

CMAA Crane Classification - A brief overview.

As to the types of cranes covered under CMAA Specification No. 70 (Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes), there are six (6) different classifications of cranes, each dependent on duty cycle. Within the CMAA Specification is a numerical method for determining exact crane class based on the expected load spectrum. Aside from this method, the different crane classifications, as generally described by CMAA, are as follows:

Class A (Standby or Infrequent Service):

This service class covers cranes where precise handling of equipment at slow speeds with long idle periods between lifts are required. Capacity loads may be handled for initial installation of equipment and for infrequent maintenance. Typical examples are cranes used in powerhouses, public utilities, turbine rooms, motor rooms, and transformer stations. This is the lightest crane as far as duty cycle is concerned.

Class B (Light Service):

This service class covers cranes where service requirements are light and the speed is slow. Loads may vary from no load to occasional full rated loads with 2 to 5 lifts per hour, averaging 10 feet per lift. Typical examples are cranes in repair shops, light assembly operations, service buildings, light warehousing, etc.

Class C (Moderate Service):

This service covers cranes whose service requirements are deemed moderate, handling loads which average 50 percent of the rated capacity with 5 to 10 lifts per hour, averaging 15 feet, with not over 50 percent of the lifts at rated capacity. Typical examples are cranes used in machine shops, papermill machine rooms, etc.

Class D (Heavy Service):

In this type of service, loads approaching 50 percent 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 averaging 15 feet, with not over 65 percent 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.

Class E (Severe Service):

This type of service requires a crane capable of handling loads approaching the rated capacity throughout its life with 20 or more lifts per hour at or near the rated capacity. Typical examples are magnet, bucket, magnet/bucket combination cranes for scrap yards, cement mills, lumber mills, fertilizer plants, container handling, etc.

Class F (Continuous Severe Service):

In this type of service, the crane must be capable of handling loads approaching rated capacity continuously under severe service conditions throughout its life. 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.

AISE Service Class - A brief overview.

Not to be outdone by CMAA, AISE also provides for different service classes for cranes covered under AISE Technical Report No. 6, "Specifications for Electric Overhead Traveling Cranes for Steel Mill Service". Like CMAA, AISE also provides a numerical method for determining crane class based on the expected load spectrum. Without getting into the specifics of this method, AISE does generally describe the different service classes as follows:

Service Class 1: Light material handling duty, less than 100,000 cycles.

Service Class 2: Medium material handling duty, 100,000 to 500,000 cycles.

Service Class 3: Heavy material handling duty, 500,000 to 2,000,000 cycles.

Service Class 4: Severe material handling duty, over 2,000,000 cycles.

Crane Certification - Just what does this mean?

What is crane certification? How often does a crane have to be certified? Who can certify a crane and just what is involved? Good questions. Lets start with exploring just what crane certification is. Aside from cranes used in the maritime industry, "crane certification" doesn't really mean a whole lot. At best, it merely serves to satisfy the normal record keeping requirements of OSHA, which should not be confused with "crane certification". But wait a minute! There are firms that offer crane inspections and certification. Some even advertise they are accredited by the United States Department of Labor to provide such certification services. Is this false advertising? Well, not technically. But what it does mean is that the certification they give you for your crane that is used in general industry (or construction) carries less weight at OSHA than you might think. Why?

Because **OSHA does not actually require cranes used in construction or general industry to be certified.** Furthermore, the Department of Labor does not give any accreditation to any firm for the purpose of certifying cranes used in construction or general industry (ie: cranes covered under 29 CFR 1926 or 29 CFR 1910). Such accreditation is provided only for certification of certain types of material handling equipment used in the maritime industry where, under 29 CFR 1919, such certification is required. So, what does crane certification mean for cranes outside of the maritime industry? It means only what the certifying entity says it means. It is, quite simply, a form, a letter, or other document that states, for the record and in writing, just what services have been rendered on a particular piece of equipment and/or its condition. It might mean that the certifying entity is "certifying" that the crane has been inspected and is in good condition; or "certifying" that the crane has been satisfactorily load tested; or "certifying" that the crane has been analyzed and modified for an increase in capacity. To get ridiculous, we could certify that the crane is yellow in color.

When it comes to "certification" of cranes used in construction or general industry, remember this: It carries no governmental stamp of approval. It satisfies no federal regulations, laws, or standards regarding such "accredited certification" (since there are none). And it does not mean your crane is in absolute compliance with any and all governmental requirements. In addition, it is interesting to note that OSHA actually prohibits any firm from using the maritime certification forms for "certifying" equipment outside the maritime industry. Although the basic format of these forms can be used, it must include wording to the effect that such "certification" is not mandated by OSHA and it cannot contain the Department of Labor heading. As for the other questions initially raised above (aside from the maritime industry), the answers are never; anyone; and anything.

Tapered Tread Trackwheels - What are they and why are they?

As applicable to top running bridge cranes, usually manufactured with tapers of 1 in 20, 1 in 25, or 1 in 16 and should almost always be installed with the larger diameter towards the inboard side of the crane. Generally used on bridge drives on long span cranes to help prevent skewing of the bridge structure. Some people swear by them. Some don't.

Drive Wheels - Don't change just one:

According to CMAA Specification No. 70, drive wheels are to be replaced in matched pairs to within .001" per inch of diameter or a total of .01" on diameter, whichever is smaller. This, of course, is to aid in the proper tracking of the wheels (on bridge drives in particular) so that one end of the crane does not travel ahead of the other. If you "run the numbers", it will show you that even a small difference in trackwheel diameter can cause one end to travel significantly farther ahead of the other after covering a long travel distance down the length of the building.

Bridge Drive Types - What is the best choice?

The general consensus in the industry is that the A-4 bridge drive is the best choice for overhead cranes, particularly on long span cranes. This type of drive consists of a separate motor and reducer at each end of the crane, thus eliminating the need for a cross shaft arrangement (ie: bridge line shaft). Its superior tracking performance makes this the drive of choice among most crane manufacturers today.

Travel Speeds - Don't always believe what the drawings say!

Travel speeds, as shown on the original design drawings for older cranes powered by DC current, may or may not accurately reflect the free running speed of the crane. In many cases, the speed shown was calculated based on the 1 hour rated rpm of the motor and not the actual free running speed of the motor after acceleration. The end result is that the free running speed of the crane is much greater than that shown on the drawings. This can become a serious issue when specifying a new crane to match the speeds of the older crane.

Poor Bridge Tracking/Excessive Trackwheel Flange Wear - Why?

The first thing they teach you in crane school is that poor tracking characteristics of any crane is the fault of the building runway structure on which it runs. This, of course, may be true in many cases. No matter how perfect the crane is, it will track poorly on a poorly aligned runway system. Such misalignment can be the result of a poorly maintained rail, sinking column foundations (which rarely sink in a true vertical direction), broken runway beam tie-backs (thrust connection at column), or even a runway beam permanently bent in the lateral direction. There are, however, other conditions that may contribute to poor tracking. And yes, despite what the "crane guys" may say, many of these conditions are the fault of the crane itself. Mismatched drive wheels, incorrect tread width, tapered wheels installed incorrectly, misaligned drive shaft, and/or bridge structure in an out-of-square (trapezoidal) condition can all lead to poor tracking of the bridge. On cranes with more than 4 wheels, localized skewing of the bridge trucks can also cause poor tracking, usually the result of some permanent damage in the area of the saddle (ie: bent saddle structure, broken saddle pin, etc.). Determining the exact cause of poor bridge tracking can be a painstaking endeavor that usually includes checking the squareness of the bridge structure as well as the bridge wheels and trucks. Though not a cure for the conditions listed above, some end users have had very good success in reducing trackwheel flange wear by installing trackwheel flange lubricators. These are usually in the form of spring loaded graphite sticks mounted on the end truck or end carriage, making continuous contact with both flanges of the trackwheels.

Ladle Crane Hoist Units - A matter of timing:

Main hoist units on many large ladle cranes (typically 4 girder type DC cranes) usually consist of 2 hoist drums, each driven by separate motors and reducers that are mechanically connected in a closed loop fashion by means of a tie shaft connecting to each reducer input shaft. This arrangement is also connected by meshing the drum gears together, either directly or through a set of idler gears. If not properly timed, one of the hoists may be just going along for the ride, letting the other hoist take all the load and thus operating outside the original design parameters. Timing these hoist units involves disconnecting the tie shaft, removing all back-lash in the gear train in each direction, then splitting the difference and reconnecting the tie shaft. Once timed, the hoists should remain "in-time" as long as the closed loop connection is maintained. Any time this connection is broken for any reason, the hoists must be re-timed. To check to see if the timing is correct is a simple matter of checking for any transmitted load through the idler gears at the drum gear train. If timed correctly, it will be possible to "rattle" these idler gears with a pry-bar.

Hoist Drum Grooving - Know your Left from your Right!

The majority of hoist drums (drums with 2 ropes paying off downward to the lower hook block) are grooved with both right and left hand grooves, right hand at one end of the drum and left hand at the other end. These grooves are really no different than right and left hand threads on a screw, but of course it is difficult to

tell which is which by just looking. The easiest way to determine left hand grooves from right hand grooves on these types of drums is to imagine yourself sitting on top of the drum with your legs dangling off the same side of the drum as the ropes (don't physically try this, please). If the ropes pay-off from the center of the drum winding towards the ends when lowering (ie: rope clamps are at the ends of the drum), then the grooves on your right are the right hand grooves and the grooves on your left are the left hand grooves. If the ropes pay-off in the opposite manner (ie: from the ends of the drum winding towards the center when lowering, with rope clamps located towards the center), then the grooves on your right are left hand grooves and the grooves on your left are right hand grooves. Confused? If so, try simulating the rotation of the drum with a screw and a piece of string; it may help (most off the shelf screws/bolts are right hand threads).

Re-machining Brake Wheels - How much is too much?

Everyone knows that the rotors on your cars brakes can only be machined (turned-down) so far before needing to be replaced. Well, the same goes for the brake wheels on your crane. The only problem here is finding out just how much is too much. Brake manufacturers are somewhat closed-lipped about this, but some do offer some guidance. One manufacturer suggests machining away no more than 10% of the rim thickness. Others give specific minimum outside diameters for re-machined wheels (varying from 1/16" under nominal diameter for the smaller wheels to as much as 1/8" under for the larger diameters). For specific guidance, contact the brake manufacturer or call us and we'll tell you what we've been told.

Hook Block Twist - Can this be straightened-out?

If your hook block is hanging in a twisted fashion (twisted about the vertical axis), don't immediately run off and blame the people who reeved it. Hoist units with relatively long lifts (reach) and with relatively few parts of hoist rope can often have hook blocks that hang in such a twisted fashion. It seems that the helical construction of the hoist rope can cause this to happen, though its predictability is rather elusive. How do we fix this problem? Well, there are several different solutions that have been tried, each with varying degrees of success. One such solution is to replace the rope with rotation resistant rope that is specifically constructed so as to avoid this problem. Generally speaking, this type of rope is constructed so that the lay of the outer strands are in the opposite direction to the lay of the inner strands. According to reports that we get, this approach has had only limited success at best. Of course, prior to any rope substitution, consideration must be given to such things as rope strength, sheave and drum size, etc. Another solution that has been tried, supposedly with fairly good success, is to reeve the block with both right and left lay rope, placing the left lay rope in the right hand grooves of the drum and the right lay rope in the left hand grooves. This, of course, can only be accomplished on hoists that utilize a dead end rope connection at the equalizer (in lieu of an equalizer sheave type of arrangement where just 1 continuous rope is used for the reeving). On hoists that

use the equalizer sheave type of arrangement, it may be possible to change to an equalizer bar type that incorporates the dead end connection, thus accommodating this type of solution. Such a change would, of course, require engineering, design and detail drawings.

Hook Latches - Are they required?

Yes, no, sometimes. Though not specified in OSHA 29CFR1910.179, ASME B30.2 does require the use of hook latches in most cases, but it also offers some relief from the requirement. Specifically, the language within ASME states that "latch-equipped hooks shall used unless the application makes the use of the latch impractical or unnecessary".

Hook Inspections - What does OSHA say?

Under [OSHA](#) regulations, hooks and chains must be visually inspected on a daily and monthly basis, with the monthly inspection recorded on a certificate form that includes the date of inspection, the signature of the person who performed the inspection and the serial number, or other identifier, of the hook or chain inspected.

Hook Rejection Criteria - How bad is bad?

According to ASME B30.10, hooks must be replaced when a) the hook has an increased throat opening exceeding 15% of the original design; or b) the hook is bent or twisted by more than 10 degrees; or c) the hook is worn more than 10% of the original dimension. Minor surfacecracks or gouges can be ground out as long as no more than 10% of the hook section is removed.

Rejected Hooks - can we save the patient?

Generally speaking, no. Give the hook its last rites, discard it and replace it. Repairing hooks by welding and reshaping is not generally recommended by OSHA or ASME. If you don't like this answer, there is one reference to which you can turn. In an interpretation letter from OSHA, a specified procedure for repairing hooks was submitted and approved by OSHA (wewere shocked too when we found this!). We don't give any endorsement for this procedure, but if you're interested in seeing it, hit this link to the [OSHA](#) web site, then click on the interpretations button.

Wire Rope Replacement Criteria - What is bad rope?

According to ASME B30.2, replacement criteria for wire rope operating on steel sheaves and drums shall be as follows: _ In running ropes, twelve randomly distributed broken wires in one lay or four broken wires in one strand in one lay. One outer wire broken at the contact point with the core of the rope, which has worked its way out of the rope structure and protrudes or loops out from the rope structure. Wear of one-third the original diameter of outside individual wires. Kinking, crushing, birdcaging, or any other damage resulting in distortion of the rope structure. Evidence of heat damage from any cause. Reductions from

nominal diameter greater than those listed below: 1/64" for ropes up to 5/16" diameter.

1/32" for ropes over 5/16" diameter up to 1/2" diameter.

3/64" for ropes over 1/2" diameter up to 3/4" diameter.

1/16" for ropes over 3/4" diameter up to 1 1/8" diameter.

3/32" for ropes over 1 1/8" diameter up to 1 1/2" diameter.

Operator Cabs - Lets give them a hand!

So you've been talking to an overhead crane salesman or perhaps an engineer or whoever, and the subject of operator cabs comes up. Then the term left hand cab or right hand cab is thrown-out to you and you're not quite sure just what this means. Well, as you suspect, it refers to the location of the cab, one end of the crane versus the other end. But which is which? OK, here it is. If you are looking at the girder on which the cab is mounted, with the other girder behind it, the cab is a right hand cab if it is mounted on the right hand side of the crane.

Conversely, the cab is a left hand cab if it is mounted on the left hand side. If the cab is at the center, it is called a center mounted cab, which is generally a different beast altogether. And one more thing, a left hand cab is physically different than a right hand cab; in fact, it is opposite hand. So, on the subject of existing cranes, changing (moving) a cab to the other end (on the same girder) may not be as easy as it sounds.

Hoist Limit Switches - Pretty much failsafe, right?

Wrong! A great many rope failures (dropped blocks) can be attributed to failure of the hoist limit switch, which can result in the hook block being hoisted into the bottom of the trolley frame structure (two blocking). In many cases, the failure stems from the fact that the limit switch drop weight did not come into contact with the hook block in the high position. Typically, this weight is loosely wrapped around one or more of the equalized (non-moving) hoist ropes to insure contact with the hook block. Should this weight become dislodged from this rope(s), contact with the block may not occur, thus rendering the limit switch ineffective. Another possible cause for limit switch failure is the "freezing-up" of the make/break mechanism inside the switch. According to [OSHA](#), the hoist limit switch must be operationally checked under no load at the beginning of each shift. The purpose of this check is two-fold. It not only verifies the operation of the switch, it also "exercises" the make/break mechanism, thus reducing the chances of it "freezing-up".

Fatigue Cracking of Cranes Made From High-strength Steel:

Bridge and trolley structures made of high-strength steel (typically ASTM A-242 among others) and manufactured in the 1950's, 1960's, and even the early 1970's are beginning to show signs of fatigue cracking. Why so soon? Generally speaking, the reason for this is that the original designs (and standards in effect at that time) did not account for fatigue considerations and were based largely on allowable stresses that increased as the strength of the steel increased. Sounds reasonable right? Well, today's crane standards require consideration of

fatigue and give no increase in allowable stress range for the high-strength steel. We are now finding that the current standards are quite justified in this approach as we are beginning to see fractures developing in fatigue sensitive areas such as weep holes, ends of partial length cover plates, ends of stiffeners, etc. Members made from high-strength steel are especially susceptible to this since the increase in original design stresses also resulted in an increase in the design stress range for fatigue (an increase not permitted under today's standards). For this reason, end users of these types of cranes should be particularly concerned with such fatigue sensitive areas of the structure.

Lost Girder Camber - Reason for concern?

Well, maybe. Camber, in and by itself, in no way relates (significantly) to the strength of the girder. Its sole purpose is to control girder deflection relative to the horizontal. When designed new, girders are made with a positive camber equal to the dead load deflection plus 50% of the live load deflection (with girder laying on it's side). This is simply to limit the amount of girder deflection below horizontal, thus helping to prevent the trolley from drifting towards center of the span when loaded. The girder will still deflect its full amount, just from a different starting point. Over time, this camber will start to flatten-out and may even go negative (ie: below horizontal). The big question of course is how much negative camber is acceptable. Well, no one has yet to go out on that limb and set forth any specific criteria. Many end users have resorted to installing a trolley travel brake or to shimming under the trolley rail when trolley drift becomes a problem, still using the girders for many years after. When negative camber does become evident however, it should not be totally ignored, especially when such loss of camber is rather sudden. Negative camber may be an indication of some failure in the structure, typically (but not exclusively) on the bottom tension flange of the girder. Overall, girders found to have negative camber should be given a thorough inspection and then frequently monitored thereafter.

Structural Connections - General Information

Generally speaking, the main structural connections on overhead traveling cranes are made with high strength bolts, usually either ASTM A-325 or A-490 designation. This should always be the case for cranes designed to the current edition of AISE Technical Report No. 6, which prohibits the use of low carbon bolts (ASTM A-307) for structural connections. High strength bolted connections are designed either as "friction type" or "bearing type" connections. Friction type connections, also termed "slip-critical connections", are designed so that the clamping forces of the connection will prevent the joining surfaces from slipping relative to each other under applied load. On the other hand, bearing type connections are designed to permit such relative movement under applied load, allowing the joining surfaces to bear against the body of the bolt. There is no physical difference in the bolts that are used for these two types of connections, the only difference is in what is allowed to occur by design. Consequently, bearing type connections are permitted a greater shear load than friction type

connections. It should be noted however, that bearing type connections may not be considered adequate for some applications, including joints subject to fatigue loading and/or significant load reversal, joints with bolts installed in oversized holes, joints in which bolts and welds share the applied load, joints with bolts installed in slotted holes where the applied load is in a direction not normal to the axis of the slot, or any other joints in which slip would critically affect the performance of the joint or structure. Of course, the proper performance of a connection made with high strength bolts depends on its proper installation and maintenance. First of all, high strength bolts must be used with nuts and washers that are compatible with the bolt material. For A-325 bolts (Types 1 and 2, plain, uncoated), this usually means using a nut conforming to ASTM A563 (Grade C, C3, D, DH or D3, plain), or ASTM A194 (Grade 2 or 2H, plain). For A-490 bolts (Types 1 and 2, plain), nuts conforming to ASTM A563 (Grade DH or DH3, plain) or ASTM A194 (Grade 2H, plain) are usually used. In either case, hardened flat washers conforming to ASTM F436 must be used under the turned part (spring type lock washers are not recommended for high strength bolted connections as they have a tendency to spread apart during installation). It is also necessary to assure that the bolts are installed with the proper tightening torque, which, for high strength bolts is specified as that torque that will produce a fastener tension equal to 70 percent of the ultimate tensile strength of the bolt material. This is usually accomplished by either the "turn-of-the-nut" method or calibrated wrench.. There are of course other things to consider, such as hole size, surface condition, etc., all of which are outside the scope of this discussion here but are outlined in detail in the AISC Manual of Steel Construction. As for maintenance, reuse of A490 bolts and galvanized A325 bolts is prohibited (retightening previously tightened bolts which have become loose by the tightening of adjacent bolts is not considered "reuse").

Crane Overloads - What is allowed?

On a routine basis, the amount of load a crane can "legally" lift, as a percent of its rated capacity, is 100.0000%, with a tolerance of +.000%/-100% (get the idea?). All kidding aside however, ASME B30.2 does provide for what is termed "planned engineered lifts" where it is necessary to make very occasional lifts (generally 2 lifts/year) in excess of rated capacity (cranes 5 ton capacity and above). The procedure varies depending on whether the lift is over 125% of the rated capacity, but generally includes a written plan, engineering analysis if over 125%, pre-lift and post-lift inspections of the crane, permanent record keeping, etc. In cases where the heavy lift occurs more frequently, ASME suggests a permanent rerating of the crane, which of course requires a formal engineering study and load test. It is noted here that OSHA 29CFR1910.179 does not, in fact, provide for or mention anything relative to such planned engineered lifts, however, in a letter of interpretation from OSHA concerning these types of lifts, the ASME procedure was deemed acceptable (reference [OSHA](#) web site).

Crane Test Loads - Acceptable tolerance

In the past, crane test loads were specified at 125% of rated capacity by both OSHA and ASME. Neither standard, however, would specify an acceptable tolerance over or under the 125% figure. The only reference to such a tolerance was given in an interpretation by ASME B30.2. Though not considered a part of the standard, this interpretation suggested a tolerance of $+0\%/-4\%$ on the weight of the test load. In effect, this suggested a test load weighing between 120% and 125% of the rated crane capacity (ie: $125\% - 125\% \times .04 = 120\%$). It is interesting to note here, however, that recent revisions to both the OSHA and ASME standards now suggest that the test weight be no less than 100% of rated capacity and no more than 125% of capacity. In other words, test loads equal to the rated capacity are now considered adequate. This would seem to indicate a major change in the requirements for load testing of cranes, which previously dictated a test weight of 125% of the capacity.