What is an Overhead Crane?

In the simplest of terms, an overhead crane is a machine, or piece of equipment, that allows you to lift and move heavy materials from one location to another in a precise manner. There is no "one size fits all" approach to defining an overhead crane, as each overhead crane is carefully designed and engineered for a specific purpose or application to suit a business' material handling needs.

Overhead cranes can be designed and built in all kinds of configurations, and different components can be swapped out or engineered to improve its capacity and performance.

Some of the most popular reasons for using an overhead crane include:

- Loading or unloading materials from a truck
- Moving materials around a facility more efficiently than a tow motor or manpower can
- Flipping or pulling dies in and out of stamping machines at a manufacturing facility
- Feeding raw material into a machine at a manufacturing facility
- Moving pieces or parts down an assembly line in a controlled fashion
- Moving containers around a shipyard or railyard

In addition to simplifying some of the processes described above, there are two main reasons why a company would want to install an overhead crane, or a series of overhead cranes, in their facility:

1. **Efficiency —** Overhead cranes are more efficient than using a group of workers or tow motors to lift and move material and can work up to 2-3 times faster. Think about how a manufacturer, mill, or warehouse can streamline their processes and procedures by introducing an overhead crane to automate the lifting, maneuvering, and unloading of materials at their facility.

2. **Safety —** Another advantage of installing an overhead crane in a manufacturing, assembly, orwarehousing facility. Cranes can be used to lift and move materials in extreme environments and can handle corrosive or dangerous materials like hot metals, chemicals, and heavy loads. A workstation or jib crane can be put in place to help workers move heavy objects in a controlled manner and help cut down on repetitive motion injuries and muscle strains.

Other benefits to using an overhead crane system include:

- Reduction in workplace accidents
- Reduction of product or material damage
- Improved workflow
- Lowered costs
- Green solution that reduces environmental impact

What are the Components of an Overhead Crane?

In order to get a better understanding of some terms we'll be using later when we describe the different types of overhead cranes, we'll discuss the different parts and components of a crane, and how they can affect performance and design.

Hook

The lifted load is supported using a hook which connects to the hoist.

Hoist

The hoist is what makes the lift and holds, raises, or lowers the load using wire rope or chain. Hoists can be powered manually (by hand), with electricity, or with compressed air (pneumatic).

Trolley

The trolley supports the hoist and moves horizontally along the crane bridge, to position the hoist and hook, prior to picking up or lowering a load. Trolleys can be configured in an Under Running or Top Running design:

- Under Running / Underhung — Trolley wheels run on the bottom flange of the crane beam.
- Top Running — Trolley wheels run on rails fitted to the top of the crane beam. Most frequently seen in higher-capacity double girder designs.

Bridge

A load-bearing beam that runs the width of the building. This is the primary structural component that connects the runways and moves the hoist forward and backward using a trolley.

A bridge can be comprised of one or two beams — more often referred to as a single girder or double girder design. Girders can be made of rolled steel or can be fabricated by welding the beams into a steel box design.

Runway

What the bridge crane travels on to move the crane up and down the bays. These are typically part of the building structure, as beams, and there are two (2) per overhead bridge crane system.

Runway Rail or Tracks

Rail supported by the runway on which the crane travels. Top-running cranes typically run on ASCE/railroad rails. Gantry cranes can also utilize a rail or track system installed in the floor to move the bridge back and forth.

End Trucks

Located on either side of the bridge, the end trucks move the bridge up and down the runway utilizing a series of wheels that ride on the rail. Each end truck can have a configuration of 2, 4, or 8 wheels based on the crane's capacity.

Bumpers

Bumpers are designed to absorb the crane's energy and reduce impact — bringing the crane to rest in a controlled manner and minimizing forces when the crane or trolley reaches the end of its travel. Bumpers can be attached to the bridge, trolley, or runway stop.

Controls

Controls are typically mounted in a panel on the crane or hoist and the pendant or remote radio console allows the operator to run the crane. The controls operate the drive and hoist motors, and can control Variable Frequency Drives (VFDs) to control hoist speed for precise load positioning.

Electrification

Insulated conductor bars or festoon systems (flat cables) bring power to the crane from the building.

What are the Different Types of Overhead Cranes?

Overhead cranes can vary so much in terms of specifications and configurations. No two crane builds are exactly alike! A crane that worked in a similar building structure, or similar lifting application, may not be the best crane for your facility or your application. So, selecting the right type of crane for your business is critical to maximizing efficiency, streamlining workflow, and getting the best bang for your buck.

Bridge Cranes

An overhead bridge crane can be configured in a single girder or double girder design. In simple terms, a bridge girder, or beam, is the support structure that allows the trolley and hoist to move from side-to-side along the bridge. The trolley is used to precisely position the hoist prior to raising or lowering a load.

Single Girder and Double Girder Bridge Cranes

To a degree, both single and double girder cranes are equal in strength and durability. The main difference between the two comes down to hook height, or how high above the ground your hoist can lift. A double girder crane can provide more hook height because the hoist is placed on top of the girders, instead of below them.

There are some instances where a double girder or single girder configuration may be the better option. We'll discuss some of these instances below:

Single Girder — The bridge consists of one girder beam supported on each side by an end truck. The trolley and hoist are most commonly underhung—meaning they run on the bottom flange of the bridge. They also tend to be less expensive due to:

- Only one girder is required to move the trolley
- Reduction in freight expenses
- Faster installation
- Simpler hoist and trolley design

However, in the instance that a crane needs to handle more than 15 tons, or the span is more than 65 feet, a double girder configuration may be the better option.

Double Girder — There are two girder beams that make up the bridge, and they are supported by an end truck on each side. The trolley and hoist run on a rail installed on top of the bridge girders. Double girder cranes are recommended for heavier-duty applications where the crane has to handle more than 15 tons, or the span is more than 65 feet.

Double girder cranes are the best option when the crane needs to be customized with things like walkways, cabs, magnet cable reels, or other specialized equipment. And on a top running design, they can provide more lifting height since the hoist isn't hanging underneath the beam.

Top Running Vs. Under Running Cranes

When it comes to defining clear differences between bridge cranes, you will want to consider if you require a top running or under running crane.

On a top running crane, the bridge runs on rails along the top of the runway beams.

On an under running, or underhung crane, the bridges are supported by the bottom of the runway beams and the wheels run along the bottom of the lower beam flange.

Top Running Cranes

These cranes have no limiting capacity — meaning they can be built to go from small capacities to very large capacities. They include a rail installed on top of each runway, and the bridge wheels move on the rail instead of the bottom flange of the runway beam. These cranes are supported by the building structure or runway support columns, or sister columns, and are ideal for moving extremely heavy loads.

Top running cranes can be designed in a single-girder or double-girder configuration:

Single Girder Top Running Benefits:

- Typical Load Capacity: .25 – 20 tons
- Typical Span: Under 65 feet
- Typical Service: Light
- Low deadweight
- More overhead space

High speed
- Lower production cost / lower overall price

Double Girder Top Running Benefits:

- Typical Load Capacity: 20 - 400 tons
- Typical Span — Over 65 feet
- Typical Service — Heavy
- Ideal when extremely high hook height is necessary
- Better hook height
- Most overhead space
- More lift
- High speed

Under Running Cranes

Often called "underhung," because the crane wheels are supported by the bottom flange of the crane runway beams acting as the crane rail. These types of cranes can allow you to maximize your facility's floor space for production and storage of material because they are supported from the ceiling trusses or the roof structure. Or, they can be designed to utilize an existing support structure (if adequate), or run on a newly-engineered support structure.

- Typically designed for lighter service / lower capacity applications
- It can become impractical and expensive to engineer an under running crane to make it a high-capacity piece of equipment
- Offers excellent side approaches and maximize utilization of the building's width and height when supported by roof or ceiling structures
- Hook height is less than top running because bridge and hoist hang underneath runways

Gantry Cranes

A gantry crane is similar to a bridge crane, but instead of moving on suspended runways, the crane uses legs to support the bridge, trolley, and hoist. These legs travel on rails that are embedded in, or on top of the floor or ground structure.

A gantry crane is ideal when you require a lightweight and quick knockdown crane for applications that require portability and corrosion resistance. They are also considered when there is a reason not to incorporate an overhead runway system and are most traditionally used in outdoor applications where full beams and columns can't be installed, or they can be used below an existing bridge crane system. Gantry cranes are commonly found in shipyards, railyards, special construction sites like where a bridge is being built, or in places like steel mills where overhead room may be an issue.

Gantry cranes come in a wide range of designs, including:

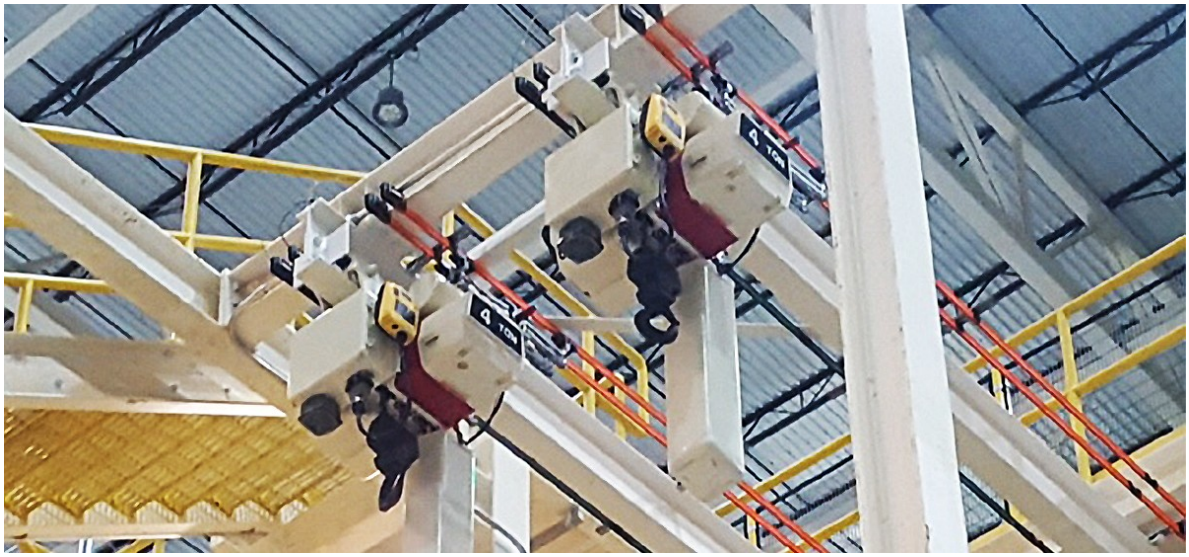
- **Adjustable Gantries —** used for warehousing applications requiring the movement of materials through aisles, doorways, around obstacles, and over or under obstructions. Welding and fabrication shops can use gantry cranes for lifting parts and equipment into position.
- **Portable Gantries —** used for plant maintenance applications requiring replacement and relocation of equipment and machinery. Service truck applications requiring quick knockdown for fast, easy movement to and from a work site.
- **Track-Mounted Gantries —** used for applications requiring lifting and moving heavy loads over a fixed route, either manually or motorized.

Moving and lifting heavy materials doesn't have to involve installing expensive equipment or permanently changing your facility. Gantry cranes do the job efficiently and economically and are ideal lifting solutions because:

- No permanent installation is required — making gantry cranes ideal if you rent or lease your facility
- Quick and easy assembly and tear-down
- Portable design allows for use in more than one facility or work area

Monorail Cranes

Most commonly found in a production or assembly line, this type of crane uses a trolley to carry the hoist along a single path. Monorail cranes do not utilize a bridge or girder design — instead, the trolley is designed to connect to an I-beam, often already built into the ceiling structure, and runs along the flat surface (flange) on the bottom of the beam. They can also utilize a configured support structure as well.

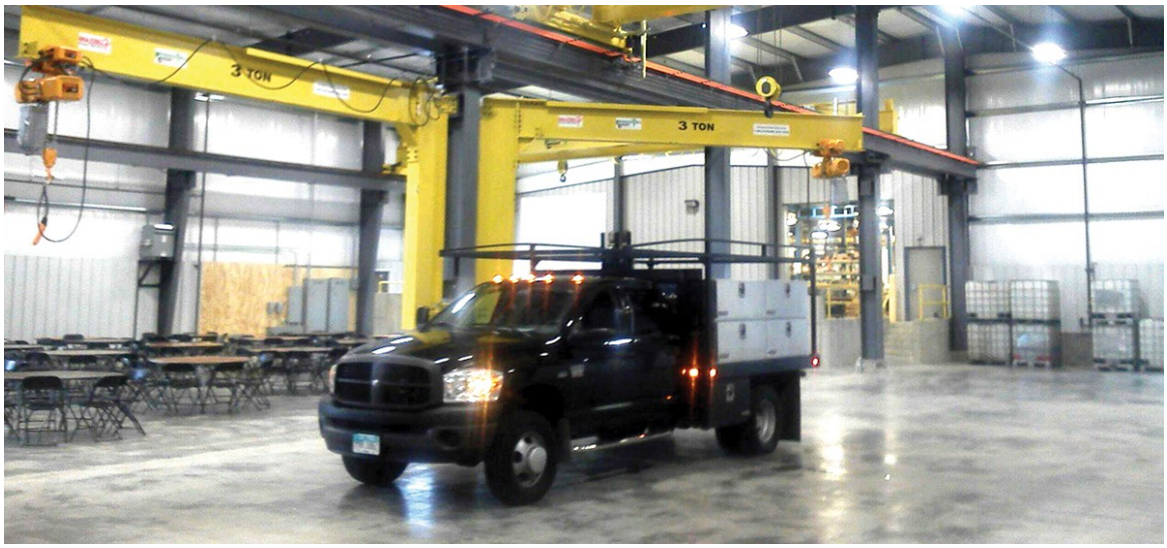


Material can be run back and forth in a straight line, or the rails can be designed with curves, branches, switches, and with changes in elevation. Monorail cranes follow a singular path and are designed for lifts that do not require the side-to-side trolley movement provided by the bridge in an overhead or gantry style crane.

Monorail cranes are perfect for lifting applications where a full-blown crane design is not required. They're a cost-effective and versatile solution for many assembly line and production applications.

Jib Cranes

Jib cranes come in a number of different styles and types but do not utilize a runway or track system. They can be stand-alone or column / wall-mounted and offer a wide variety of capacities, heights, and spans.



Jib cranes are space-saving, economical, and are ideal for jobs like maneuvering or moving items for assembly within a smaller radius. They can typically offer 180-360° of rotation, and even small ones can hoist several tons of material.

The best way to determine what type of jib crane is best for your application is to consider the following:

- What type of operation or usage will this equipment see?
- What height clearances or spans are required in this work area?
- Is there available support structure available for mounting, or will this be a standalone unit — floor, wall, and ceiling?
- What other special options or considerations are required?
- What is the available budget for the system and installation?

Workstation Cranes

Workstation cranes are designed to allow the operators an ergonomic means of moving or lifting loads with limited effort in a smaller size work area. Workstation cranes are typically lighter-duty systems — lifting materials from 150 lbs. up to 2 tons in capacity. They're designed for repetitive lifting of loads, positioning of loads, increasing worker productivity and

ease of work flow.

They can be built and installed easily using a modular design for greater flexibility and do not require an existing support structure for installation.

How to Determine Duty Cycle / CMAA Service Classifications

Selecting the right class and duty cycle for an overhead crane is critical for a customer who is trying to balance the initial investment of a crane system with the cost of future maintenance that will be required.

These four factors are the most important requirements that you should identify to make sure that your crane is specified for the correct duty cycle and classification:

1. **Rated Load —** Estimation of the loads lifted at or near capacity
2. **Service —** Total hours in operation per day
3. **Number of Lifts —** Average lifts and trolley and bridge movements made each hour
4. **Distance —** Average length of each movement

Other factors that may not directly affect the overhead crane classification, but should still be taken into consideration when designing and specifying an overhead crane, are:

- **Speed —** how quickly can the crane transfer materials or equipment? How many lifts per hour can the crane perform?
- **Maintenance Requirements —** will the crane need to be serviced regularly and how will maintenance or repair affect production and downtime?
- **Operating Environment —** In what type of environment or conditions will the crane be operating?
- **Future Needs —** Any changes or increases in production requirements down the road? If you design a Class C crane, but know that down the road you be lifting heavier loads or using your crane more frequently, you may need to consider a Class D range crane.

Why Do You Need to Classify Cranes by Duty Cycle or Service Class?

Crane service classifications allow you to select and build an overhead crane that is the most economical and safest design for your lifting application. Selecting the right duty cycle or service classification of an overhead crane helps ensure that the components of the overhead crane are durable enough to withstand the load and usage requirements.

Two cranes with an equal capacity and span could vary in price as much as $100,000 because high duty cycle cranes (Class D, E, or F) require specialized components like the hoist, end trucks, motor, bearings, and controls. Low duty cycle cranes can get away with more standardized and economical components—resulting in significant cost savings.

When designing an overhead crane, you'll also want to give special consideration to any future usage requirements. If you think that your production may expand down the road which may result in higher capacity lifts or an increase in the number of lifts per day, then you may want to spec out the crane and components so it can accommodate your future growth.

Different Types of Duty Cycles and Crane Classifications

There are six (6) different classifications for overhead cranes, specified by the Crane Manufacturers Association of America (CMAA). Overhead crane service classifications were established so that the manufacturer and end-user could design the most economical crane for the application, based mostly on the average rated load that the crane will lift, and how often the crane will be performing lifts.

Below we'll identify and define the six types of overhead crane classes and provide types of businesses or industries that match up the best with each overhead crane classification.

CLASS A1 (STANDBY SERVICE)

This service class covers cranes where precise handling of valuable machinery at slow speeds with long idle periods between lifts is required. Rated loads may be handled for initial installation of machinery and for infrequent maintenance.

Typical examples are cranes used in power houses, public utilities, turbine rooms, nuclear reactor buildings, motor rooms, nuclear fuel handling and transformer stations.

- Bearing Life: 1,250 hours
- Number of Lifts: Up to 2 per hour
- Motor Starts/Stops: 75 per hour

CLASS A2 (INFREQUENT USE)

These cranes will be used in installations where the loads are relatively light, the speeds are slow, and a low degree of control accuracy is required. The loads may vary anywhere from no load to full rated load with a frequency of a few lifts per day or month.

Typical examples are small maintenance shops, pump rooms, testing laboratories, etc.

- Bearing Life: 1,250 hours
- Number of Lifts: Up to 2 per hour
- Motor Starts/Stops: 75 per hour

CLASS B (LIGHT SERVICE)

This service class covers cranes where service requirements are light and the speed is slow and loads may vary from no load to occasional full rated loads.

- Average load is 50% of the rated capacity
- 2 to 5 lifts per hour
- Average lift distance of 15 feet
- No more than 50% of the lifts at rated capacity

Typical examples are cranes used in repair shops, light assembly operations, service buildings, light warehousing, etc.

- Bearing Life: 2,500 hours
- Number of Lifts: 2-5 per hour
- Motor Starts/Stops: 75 per hour

CLASS C (MODERATE SERVICE)

This service covers cranes where service requirements are deemed moderate.

- Average load is 50% of the rated capacity
- 5 to 10 lifts per hour
- Average lift distance of 15 feet
- No more than 50% of the lifts at rated capacity

Typical examples are cranes used in machine shops, paper mill machine rooms, etc.

- Bearing Life: 5,000 hours
- Number of Lifts: 5-10 per hour
- Motor Starts/Stops: 150 per hour

CLASS D (HEAVY SERVICE)

In this type of service, heavy-duty production is required but with no specific cycle of operations.

- Average loads approaching 50% of the rated capacity will be handled constantly during the work period
- High speeds are desirable for this type of service with 10 to 20 lifts per hour
- Average lift distance of 15 feet
- No more than 65% of the lifts at rated capacity

Typical examples are cranes used in heavy machine shops, foundries, fabricating plants, steel warehouses, container yards, lumber mills, etc., and standard duty bucket and magnet operations where heavy-duty production is required.

- Bearing Life: 10,000 hours
- Number of Lifts: 10-20 per hour

Motor Starts/Stops: 300 per hour

CLASS E (SEVERE SERVICE)

This type of service requires a crane capable of handling loads approaching the rated capacity continuously, in repetition throughout a stated period per day, in a predetermined cycle of operation.

- Average load at or near the rated capacity
- High speeds are required with 20 or more lifts per hour
- The complete cycle of operation should be specified

Typical examples are magnet, bucket, magnet / bucket combination cranes for scrap yards, cement mills, lumber mills, fertilizer plants, container handling, etc.

- Bearing Life: 20,000 hours
- Number of Lifts: 20+ per hour
- Motor Starts/Stops: 600 per hour

CLASS F (CONTINUOUS SEVERE SERVICE / STEEL MILL AISE SPECIFICATION)

In this type of service, the crane must be capable of handling loads, approaching rated capacity continuously under severe service conditions throughout its life. Cranes in this class are covered by the current issue of The Association of Iron and Steel Engineers' Standard No. 6-1969, Specification for Electric Overhead Traveling Cranes for Steel Mill Service.

Typical examples are custom-designed specialty cranes essential to performing the critical work tasks affecting the total production facility, providing the highest reliability, with special attention to ease of maintenance features.

How Load Class and Load Cycles Affect Crane Service Class

In both CMAA #70 and CMAA #74, there is a table that shows the relationship between the Load Classes and Load Cycles and how those affect the CMAA Crane Service Classification.

Load Classes:

- L1 = Cranes which hoist the rated load exceptionally and normally—very light loads.
- L2 = Cranes which rarely hoist the rated load and normal loads of about 1/3 of the rated load.
- L3 = Cranes which hoist the rated load fairly frequently and normally—loads between 1/3 and 2/3 of the rated load.
- L4 = Cranes which are regularly loaded close to the rated load.

Load Cycles:

- N1 = 20,000 to 100,000 cycles
- N2 = 100,000 to 500,000 cycles
- N3 = 500,000 to 2,000,000 cycles
- N4 = Over 2,000,000 cycles