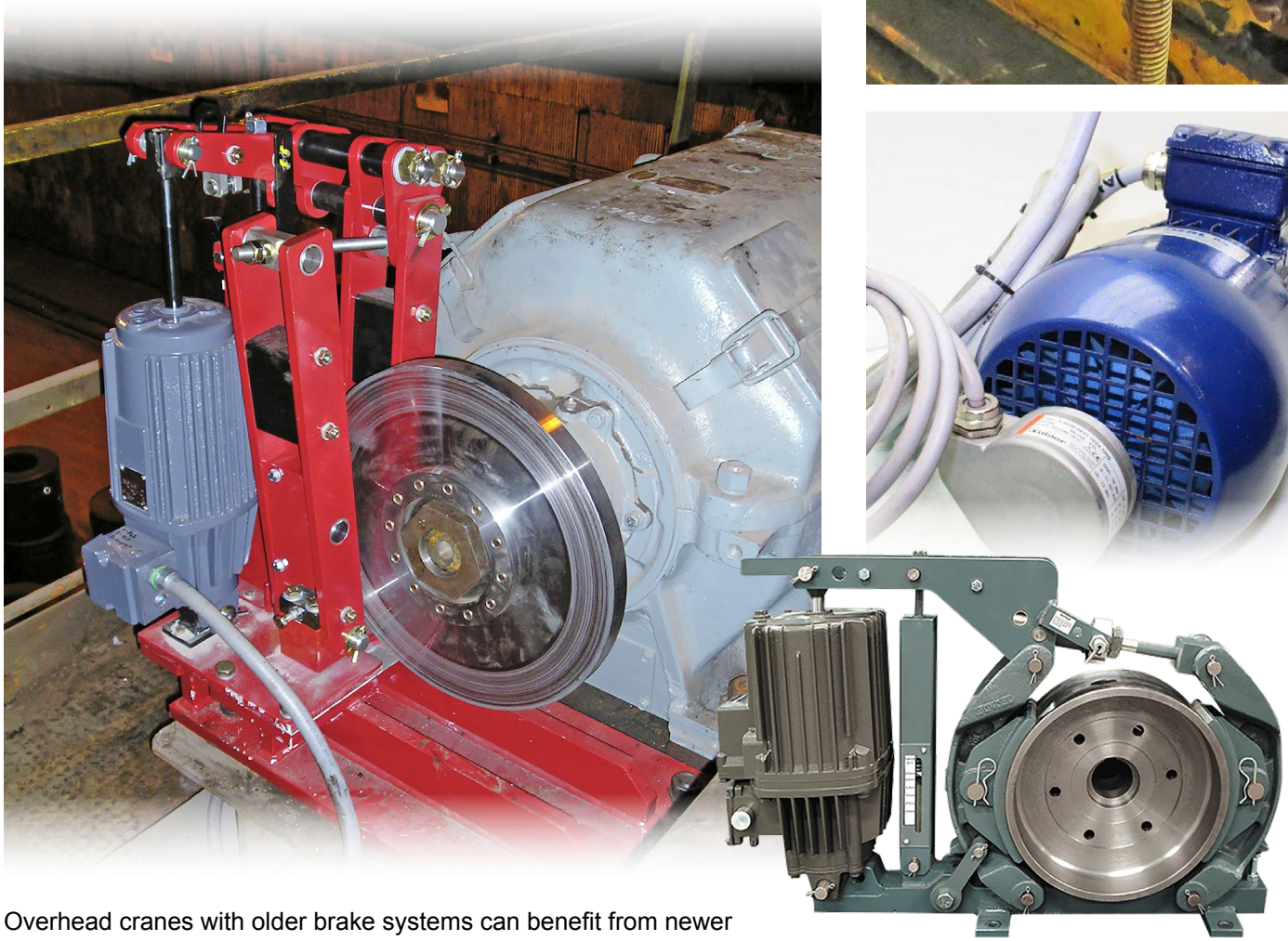
Not only can the operator work on the floor safely away from hazards, but they'll also get a better vantage point to perform the lifts effectively. The operator doesn't necessarily have to walk with the load as it moves down the crane bay, so radio controls help keep the operator away from trip or fall hazards like obstacles on the floor, workers, and other machinery or equipment in operation. They're also ideal for higher duty classes like D, E, or F where the crane runs up and down the runways more often, and at a faster rate.

Productivity can also be improved with better visibility — helping with faster load positioning and damage control as the operator can better judge load and clearance obstacles from the ground.

BRAKE-SLIP DETECTION

If you choose to upgrade your crane's brake system at the same time that you add variable frequency drive controls, you can greatly reduce the wear and tear and maintenance on your brake system. Having a microprocessor control the motor and slow the crane's motion versus using the brakes to slow down the crane, can prolong the life of the brake system.





Overhead cranes with older brake systems can benefit from newer technologies like wear sensors and auto-adjust features. Auto-adjust features make sure the brake is always in proper adjustment, and doesn't require maintenance or service personnel to manually and repeatedly adjust the brakes. This results in equal wear on the brake pads and less wear and tear on the moving components. When the sensors detect anything out of the predetermined variance, they can inform maintenance personnel when brake adjustment is needed.

MONITORING AND DIAGNOSTICS

Cranes equipped with variable frequency drives or modern-style radio controls have the ability to provide diagnostics and monitoring of overhead crane equipment — either on the equipment itself or to users in a remote location.

Operators and production or maintenance personnel can use a radio or belly box, mobile device, tablet, or workstation computer to view real-time diagnostic data, including:

- **Number of lifts and cycles that the drives have made**
- **Fault codes**
- **Capacity of lifts**
- **Maintenance requirements and intervals for individual components**

Maintenance personnel can monitor the time between recommended maintenance intervals for individual components and also use it as a tool to schedule preventative maintenance to help reduce equipment downtime. For example, by monitoring the predictable preventative maintenance schedule of a crane's hoist, they can help improve the crane's safety by knowing when the hoist has reached the end of its useful life. This allows them to determine if they should either rebuild the internal components or replace it with an entirely new unit.

This diagnostic information also helps maintenance personnel troubleshoot problems with overhead crane equipment, and gives others the ability to remotely access the data and troubleshoot for more complex issues or specialized problems.

MONITORING AND DIAGNOSTICS (CONTINUED)

Another advantage to having a monitoring and diagnostics system is that the crane can alert the operator, safety managers, or other designated personnel if it has been overloaded. An overload occurs when a lift exceeds the crane's rated capacity. Overloads are prohibited according to OSHA and ASME B30 standards, and can stress and damage the crane equipment — putting nearby employees in danger if the crane were to fail.

If the crane is making a lift near, at, or in excess of a calibrated capacity, the drive system can send a read-out to end-users through a variety of methods, including:

- **Displaying on the operator's radio control or belly box**
- **Displaying on pendant stations equipped with an LED read-out**
- **Displaying on the crane itself, so the operator can read the load the crane is lifting**
- **Sending it to a remote laptop or workstation**

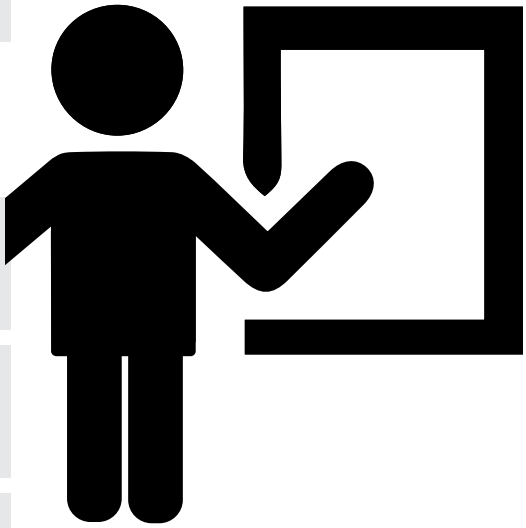
There are also more basic ways to determine if you're overloading a crane's capacity, including installing a load cell sensor that measures the tension force on the hoist's wire rope. When the load exceeds a pre-determined percentage of the rated capacity (usually 100-125%), the overload device temporarily stops the hoist so that the only further action the crane can perform is to lower the load.

CRANE OPERATOR TRAINING

Ultimately, providing training for your overhead crane operators is the most important thing you can do to make your overhead lifting program safer. A 30-year old crane with single or dual speed drives can be operated just as safely as a brand new crane with variable frequency drives and a collision avoidance system. It doesn't matter how many bells and whistles you add to an overhead crane system if the operators haven't been trained on how to run it safely.

THE CMAA CRANE OPERATOR'S MANUAL CLEARLY STATES:

> ***"It is the responsibility of the owner of the Crane to make personnel aware of all federal, state and local rules, codes, and plant safety rules and regulations and instructions, and to make certain operators are properly trained."***

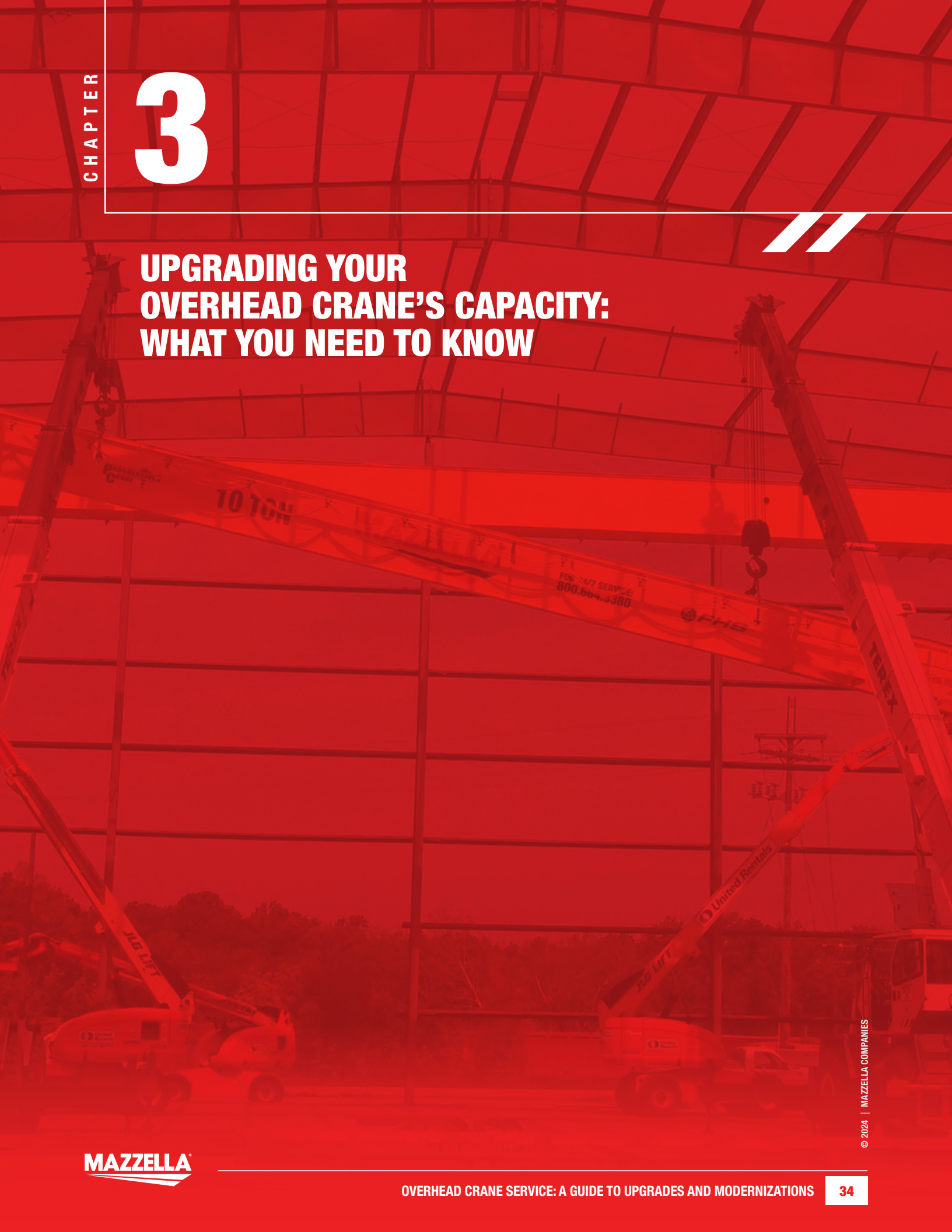


AS THE OWNER OF THE CRANE EQUIPMENT, IT'S UP TO YOU TO ARRANGE FOR THE FOLLOWING:

- **Have your operators trained by a Qualified Person (per ASME and CMAA)**
- **Determine the frequency of training your operators receive**
- **Have your overhead crane inspected to OSHA, ASME, and CMAA standards**

CHAPTER 3

UPGRADING YOUR OVERHEAD CRANE'S CAPACITY: WHAT YOU NEED TO KNOW



UPGRADING YOUR OVERHEAD CRANE'S CAPACITY: WHAT YOU NEED TO KNOW

Partner with a reputable and experienced crane service provider to determine if an upgrade to the capacity of your overhead crane equipment is feasible, and put an action plan together.

One of the biggest benefits of an overhead crane system is the ability to modernize or upgrade the individual components of the crane without having to replace the entire system. An overhead crane can be upgraded to meet modern safety and efficiency standards, but it can also be upgraded to a higher capacity if your company's production or processes have changed.

It can be much more cost-effective to upgrade and modify the capacity of an existing crane in your facility than to buy an entirely new crane system. If you think your crane is currently exceeding its capacity and service classification, or you know your production needs will be changing in the future, contact a reputable crane service provider to schedule a consultation or feasibility study. This will help to determine if your crane's mechanical, electrical, and structural components are capable of being upgraded to meet your new lifting or usage requirements.

WHY WOULD YOU NEED TO UPGRADE AN OVERHEAD CRANE'S CAPACITY?

Upgrading an overhead crane's capacity comes down to one thing: Something has changed in your manufacturing or production processes. That change can be related to a number of different things, including:

LIFTING A NEW TYPE OF MATERIAL – Are you now lifting a new type of material that requires the use of a below-the-hook device? How much additional weight does this device add to the total load?

LIFTING A HEAVIER TYPE OF MATERIAL – For 10 years, you may have lifted a die that weighed 10,000 lbs. You had to replace that die and the new one you received weighs 20,000 lbs.

MAKING MORE FREQUENT LIFTS – You're now making more lifts per hour, or you added a second or third production shift — meaning the crane is being used more times per day.

Any of these changes can create additional wear and tear on the individual components of your overhead crane system. Making more frequent or heavier lifts can put a strain on your crane equipment if the demands of the new process exceed the duty cycle or crane service classification that they were originally designed for.

Over time, this can lead to premature wear or even failure of the crane components. Costs related to service calls to repair or replace individual components can add up and eventually exceed the cost of an upgrade.

Often times, the customer is aware that they're exceeding the capabilities of their crane and will reach out to their crane service provider to see what can be done to help extend the crane's operating life. Other times, the service provider may make the recommendation to consider an upgrade or modernization to help protect against frequent repairs or shutdowns.

WHAT TYPES OF OVERHEAD CRANES CAN BE UPGRADED?

When it comes to truly upgrading the capacity of an overhead crane, we're really talking about:

Workstation cranes are typically package systems that have specialized components specifically engineered to work together — all the way down to the connection points and individual bolts. You typically can't upgrade a workstation crane's capacity — you would need to do a total replacement with a different type of system. You can add additional track to a workstation system, or swap out the hoist, but that's about it.

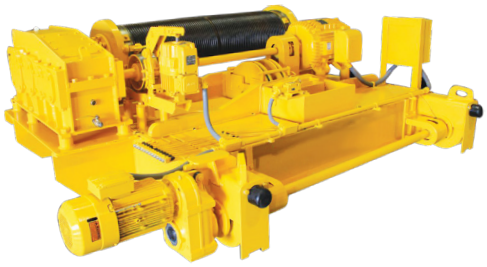
Jib cranes are engineered to a very specific capacity, and if that capacity needs to be increased, it will be a complete replacement. Wall or column-mounted jib cranes are engineered for a specific support style that has its own load rating. In order to upgrade the jib, you'd also have to increase the load rating or reinforce the support that it's mounted to.

WHAT COMPONENTS OF THE CRANE NEED TO BE UPGRADED?

The most important thing you can do is have a feasibility study performed by a third-party Professional Engineer (P.E.). A P.E. can evaluate your entire crane system and determine if and how your crane's productivity and reliability can be increased through a capacity upgrade. The P.E. will also provide a recommendation of what mechanical and structural components will need to be upgraded.

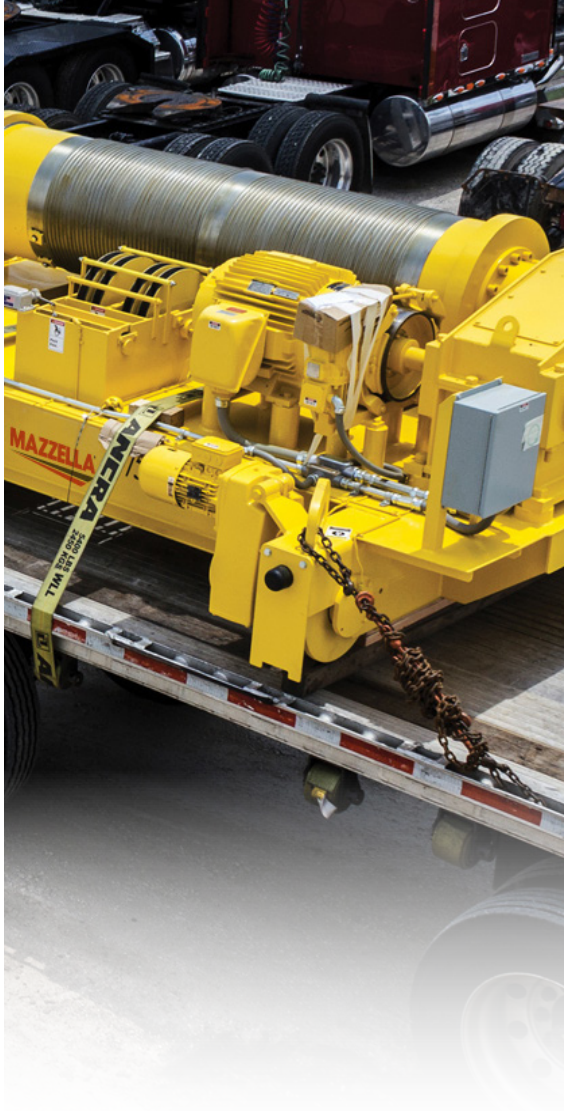
Next, we'll take a look at what components are typically upgraded when you increase your crane's capacity, and what that might entail.

HOIST

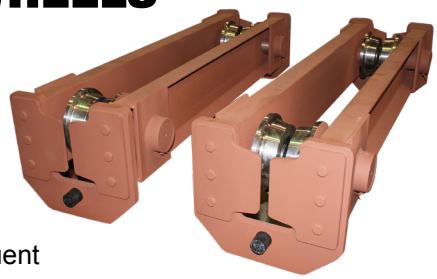


If your crane is equipped with a built-up hoist, then a lot of the internal components can be swapped out or interchanged without having to completely remove and replace your existing hoist and trolley. The internals were originally specified to meet application-specific requirements, so if you upgrade your crane's capacity, the internal components including the gear sets and motor will need to be swapped out with more substantial parts. It's possible that an upgrade to the wire rope reeving system could be recommended as well.

For lower-duty electric or pneumatic hoists, these systems come as a complete system and would need to be swapped out and replaced with a heavier-duty hoist package and re-installed.



END TRUCKS AND WHEELS



One of the most common problems with overhead cranes is uneven and excessive wear to the end truck wheels. The wheels on an overhead crane will naturally wear down due to normal use and may require more frequent maintenance, replacement, and adjustment than other components. However, a crane that is out of alignment or is moving loads outside of the capacities and service classes that it was designed for, will put extra stresses on the end truck and wheels as it moves down the runway.

You can upgrade to wheels made of a harder material that is better suited for the application and for the hardness of the rail itself. A wheel that is harder than the hardness of the rail will begin to cause excessive wear to the rail or beam itself, so make sure that the wheels were made specifically for the rail they're running on, but can also handle the added load.

The bearings can also be upgraded with an anti-friction design to reduce wear while increasing productivity demands.

BRIDGE, RUNWAYS, AND STRUCTURE

During the feasibility study, a P.E. or structural engineer can help determine what type of reinforcements may be required to strengthen the existing bridge and runway girders in order to support the new wheel loads. The beams themselves may need to be reinforced by adding a cap channel, or you may have to have specially-engineered plating designed and installed to allow the existing bridge and runway beams to handle the new loads being applied to the crane system and supports.

At the same time, the P.E. can make a recommendation on any changes that should be made to the bridge motor, bridge gearbox, and bridge braking systems.

When you think structure, most people always think about the building and the runways and bridge beams, but overlook the foundation. A foundation survey should also be performed to ensure that the foundation and flooring of the building can support the crane's new load requirements. A third-party surveyor should be brought in to assess the foundation and issue a report to the customer and the installer before any work begins.

CONTROLS

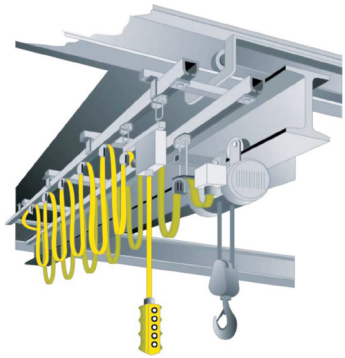
When the work of the motor changes, the drive system changes as well. Any changes to gear sets or motor size will require changes to the crane's drive system and controls as well.

Adding in a modern control system, like a variable frequency drive, can provide smoother acceleration and deceleration controls — which eliminates abrupt starts and stops and helps prevent load sway. Smoother starts and stops, and less load swing all help prevent everyday wear and tear on your crane equipment.

Modern-style radio controls also offer diagnostics and monitoring (off-site or on-site). Crane operators and production personnel can use mobile devices, tablets, workstation computers, or an operator's "belly box" to view real-time diagnostic data, including:

- **Fault codes**
- **Number of lifts and cycles that the drives have made**
- **Capacity of lifts**
- **Maintenance requirements for certain components**
- **Amp draw and voltage**

ELECTRIFICATION

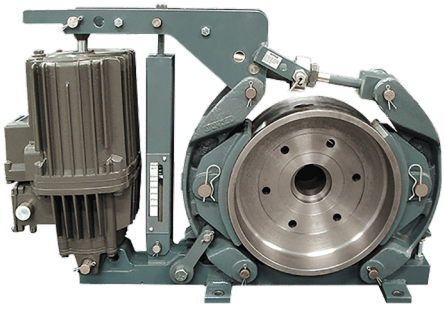


When you increase the capacity of an overhead crane, you're also increasing the overall amperage draw. You can upgrade the size of the wiring in the crane's electrification system to accommodate the higher amperage, and also upgrade the size of the electrification. Different and/or higher capacity festoon cabling can be installed, or the conductor bar system can be removed and replaced with a higher amperage system.

If the new amperage requirements exceed the existing requirements in place, then a new disconnect equipped to handle higher amperage will be required to safely disconnect power from the crane equipment in the event of an emergency — per *OSHA 1910.179(g)(3)(i)*.

Any other upgrades or changes to the electrical system, to accommodate the additional amperage resulting from the upgrade, must be made by the customer. This will allow the installers and service team to properly power up and test the equipment once the upgrade is complete.

BRAKE SYSTEMS



If you choose to upgrade your crane's brake system at the same time that you add variable frequency drive controls, you can greatly reduce the wear and tear and maintenance on your brake system — especially if the crane is lifting and moving loads heavier than the original brakes were specified for. Having a microprocessor control the motor and slow the crane's motion versus using the brakes to slow down the crane, can prolong the life of the crane's brake system.

WHAT TYPE OF TESTING AND TRAINING IS REQUIRED AFTER THE UPGRADE?

Once the upgrade work has been completed, the crane will need to be started up and load-tested to make sure everything is in working order. A third-party testing company may be brought in to perform the test and ensure that the crane will operate safely and productively.

Per *OSHA 1910.179 Overhead & Gantry Cranes Regulations*, your new crane system will need to have two operational tests, plus a rated load test performed prior to initial use:

Testing of the hoist operation up and down; trolley travel; bridge travel; limit switches; and locking and safety devices.

Testing of the trip setting of the hoist limit switches to make sure the actuating mechanism of the limit switch is functioning properly.

Load test the crane at no more than 125% of the rated load and keep test reports on file where readily accessible.

The weight for load tests must be “known,” so the load testing of the crane can be performed using a certified weight from a load-testing company, or the known weight of a variety of materials including concrete, steel, or water weight bags.

In most cases, any type of operator training that the customer wants after the upgrade is complete will be written into the specifications of the project. Training could be as simple as showing one operator how to use the new features of the crane, or it could be a 2 to 3 day class involving multiple operators and other production and maintenance personnel.

WHAT TYPE OF TESTING AND TRAINING IS REQUIRED AFTER THE UPGRADE? (CONTINUED)

During the training, the operators will be shown how to use the new features of their crane equipment, including:

- **Using new remote radio or pendant controls**
- **Troubleshooting fault codes**
- **Stopping and starting the crane with new VFD technology or anti-sway controls**
- **Precision tuning the drives to the preference of the operator(s)**
- **Demonstrating how to properly inspect and maintain the new equipment**

There can be a learning curve for operators to get used to the new crane equipment once the capacity has been upgraded. It could even be weeks or months before they're 100% used to the new operating characteristics of their crane.

Operators may be used to letting off of a lever or button on the controls and the crane starts or stops immediately. A new drive system builds in time for controlled acceleration and deceleration, so the crane may still travel an additional 5 to 10 feet once the operator lets off of the controls. The goal for most crane upgrades and modernizations is to prevent load swing, so adding in acceleration and deceleration controls can take some time to get used to. In the long run, it will significantly decrease the wear and tear on the motors, drives, brakes, and structural components of the overhead crane equipment.

HOW LONG DOES IT TAKE TO UPGRADE AN OVERHEAD CRANE'S CAPACITY?

Depending on the scope of the project and how many cranes are scheduled to be upgraded, it can take anywhere from 5 to 20 working days to upgrade an overhead crane system. Most crane service companies prefer to do the upgrade Monday through Friday during regular business hours. Upgrades can be performed at night, on weekends, or during a holiday break, but pricing will be subject to overtime rates.

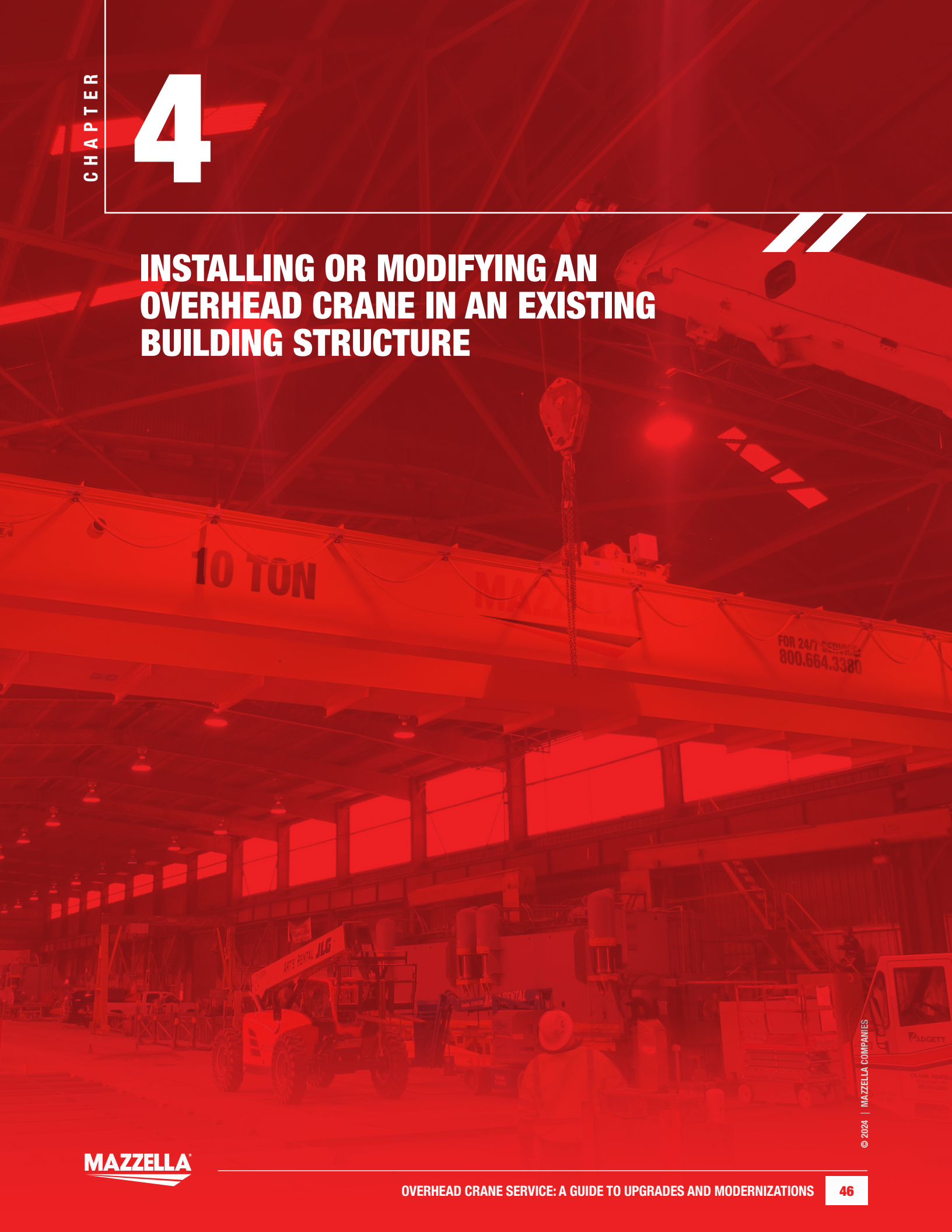
During the upgrade, the crane equipment and any other equipment or machinery operating nearby should be shut down with the customer understanding it is not to be used, whatsoever, while the upgrade is being performed. This protects the service techs and installers, as well as any of the customer's employees working nearby.

Most customers will schedule their upgrade during a planned production shutdown so it doesn't interfere with the bottom line. They can plan accordingly to make sure machinery and equipment won't be operating nearby, the crane won't be in use, and extra employees and other personnel won't be working nearby.

CHAPTER

4

INSTALLING OR MODIFYING AN OVERHEAD CRANE IN AN EXISTING BUILDING STRUCTURE

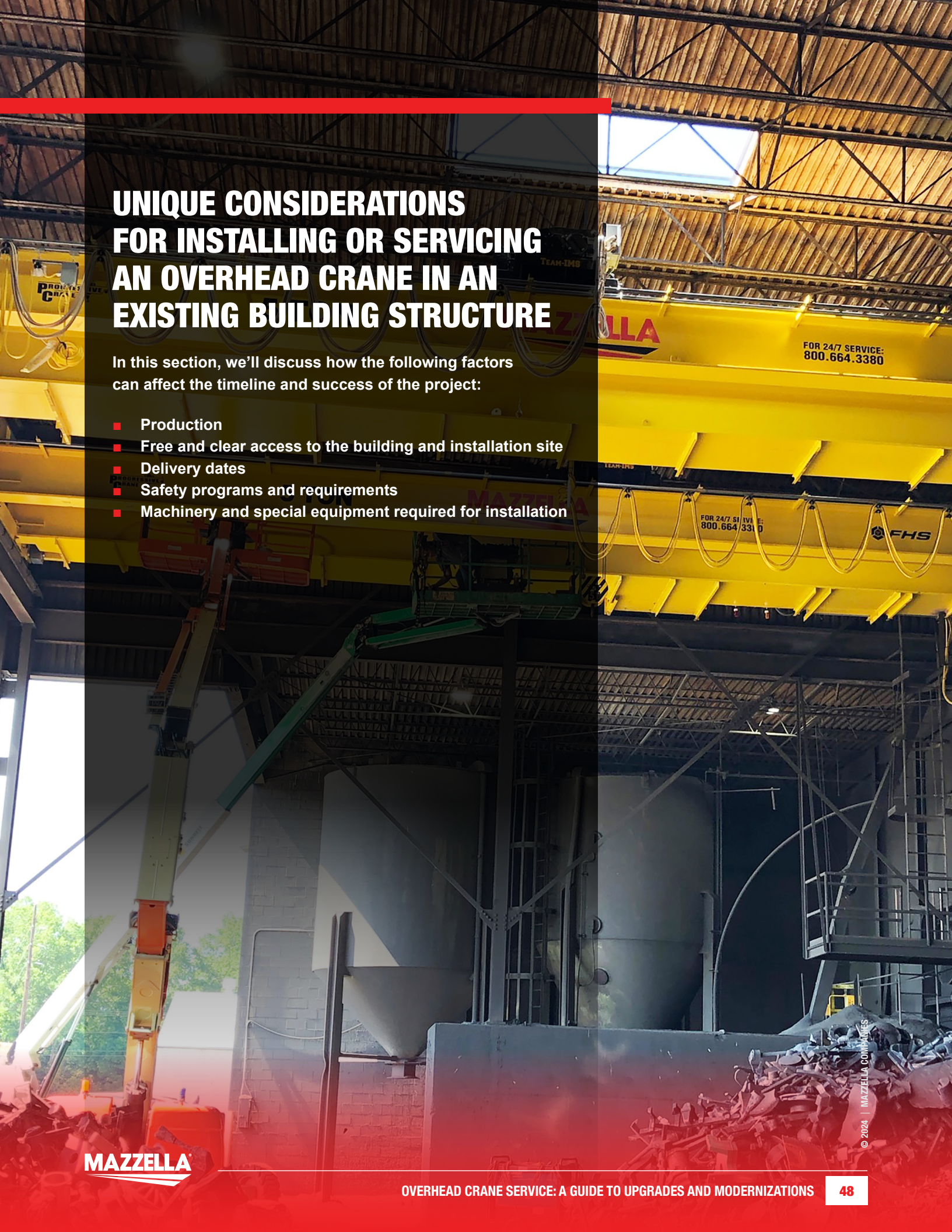


INSTALLING OR MODIFYING AN OVERHEAD CRANE IN AN EXISTING BUILDING STRUCTURE

A reputable and experienced overhead crane service team can work with you to design or modify an overhead crane that meets your lifting requirements and fits in your existing building structure.

When it comes down to it, installing an overhead crane system into an existing building structure is a completely different process than installing a crane into a new construction facility. With a new construction installation, the building's support structure, layout, plumbing, electrical / lighting, HVAC and duct work can all be designed so that they don't interfere with the installation and operation of an overhead crane. The installation window can be more flexible because you don't have to worry about affecting production.

Unfortunately, most crane installs and modifications don't occur in a brand new facility with a flexible installation timeframe and a blank slate to design and build the structure around the crane itself. In most cases, the design and engineering team has to retrofit an overhead crane and its support structure into a space that wasn't originally designed for a crane system. To further complicate things, production is already up and running with employees moving about and machinery and other equipment in operation — all creating obstacles for getting installation equipment and materials into the building.



UNIQUE CONSIDERATIONS FOR INSTALLING OR SERVICING AN OVERHEAD CRANE IN AN EXISTING BUILDING STRUCTURE

In this section, we'll discuss how the following factors can affect the timeline and success of the project:

- Production
- Free and clear access to the building and installation site
- Delivery dates
- Safety programs and requirements
- Machinery and special equipment required for installation

PRODUCTION

If you ask any overhead crane service provider, the most important consideration for installing or servicing an overhead crane comes down to production.

> ***The customer's Production and Operations teams absolutely need to be on-board with the agreed-upon service window and time frame.***

Because the crane is being installed or worked on in a facility where production is already operational, the work will typically be scheduled during a total or partial production shutdown. It's ideal for the service team to not have to worry about other machinery or equipment that might be running, or to have to worry about employees being near or in the area where the technicians will be working. This increases the efficiency of the work being performed and also the safety for both the installers and the customer's employees.

However, it's understandable that not all customers are willing to totally shut down their production. To prevent any disruption in production, service companies can be flexible and schedule installations or modifications during weekends, 2nd or 3rd shifts, or during holiday breaks. These time frames typically come at a higher rate than the standard hourly rate because the techs are working non-traditional hours and may have to run continual shifts to complete the work during the desired time frame.

FREE AND CLEAR ACCESS TO THE BUILDING AND INSTALLATION SITE

Prior to the work, service techs will visit the customer's facility and perform a Job Site Overview (JSO). During their visit, they may rope off or mark the area where the overhead crane system will be worked on and they'll also get an understanding of the building layout. Most importantly, they need to come away with an understanding of where and how they can bring their trucks and equipment into the facility — including access to doorways and ramps that they can utilize.

Will the equipment and machinery need to travel through areas where production is running? Will production be shut down? Is the work being performed in a part of the building that isn't in use yet? The service team needs a clear understanding of what obstacles or machinery they need to maneuver around and what employees, if any, will be working in those areas, so they can develop an action plan.

During the JSO, they also need to have an understanding of the load requirements for certain parts of the building, including:

- **Structural support beams**
- **Roofing**
- **Foundation and flooring (concrete, dirt, gravel, etc.)**
- **Any existing runway structures**

These load surveys need to be performed by a third-party civil or structural engineer and are the responsibility of the customer to coordinate and facilitate prior to the work being performed.

DELIVERY DATES

During the project quotation process, the Project Manager or Sales Engineer will work with their team to determine how quickly they can source the components, get them ordered, and have them delivered based on the customer's specifications. The biggest contributing factor to whether the work can be performed during the customer's preferred timeline is how quickly the main components — including the hoist, trolley, and end trucks — can get approved and how fast the supplier can ship them. The crane service company can work with their vendors to expedite or rush delivery, but those expedited fees will get passed on to the customer.

SAFETY PROGRAMS AND REQUIREMENTS

Some facilities require contractors and vendors to have site-specific safety training, perform a background check, take drug tests, or have certified operator cards to use forklifts or manlifts. If your job site has these requirements, make sure the service techs are aware so any unplanned delays don't affect the timing and cost of the work being performed. In some cases, like where a background check is required, this process needs to be started several weeks in advance to ensure completion before the work begins.

MACHINERY AND SPECIAL EQUIPMENT REQUIREMENTS

Overhead crane service providers typically bring their own equipment, or rental equipment, on-site for an installation, but can use a customer's generators, welding equipment, manlifts, Lull material lifts, or forklifts if it presents a cost-savings opportunity to the customer. However, if an agreement is reached where the service team will use the customer's equipment, the installers require exclusive use and the customer will have to agree to forfeit use of the equipment for the duration of the work being performed.

Each job is unique and requires its own set of equipment and machinery to lift the runway beams, bridge girders, and hoist up into the air and into their final position.

Often times, the materials required for installation need to be lifted up and over existing equipment on the production floor, lowered down into a pit, or raised up into a mezzanine. In some extreme cases, we've even cut a small hole into the roof to allow the hook block to drop through the opening to achieve greater lifting headroom.

Some of the pieces of equipment that may be required, include:

- **Carry deck cranes**
- **Mobile cranes with operators**
- **Existing overhead cranes in the facility**
- **Man lifts — boom lifts and scissor lifts**
- **Lull material handlers**
- **Versa Lifts / Tri-Lifters**
- **Ladders and scaffolding**

Another thing to keep in mind is that you'll need to reserve an area on your property where the installers can stage their equipment when not in use. They'll need a place to park flatbeds and trailers, as well as keep their mobile cranes, scissor lifts, and the support structure beams. These can be kept on open land, in a reserved area of the parking lot, or in an empty area of the building if the entry doors and building space allows it.

WHAT STRUCTURAL CONSIDERATIONS AFFECT THE DESIGN OF THE CRANE?

A bridge crane can be supported by the roof/ceiling, a freestanding support system, or can be tied back to the existing building supports. In an existing building structure, you have to have a clear understanding of the load ratings for the roof, concrete and foundation, and existing building supports before any work can begin.

A third-party should come in to provide a structural survey — you may need independent surveys of the:

- **Concrete or flooring to determine load ratings**
- **Roof load ratings**
- **Existing structural support load ratings**

To make sure the building is structurally sound to support the work being performed, it's the customer's responsibility to have their building surveyed by a third-party, or by their own building engineers, prior to the installation.

A crane service company may be able to help coordinate the effort, but they will not perform the surveys or load ratings themselves. The results of these ratings can determine if the crane is supported from the roof, is a free-standing design, or can be tied back to existing supports.

WHAT STRUCTURAL CONSIDERATIONS AFFECT THE DESIGN OF THE CRANE? (CONTINUED)

The deadweight of the crane, or the loads on the structure which remain fixed even when the crane is not performing a lift, need to be considered. Ceiling beams, flooring, and support beams can be reinforced with internal bracing, or can be totally redesigned to spread the load between multiple points versus a single point.

Clearance space around the area of the crane will also affect the design and specifications of the work being performed. If there's low headroom in the facility, then the crane may have to be designed to be under running vs. a top running design. If the crane needs to lift material high into the air, then a top running double girder design would be ideal. If hook approach on either end of the bridge is a factor, then a single girder bridge design will allow your trolley the most travel across the bridge to take advantage of the full span of the crane system.

Lastly, the service team will need to have a clear understanding of the building's voltage supply. The customer will need to confirm whether the building is equipped with a 230V or 460V electrical supply. This voltage needs to be determined prior to ordering any components such as hoists or end trucks.

TESTING THE NEW OVERHEAD CRANE SYSTEM

Once the overhead crane installation or upgrade is complete, the service techs will test the functionality of the new overhead crane system and also perform a rated load test. *OSHA 1910.179 Overhead & Gantry Cranes Regulations* states that:

Prior to initial use, all new and altered cranes shall be tested to insure compliance with this section including the following functions:

- **Hoisting and lowering**
- **Bridge travel**
- **Trolley travel**
- **Limit switches, locking and safety devices**

The trip setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located so that it will trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.

Load testing is included with any installation or crane upgrade or modernization. Test loads shall not be less than 100%, or more than 125%, of the rated load unless otherwise recommended by the manufacturer. These test reports shall be placed on file where readily available to appointed personnel. Overhead cranes can be tested using water weights or by using loads with a known weight that are available on-site.

Lastly, once the new overhead crane equipment has been tested for proper functionality, the service provider will provide training to the operators and end-users on their new equipment. Training can range from a couple of hours to a couple of days—it all depends on the customer's requirements. Most of the time, the training requirements will be written into the project specifications, so the length and thoroughness of training will be agreed-upon prior to the work being performed.

Training can be as simple as walking one operator through the basic motion controls of the crane, or it could be more in-depth focusing on troubleshooting maintenance issues for individual components and understanding and identifying diagnostics and fault codes.

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