

APPLICATIONS

MATERIAL HANDLING

Bridge and Gantry Cranes

The material handling industry is old and well established, but in recent years the industry has had to become much more advanced and sophisticated to meet the high duty cycle and precision demanded by their users. The old "rule of thumb" and general formulas used to select drives in the past are not adequate to provide the performance required in today's machines.

At the turn of the century there were only a handful of hoist and crane builders. These companies became experts in their field. They designed and manufactured all the components used in their products. This included the gears, gearcases and, for some companies, even the motors and controls. They developed the standards for the industry.

When the oil shortage hit this country, the cost of shipping the heavy cranes long distances became a major factor in the overall cost of the product. This opened the door for local steel fabrication shops to construct bridge cranes and trolleys. The major crane builders would supply these shops with hoists, bridge end truck wheel assemblies, drive and control packages and even customized construction plans.

These local shops may have little or limited engineering expertise, but many are aggressive and have grown quite well. The large crane builders have not been able to keep pace technologically in all areas of expertise so the small shops are looking to suppliers who specialize in reducers, motors, couplings, controls, etc.

This is where Eurodrive engineered drive systems can help. Our trained and experienced staff of engineers and salesmen can assist in providing a complete drive package tailored to exactly match the application requirements. Our familiarity with Crane Manufacturers Association of America (CMAA) specifications eliminates confusion when discussing customer needs. A few special areas of consideration:

- Motors are sized based on exact requirements for acceleration rates and duty cycle. Oversizing motors on bridge crane drives will cause such problems as wheel spinning, abrupt starts, overheating, larger and more complicated control systems.
- High inertia motor fans are used to soften the starts effectively, replacing expensive resistors and electronic controls.
- Two speed motors allow precision stopping because braking is from the low speed.
- Brake torque is matched to the motor torque requirements to give deceleration rates which match acceleration rates.
- Variety of our product allows freedom to design economical mounting arrangements; broad range lets the designer meet exact speed and torque requirements.
- Reducers are service factored for the duty cycle requirements as described in the CMAA Spec 70 for the crane service class desired.
- Eurodrive's integral design provides single sourcing and responsibility for the complete drive package.

Lifting requirements are still handled by the hoist manufacturers. Hoisting drives are an integral part of the hoist design requiring special size, configuration and location. Additionally, codes demand specific braking requirements which our drives cannot match. Some crane builders use "off the shelf" reducers for their hoists, but this is the exception to the rule.

The following article taken from *Plant Engineering* magazine is a good primer for familiarization with the bridge and crane industry.

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BRIDGE & GA

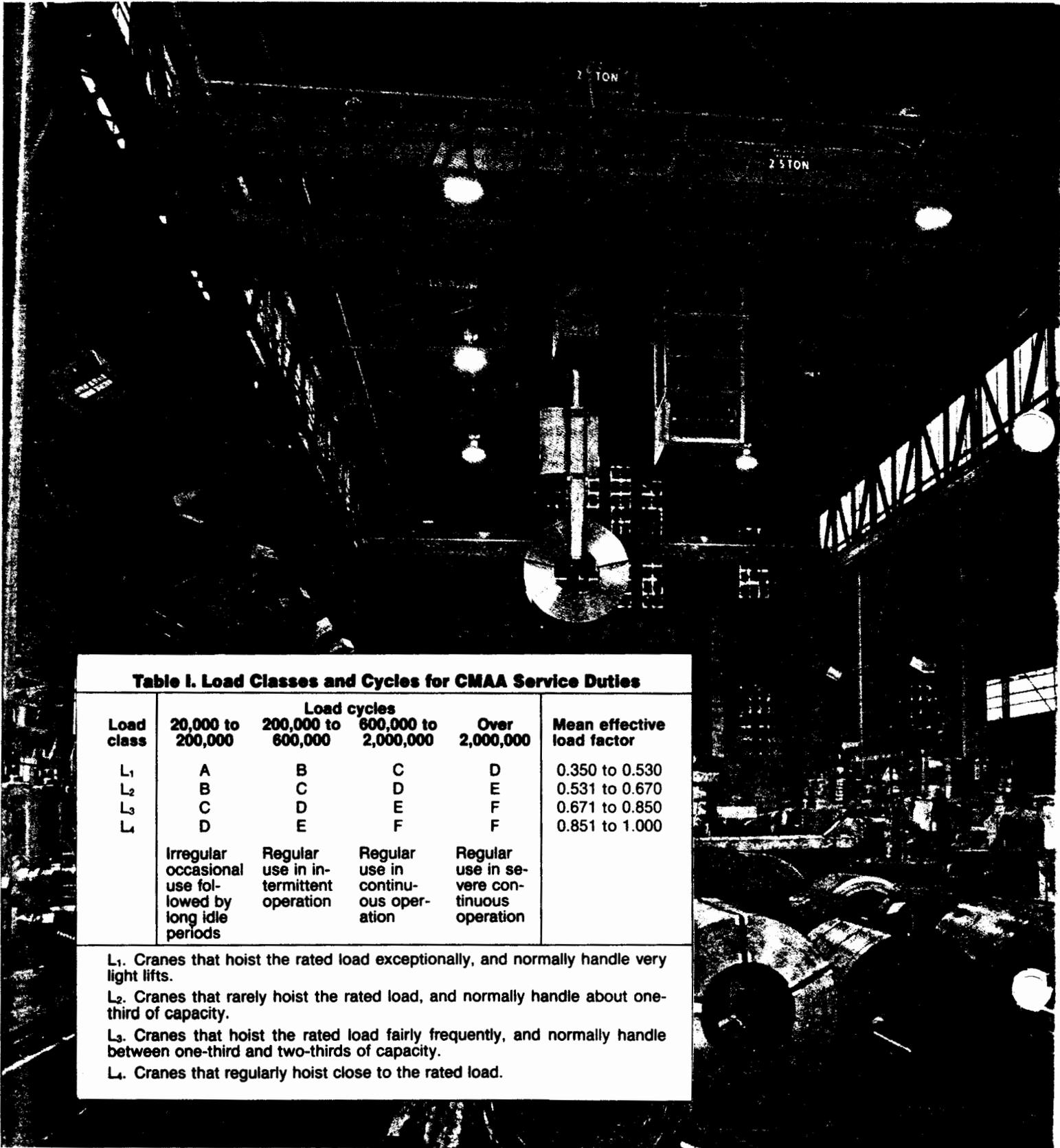


Table I. Load Classes and Cycles for CMAA Service Duties

Load class	Load cycles				Mean effective load factor
	20,000 to 200,000	200,000 to 600,000	600,000 to 2,000,000	Over 2,000,000	
L ₁	A	B	C	D	0.350 to 0.530
L ₂	B	C	D	E	0.531 to 0.670
L ₃	C	D	E	F	0.671 to 0.850
L ₄	D	E	F	F	0.851 to 1.000
	Irregular occasional use followed by long idle periods	Regular use in intermittent operation	Regular use in continuous operation	Regular use in severe continuous operation	

L₁. Cranes that hoist the rated load exceptionally, and normally handle very light lifts.

L₂. Cranes that rarely hoist the rated load, and normally handle about one-third of capacity.

L₃. Cranes that hoist the rated load fairly frequently, and normally handle between one-third and two-thirds of capacity.

L₄. Cranes that regularly hoist close to the rated load.

ENTRY CRANES

Masters of Overhead Handling

A variety of crane configurations are available for handling bulky or precise lifting and transporting movements of loads ranging from 1 to 1000 tons

RON HOLZHAUER, Senior Editor

A carefully designed and installed bridge or gantry crane can dramatically increase production, significantly reduce material handling costs, and substantially lower the risk of employee injury. A properly maintained crane lasts at least 20 years, could reach age 50 or more, and occasionally outlives the structure or company originally housing or using the equipment.

Cranes are often considered the "grunts" of material movement, maneuvering large, bulky loads through the plant for shipping and receiving, relocating and staging, or integrating with heavy-duty manufacturing operations. However, the advent of more sophisticated and critical production techniques introduced a new degree of preciseness to crane capabilities. Computers and other control packages near the equipment, or at a remote supervisory location, allow the crane to match closely almost any size and type of load, where and when needed, under all operational or environmental conditions.

Most larger tonnage cranes are custom engineered to match the plant's particular requirements. Some plants combine bridge, gantry, jib, and stacker crane capabilities to facilitate moving, lifting, and placing duties. Also, a single bridge crane could include primary and secondary lifting arrangements, such as separate 100 and 15-ton hoists, to provide the most effective material movement operations. The heavier capacity hoist is usually rather slow, while the auxiliary lifter is much faster and

able to handle more frequent loads. A single bay, often several hundred feet long, could have several cranes of different capacities on the same runway if simultaneous lifting requirements exist.

Hoisting speeds over 200 fpm, bridge speeds to 1000 fpm, and capacities reaching 1000 tons are available, although slower movements and smaller loads are the norm. Cranes are usually 15 to 30 ft overhead, but could be as much as 200 ft to clear floor-mounted equipment, to place material where needed in the manufacturing operation, or for safety reasons. Overhead obstructions, as well as operational needs, should be considered when installation heights are selected. A variety of mechanisms, such as hooks, magnets, or buckets, are available on the hoist to match particular grabbing or lifting requirements.

Regardless of the specific operation's characteristics demanded by the installation, all cranes should comply with appropriate and current American National Standards Institute (ANSI) standards, mandatory Occupational Safety and Health Administration (OSHA) requirements, and Crane Manufacturers Association of America (CMAA) specifications.

Crane Options

Bridge cranes are available in top-running and underhung configurations, and single or double girders, to match particular plant structural and lifting requirements. Gantry cranes are constructed in single or double-leg, single or double-girder, and top-running or underhung versions. The section "Typical Crane Configurations" depicts component arrangements for six types.

A 25-ton cab-operated, top-running, double-girder crane transfers a rolled coil from receiving to a slitting operation. (Courtesy Philadelphia Tramrail Co.)



Bridge cranes are traditionally considered the most rugged entrant in the overhead handling market

Bridge cranes are usually appropriate for higher tonnages, longer spans, and heavier duties. (Duty service classifications are discussed later in this article.) Although available in several forms, each crane design contains several pieces of common equipment:

- Hoists lift and lower the load.
- Trolleys consist of a frame, end trucks or wheels with side frames, and drive. They suspend or support the hoist, rope, and load block, and travel on one or more bridge rails or beams.
- Girders are the principal horizontal structural steel beams holding the hoist and trolley. They are supported by the end trucks and are perpendicular to the runway. Very wide or large capacity cranes require two or more girders.
- Runways consist of structural steel rails, girders, brackets, and framework. They support and allow movement of the crane through the plant.
- End trucks are an assembly of structural members, wheels, bearings, and axles that

support the girders or trolley cross members.

- Bridges consist of girders, end trucks, walkways, crossbridge electrification controls, and drive mechanisms. They carry the trolley and travel along the runway rails.

Top-running, double-girder cranes are the original overhead type, developed in the late 1800s. These cranes provide the highest possible vertical lift because the trolley rides on rails mounted on top of the bridge girders, with the hoist above the trolley wheels. The entire bridge moves with double-flanged wheels rolling on top of what looks like a small railroad track. Runways are supported by floor-mounted steel columns with base plates; concrete footings are usually required.

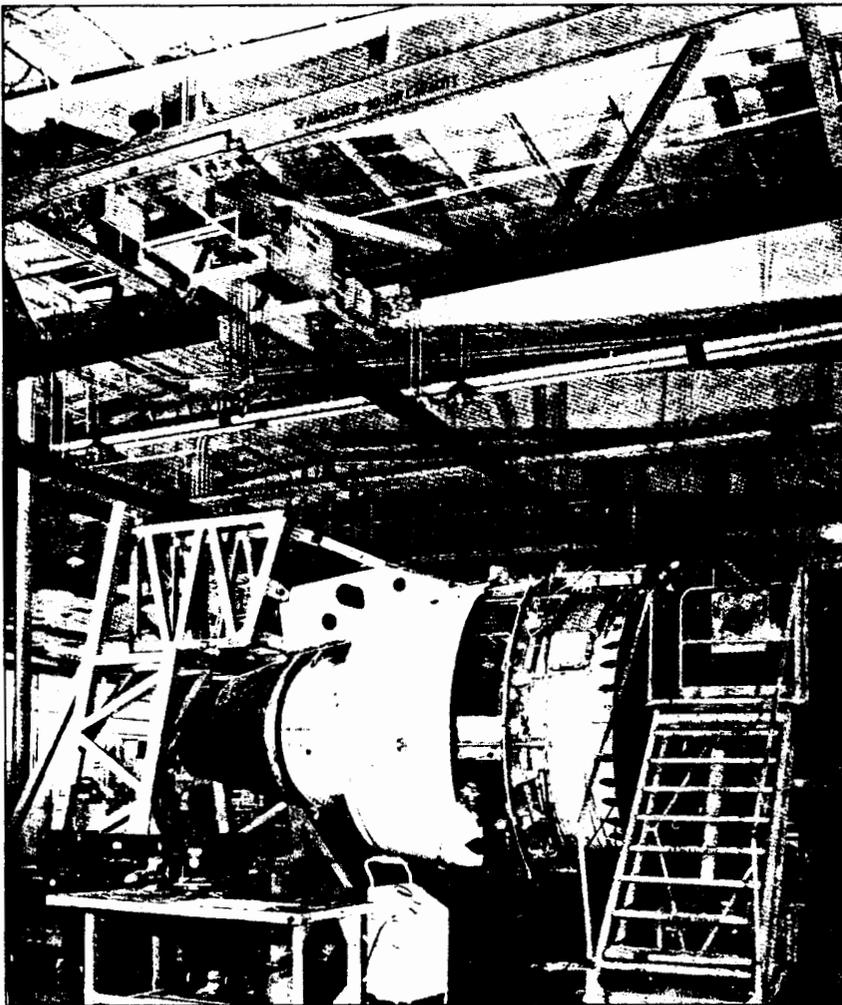
Top-running, double-girder equipment is appropriate for capacities to 1000 tons moving across a 100-ft span; more common maximums are 200 tons and 60 ft. Practically speaking, most double-girder cranes are 30 tons or less. Light-duty handling down to 5 tons is also served, although this type of crane is not usually the most practical or economical choice in these situations.

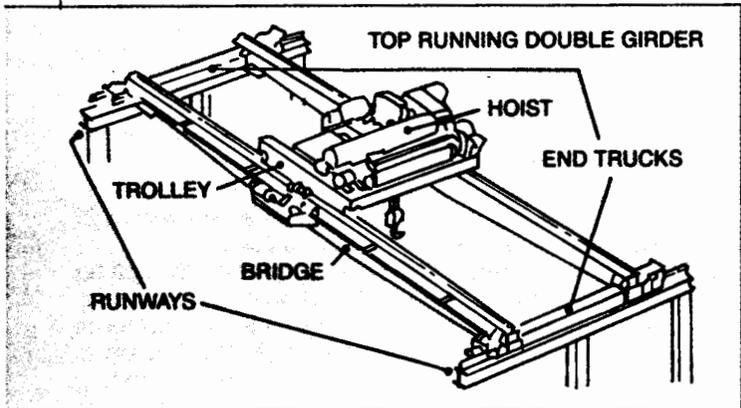
Top-running, single-girder cranes have a one-beam bridge that is attached to the end trucks and rides on a rail atop the runway support beam, similar to the double-girder version. However, the trolley runs on the lower flange of the girder; therefore, the hoist body is below the bridge and takes up more headroom, which reduces lifting height. The top-running, single-girder crane is less expensive than its two-girder brother, handles capacities to 30 tons (usually less than 20 tons), and spans up to 60 ft with standard configurations and components.

Underhung cranes use runway tracks usually fastened to overhead building structures. Hinge clamps grip structural beams and ceiling supports, tie rods provide leveling adjustments, and sway bracing produces rigidity. End trucks travel along the lower flanges of the parallel supporting runway tracks, similar to a monorail. Underhung runways and tracks are available in a wide assortment of types, including I-beam, wide-flange, and patented. Specific manufacturers have their own preferences, and it is advisable to compare the merits of each possibility with the plant's particular needs.

Single-girder underhung cranes have the hoist body below the trolley wheels; the double-girder approach has the hoist mounted above the trolley, providing a couple of extra feet of headroom. Double-

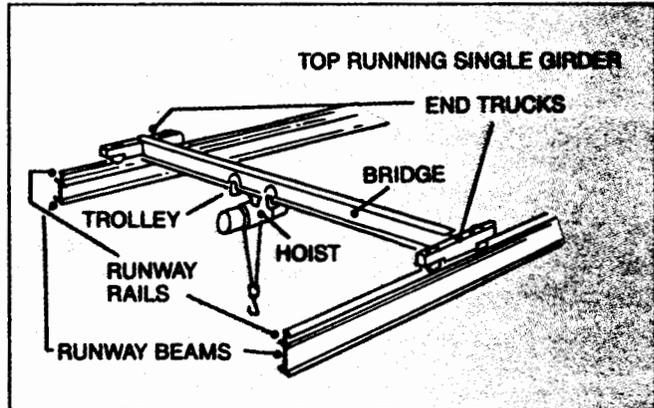
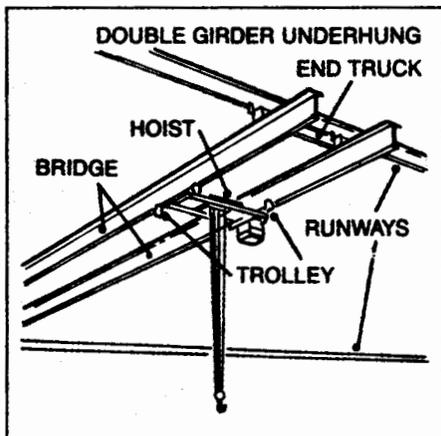
A 10-ton, underhung, double-girder crane transports a jet engine and its housing along the entire production line. (Courtesy Spanmaster Div., Jervis B. Webb Co.)



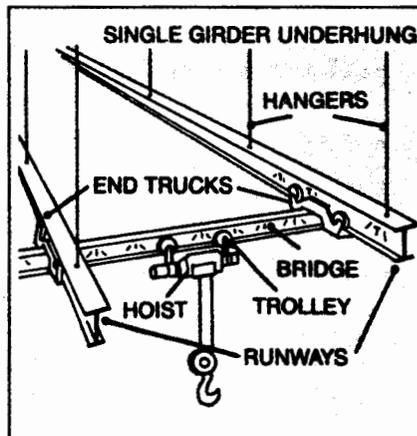


Top-running, double-girder cranes offer the greatest lifting heights, highest tonnages, widest spans, and heaviest duties.

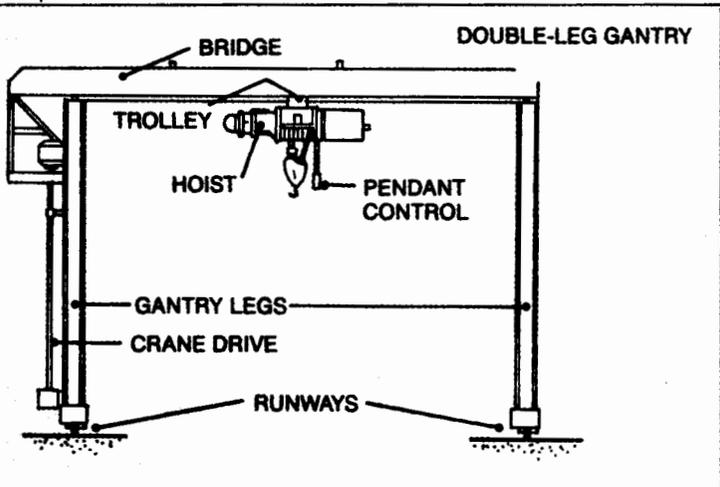
Double-girder underhung cranes have the hoist mounted above the bridge attain a bit more headroom than the single girder version. Capacities range to 50 tons.



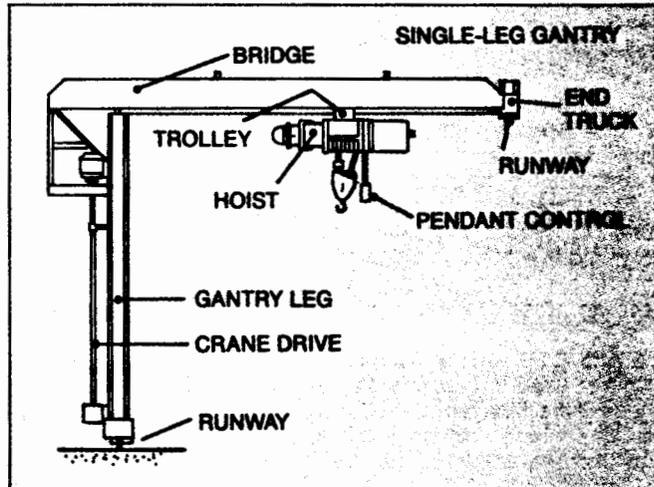
Top-running, single-girder cranes have a one-beam bridge that rides on a rail atop the runway. Capacity is generally limited to 30 tons.



Single-girder underhung cranes have the bridge end trucks running on the lower flanges of the runway beams. Capacity with this arrangement is usually limited to 10 tons.



Double-leg gantry cranes move along floor rails or guidepaths. Capacity is typically less than 30 tons, although units reaching several hundred tons are in service.



Single-leg gantry cranes substitute a wall-mounted runway for the second leg. They are usually designed to handle loads of less than 20 tons for a specific operation.

Gantry cranes are able to perform virtually all lifting jobs handled by comparably-sized bridge cranes

girder models typically handle up to 50 tons. Single-girder equipment ranges to 15 tons in standard configurations; special beams and trolleys move the capacity to a maximum of 30 tons.

Maximum span for an underhung crane is usually about 60 ft. The distance is extended by using three or four-track runways, which distribute the load over a larger portion of the building structure. Shorter spans are provided between support points; therefore, smaller girders are used and lifting heights are increased.

Overhead cranes often include access platforms to facilitate maintenance or repairs, particularly if the equipment cannot be reached by aerial lifts. Large bridge cranes usually include service walkways.

The choice between a top-running and underhung crane is largely a matter of capacity. Underhung cranes are limited by the wheel load applied to the runway and structural beam capability. Using additional runways increases the capacity, but

flange loading eventually reaches an upper limit of 60 tons or so.

Basically, underhung equipment is best suited for lighter loads and service duties; top-running cranes are most applicable to the opposite situations. The middle capacity and service ground could be serviced by either type, and an analysis of the options dictates the best choice. Underhung cranes should be kept indoors; top-running are equally at home inside and out.

Single or double-girder considerations follow similar reasoning, with the single used for lighter loads and duties.

Wall-traveling cranes are special-application models in the overhead family, particularly suited to lifting and moving needs along interior or exterior walls. The crane moves down a rail installed on the building wall, while an articulating or fixed boom with a traveling hoist and trolley arrangement reaches out to handle required duties. Maximum capacity is usually limited to about 10 tons because of the extended arm loading.

Gantry cranes, often a practical alternative to bridges, are capable of serving the same lifting, traveling, and duty classifications. This floor-mounted equipment essentially "bridges" the lifting and moving service area as the crane rolls down a pre-designed path on legs.

Gantries are suitable if the building structure cannot handle the bridge loading, overhead runways are long, costly to erect, and difficult to maintain in alignment, or the installation is temporary and may require relocation at a later date. The gantry is common in situations where the crane itself does little or no traveling, and material transfer is handled almost exclusively by the trolley.

On the negative side, the bridge weight of the gantry crane is much greater than an equivalent-capacity overhead. Therefore, the bridge motor must be larger or the speed slower to compensate for the additional mass. A slower traveling speed is also necessary to reduce the risk of the legs running into personnel; a motion detection device is often included to stop the unit or sound a warning. The legs could create an obstruction problem, and tracks or floor guides could cause a tripping hazard.

Gantry cranes have one or two supporting legs. In the double-leg version the crane bridge is rigidly fixed at each end to support columns or legs. Wheels mounted at the bottom of the legs permit the crane to travel along a track in the floor or next to a guide path.

The trolley, typically top running, travels between the legs. The double-leg gantry

Crane Service Classifications

The Crane Manufacturers Association of America, Inc., defines six duty service classifications for overhead traveling cranes:

CLASS A (Standby or Infrequent Service)

Cranes used in power houses, public utilities, turbine and motor rooms, transformer stations, and other locations where precise handling of equipment at slow speeds, with long idle periods between lifts, is required. Capacity loads are handled for the initial installation of equipment and infrequent maintenance.

CLASS B (Light Service)

Cranes used in repair shops, assembly operations, service buildings, warehousing, and other locations where service requirements are light and the speeds are slow. Between two and five lifts, averaging 10 ft, are made per hour; loads range from zero to occasional full rated.

CLASS C (Moderate Service)

Cranes used in machine shops, paper mill machine rooms, and other locations where service requirements are moderate. Cranes handle loads averaging 50% of the rated capacity. Between 5 and 10 lifts, averaging 15 ft, are made per hour; no more than 50% of the lifts are at the rated capacity.

CLASS D (Heavy Service)

Cranes used in machine shops, foundries, fabricating plants, steel warehouses, container yards, lumber mills, standard-duty bucket and magnet operations, and other locations where heavy-duty production is required. Loads approaching 50% of the rated capacity are handled constantly during the working period. High speeds are desirable. Between 10 and 20 lifts, averaging 15 ft, are made per hour; not over 65% of the lifts are at the rated capacity.

CLASS E (Severe Service)

Cranes used in scrap yards, cement mills, lumber mills, fertilizer plants, and other locations where severe duty is encountered. Magnet, bucket, and magnet/bucket combination cranes typically handle these applications. Over 20 lifts per hour, at or near the rated capacity, are common.

CLASS F (Continuous Severe Service)

Custom-designed specialty cranes used continuously to perform critical work tasks affecting the total production facility where severe service is experienced. Cranes must provide the highest reliability, with special attention to ease of maintenance features. Loads approaching full-rated capacity are handled on a continual basis.

does not require the building for support, can carry high loads, and is practical for outdoor applications. If placed outside, proper compensation should be made for wind gusts to guarantee gantry stability.

The single-leg gantry has one end rolling on the floor with rubber or steel wheels, and the other end of the bridge riding on a runway mounted to the wall. This gantry is often used as a secondary crane, serving specific areas under an overhead bridge crane. Capacity is limited by the design of the support steel used for the runway.

Single and double-leg, single-girder cranes typically handle less than 20 tons, although models that handle up to about 60 tons are available with special construction features. The two double-girder types usually have capacities less than 30 tons, but again, exceptions exist and some versions handling several hundred tons are in service.

Most manufacturers produce both bridge and gantry cranes. The listing at the end of this article provides a product cross-section for 37 manufacturers and suppliers.

Selection Considerations

In the past, virtually every bridge crane installed was oversized, hoping to match that one extreme handling case that might occur in the equipment's lifetime. Today's economic pressures, along with the computer's ability to match application requirements and equipment precisely, has drastically altered the procedure to a much more exact selection.

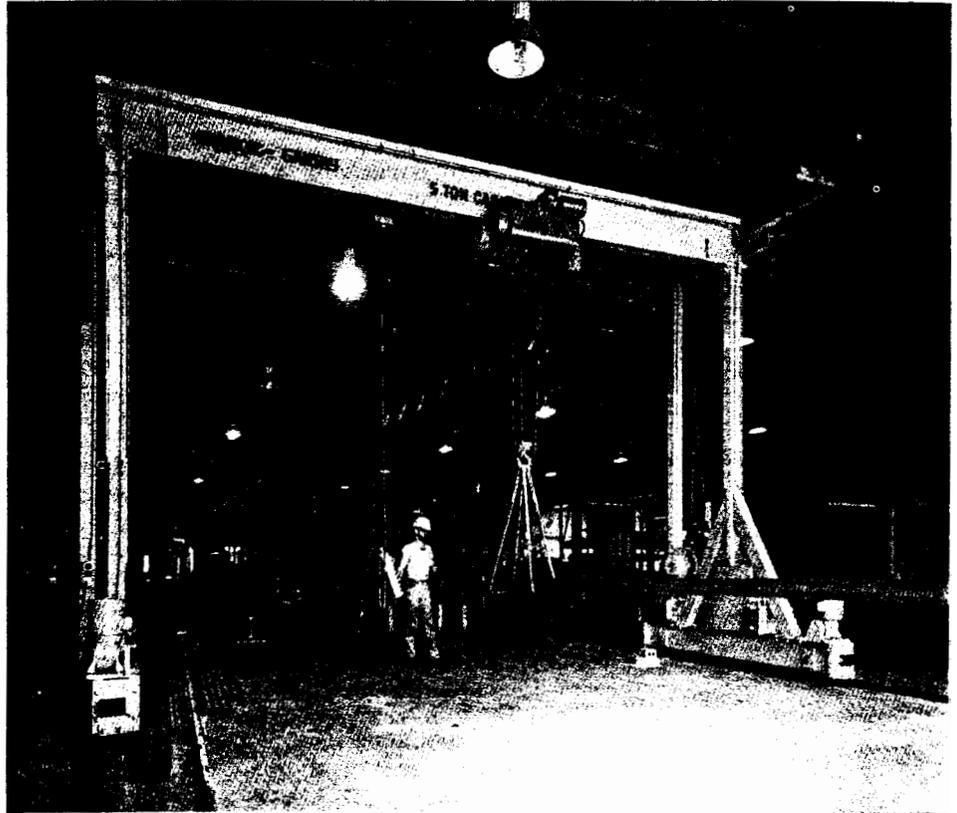
Actual load handling requirements and duty cycles are the key to crane selection. To facilitate the picking procedure, CMAA identified six types of duty requirements, discussed in the "Crane Service Classifications" section. Matching actual requirements with the proper crane is critical, because underspecifying could create excessive maintenance, and overspecifying increases the capital investment.

Table I further defines the use of these classifications for handling different types of loads across various duty cycles.

Operating speeds for the hoist, trolley, and bridge, based on duty classification and type of operation, are then selected. The picked figures are important, because excessive speed increases original and energy costs due to the larger motors, and too slow a movement could create a production bottleneck.

Table II provides typical speeds for the three principal moving elements on a floor-controlled, top-running crane. Cab-controlled crane speeds tend to be a bit higher.

CMAA specifications provide detailed



Operator walks along as a 5-ton, rail-guided, double-leg gantry crane cradles and transports a long pipe to a processing operation. (Courtesy Spanco, Inc.)

Table II. CMAA Suggested Operating Speeds, fpm, for Floor-Controlled, Top-Running Cranes

Capacity, tons	Hoist			Trolley			Bridge		
	Slow	Medium	Fast	Slow	Medium	Fast	Slow	Medium	Fast
3	14	35	45	50	80	125	50	115	175
5	14	27	40	50	80	125	50	115	175
7.5	13	27	38	50	80	125	50	115	175
10	13	21	35	50	80	125	50	115	175
15	13	19	31	50	80	125	50	115	175
20	10	17	30	50	80	125	50	115	175
25	8	14	29	50	80	125	50	115	175
30	7	14	28	50	80	125	50	115	150
35	7	12	25	50	80	125	50	115	150
40	7	12	25	40	70	100	40	100	150
50	5	11	20	40	70	100	40	100	150
60	5	9	18	40	70	100	40	75	125
75	4	9	15	40	70	100	30	75	125
100	4	8	13	30	60	80	25	50	100
150	3	6	11	25	60	80	25	50	100

Note: Consideration must be given to the length of the runway for bridge speed, span of the bridge for trolley speed, average travel distance, and spotting characteristics required.

Overhauling old cranes with new components and controls creates a basically new system at a modest cost!

information on requirements for all crane components. In addition to service classifications and speed, suggested requirements for the bridge (girders, end trucks, wheels, bumpers, and rails), runways, hoists, electrical equipment, and controls are presented in various CMAA specification publications.

Several crane control options are available. A pushbutton pendant permits one-man operation at floor level. Radio control from the work floor is practical in crowded areas or when several people are operating the crane. A cab, available with such amenities as air conditioning and a radio, is used if heavy-duty, high-speed movements are required and the operator needs an elevated view because of obstructions. A control station on the side wall or mezzanine allows the operator to view and maneuver the crane. The ultimate control scheme has the operator in a remote location regulating movement through television monitors or computer feedback.

The working environment of the crane should also be considered. Heat, corrosives, moisture, and explosive potential should be investigated before component packages are assembled.

Selection of a high-capacity (more than 15 tons) heavy-duty gantry crane requires consideration of most bridge factors. In the smaller sizes, where the overwhelming number are found, several other factors enter the equation, including aluminum or

steel construction, adjustable or fixed height, span, type of casters, and height from floor to I-beam. Spans from 8 to 40 ft and heights from 6 to 35 ft are available.

Crane Improvements

The extended life span of cranes makes the equipment an excellent long-term investment and offers numerous opportunities for modernization, which enables the products to match the latest updates in technology while performing at peak efficiency. The final result is improved productivity, reduced maintenance, and a like-new crane system.

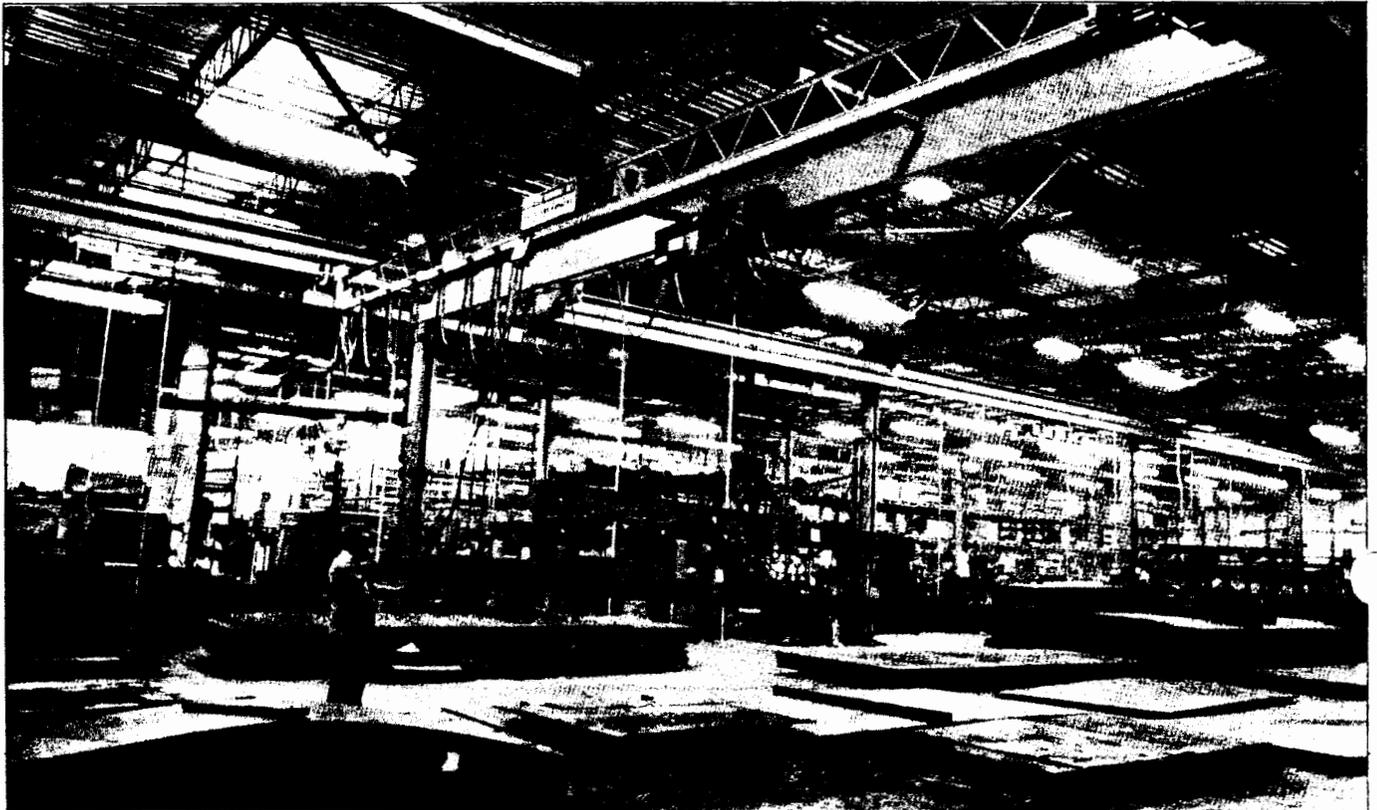
Most of the changes involve state-of-the-art control packages that require less attention than their old counterparts and indicate potential trouble situations before the critical stage. In addition, updated controls are very reliable and reasonably priced in relation to performance and benefits realized.

Several crane manufacturers and specialty companies offer rebuilding, upgrading, repairing, and modernizing of existing cranes.

PLANT ENGINEERING magazine would like to thank Handling Systems, Inc., LaGrange, IL, and Philadelphia Tramrail Co., Philadelphia, PA, for their special contributions to the development of this article.

For information on how to order copies of this article circle 700 on post card

Pendant-controlled, single-girder, underhung crane with magnetic lifting attachment handles sheet steel weighing up to 5 tons.
(Courtesy Twin City Monorail, Inc.)



Quick Sourcing Reference to Bridge and Gantry Cranes

	Top running double girder	Top running single girder	Underhung double girder	Underhung single girder	Wall traveling	Single leg single girder	Single leg double girder	Double leg single girder	Double leg double girder	Circle
Acco Chain & Lifting Products	30	10	15	15	—	10	30	10	30	51
Action Crane & Monorail	30	20	20	15	30	15	30	15	30	52
Air Technical Industries	—	—	—	—	—	—	10	—	10	53
American Crane & Equipment	200	15	30	15	10	15	25	15	200	54
Anchor Crane	50	15	15	15	15	20	50	20	50	55
Bushman Equipment	—	—	—	—	—	—	—	10	—	56
CraneMasters	60	60	60	60	5	60	60	60	60	57
Custom Industries	—	—	1	½	—	—	—	—	—	58
Detroit Hoist & Crane	30	15	30	15	—	15	30	15	30	59
Ederer	1000	20	50	20	10	20	1000	20	1000	60
Gorbel	—	—	—	1	—	—	—	1	—	61
Handling Systems	20	20	20	20	10	20	20	20	20	62
Harnischfeger	100	—	—	—	—	—	—	—	—	63
Harrington Hoists	10	10	5	5	—	—	—	—	—	64
Heco Pacific	100	10	30	10	5	—	—	—	30	65
Hercules Industries	—	—	—	—	—	—	—	3	—	66
Industrial Crane & Equipment	15	15	10	10	—	10	—	10	—	67
Ingersoll-Rand Material Handling	—	5	—	5	—	—	—	—	—	68
Itnac	—	—	—	—	—	15	—	—	—	69
Kone/Landel	500	15	30	15	15	60	500	60	500	70
Kranco	700	20	40	25	10	15	500	15	500	71
Lift-Tech	600	15	10	10	5	20	250	20	250	72
Mannesmann Demag	125	14	10	10	10	14	30	14	30	73
Marathon LeTourneau	—	—	—	—	—	50	—	—	100	74
North American Industries	40	30	20	20	—	30	40	40	40	75
Northern Engineering	125	—	—	—	—	—	50	—	50	76
Philadelphia Tramrail	100	20	20	20	5	20	40	20	40	77
Shepard Niles	150	20	20	20	10	20	50	20	50	78
Spanco	10	10	5	5	5	15	20	15	20	79
StansPec	150	20	30	20	25	20	150	20	150	80
Trambeam	—	10	30	10	—	5	10	5	10	81
Twin City Monorail	30	10	20	10	—	10	20	—	—	82
B. E. Wallace Products	—	—	—	—	—	—	—	15	—	83
Jervis B. Webb, Spanmaster Div.	40	10	20	10	—	—	—	—	—	84
Whiting	600	30	—	—	—	30	30	50	500	85
Zenar	200	20	20	20	—	20	100	20	200	86
D. W. Zimmerman	—	—	—	1	—	—	—	—	—	87