

General Safety & Health Standards
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Cranes 281

281. CRANES

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281. CRANES. (7-1-97)

01. Scope: (7-1-97)

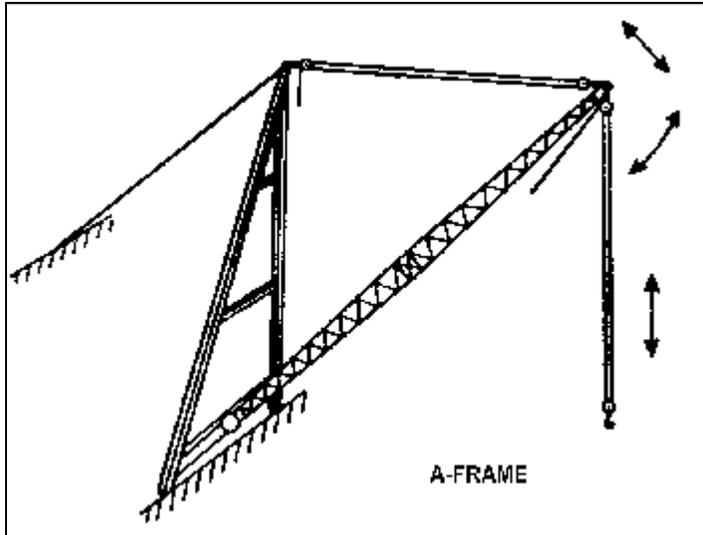
a. Crane operations and material handling shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. (7-1-97)

02. Definitions: For definitions of other terms used in this section, see sub-section 010 of this standard. (7-1-97)

a. Accessory is a secondary part or assembly of parts which contributes to the overall function and usefulness of a machine. (7-1-97)

b. A-Frame Derrick is a derrick in which the boom is hinged from a cross member between the bottom ends of two (2) upright members spread apart at the lower ends and joined at the top; the boom point secured to the junction of the side members, and the side members are braced or guyed from this junction point. (See Figure 281.2-A.) (7-1-97)

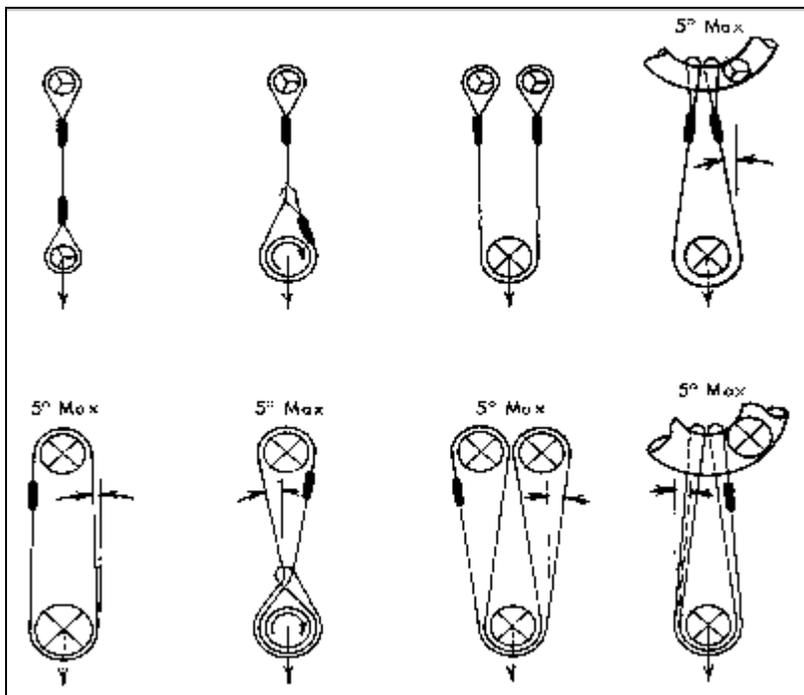
FIGURE 281.02-A



c. Angle Indicator (boom) is an accessory which measures the angle of the crane boom to the horizontal. (7-1-97)

d. Angle of Loading is the inclination of a leg or branch of a sling measured from the horizontal or vertical plane as shown in Figure 281.02-B, provided that an angle of loading of five (5) degrees or less from the vertical may be considered a vertical angle of loading. (7-1-97)

FIGURE 281.02-B



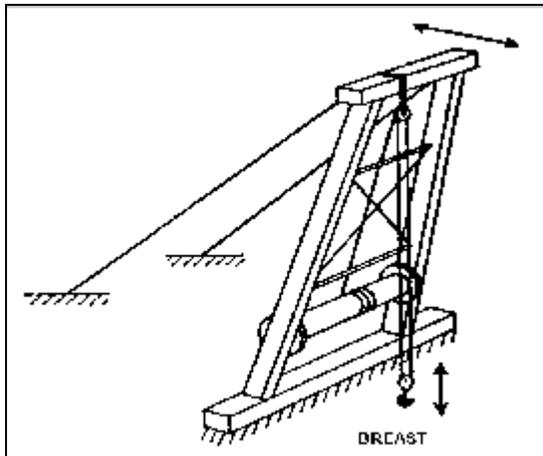
e. Automatic Crane is a crane which when activated operates through a preset cycle or cycles. (7-1-97)

- f.** Auxiliary Hoist is a supplemental hoisting unit of lighter capacity and usually of a higher speed than provided for the main hoist. (7-1-97)
- g.** Axis of Rotation is the vertical axis around which the crane superstructure rotates. (7-1-97)
- h.** Axle is the shaft or spindle with which or about which a wheel rotates. On truck- and wheel-mounted cranes, it refers to an automotive type of axle assembly including housings, gearing, differential, bearings, and mounting appurtenances. (7-1-97)
- i.** Axle (Bogie) is two (2) or more automotive-type axles mounted in tandem in a frame so as to divide the load between the axles and permit vertical oscillation of the wheels. (7-1-97)
- j.** Base (mounting) is the traveling base or carrier on which the rotating superstructure is mounted such as a car, truck, crawlers, or wheel platform. (7-1-97)
- k.** Basket Hitch is a sling configuration whereby the sling is passed under the load and has both ends, end attachments, eyes or handles on the hook or a single master link. (7-1-97)
- l.** Boom (crane) is a member hinged to the front of the rotating superstructure with the outer end supported by ropes leading to a gantry of A frame and used for supporting the hoisting tackle. (7-1-97)
- m.** Boom (derrick) is a timber or metal section or strut, pivoted or hinged at the heel (lower end) at a location fixed in height on a frame or mast or vertical member, and with its point (upper end) supported by chains, ropes, or rods to the upper end of the frame mast, or vertical member. A rope for raising and lowering the load is reeved through sheaves or a block at the boom point. The length of the boom shall be taken as the straight line distance between the axis of the foot pin and the axis of the boom point sheave pin, or where used, the axis of the upper load block attachment pin. (7-1-97)
- n.** Boom Angle is the angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centerline is a straight line between the boom foot pin (heel pin) centerline and boom point sheave pin centerline. (7-1-97)
- o.** Boom Harness is the block and sheave arrangement on the boom point to which the topping lift cable is reeved for lowering and raising the boom. (7-1-97)
- p.** Boom Hoist is a hoist drum and rope reeving system used to raise and lower the boom. The rope system may be all live reeving or a combination of live reeving and pendants. (7-1-97)
- q.** Boom Point is the outward end of the top section of the boom. (7-1-97)
- r.** Boom Stop is a device used to limit the angle of the boom at the highest position. (7-1-97)
- s.** Brake is a device used for retarding or stopping motion by friction or power means. (7-1-97)

t. Braided Wire Rope is a wire rope formed by plaiting component wire ropes. (7-1-97)

u. Breast Derrick is a derrick without boom. The mast consists of two (2) side members spread farther apart at the base than at the top and tied together at top and bottom by rigid members. The mast is prevented from tipping forward by guys connected to its top. The load is raised and lowered by ropes through a sheave or block secured to the top crosspiece. (See Figure 281.02-C.) (7-1-97)

FIGURE 281.02-C



v. Bridge is that part of a crane consisting of girders, trucks, end ties, foot walks, and drive mechanism which carries the trolley or trollies. (7-1-97)

w. Bridge Travel is the crane movement in a direction parallel to the crane runway. (7-1-97)

x. Bridle Wire Rope Sling is a sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook. (7-1-97)

y. Bumper (Buffer) is an energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel; or when two (2) moving cranes or trollies come in contact. (7-1-97)

z. Cab is the operator's compartment on a crane. (7-1-97)

aa. Cab-Operated Crane is a crane controlled by an operator in a cab located on the bridge or trolley. (7-1-97)

bb. Cable Laid Endless Sling Mechanical Joint is a wire rope sling made end-less by joining the ends of a single length of cable laid rope with one or more metallic fittings. (7-1-97)

cc. Cable Laid Grommet-Hand Tucked is an endless wire rope sling made from one length of rope wrapped six (6) times around a core formed by hand tucking the ends of the rope inside the six wraps. (7-1-97)

dd. Cable Laid Rope is a wire rope composed of six (6) wire ropes wrapped around a fiber or wire rope core. (7-1-97)

ee. Cable Laid Rope Sling-Mechanical Joint is a wire rope sling made from a cable laid rope with eyes fabricated by pressing or swagging one (1) or more metal sleeves over the rope junction. (7-1-97)

ff. Cantilever Gantry Crane is a gantry or semi-gantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one (1) or both sides. (7-1-97)

gg. Choker Hitch is a sling configuration with one end of the sling passing under the load and through an end attachment, handle or eye on the other end of the sling. (7-1-97)

hh. Clearance is the distance from any part of the crane to a point of the nearest obstruction. (7-1-97)

ii. Clutch is a fraction, electromagnetic, hydraulic, pneumatic, or positive mechanical device for engagement or disengagement of power. (7-1-97)

jj. Coating is an elastomer or other suitable material applied to a sling or to a sling component to impart desirable properties. (7-1-97)

kk. Collectors (current) are contacting devices for collecting current from runways or bridge conductors. (7-1-97)

ll. Conductors, Bridge, are the electrical conductors located along the bridge structure of a crane to provide power to the trolley. (7-1-97)

mm. Conductors, Runway (main), are the electrical conductors located along a crane runway to provide power to the crane. (7-1-97)

nn. Control Braking is a method of controlling crane motor speed when in an overhauling condition. (7-1-97)

oo. Controller, Spring Return, is a controller which when released will return automatically to a neutral position. (7-1-97)

pp. Counter Torque is a method of control by which the power to the motor is reversed to develop torque in the opposite direction. (7-1-97)

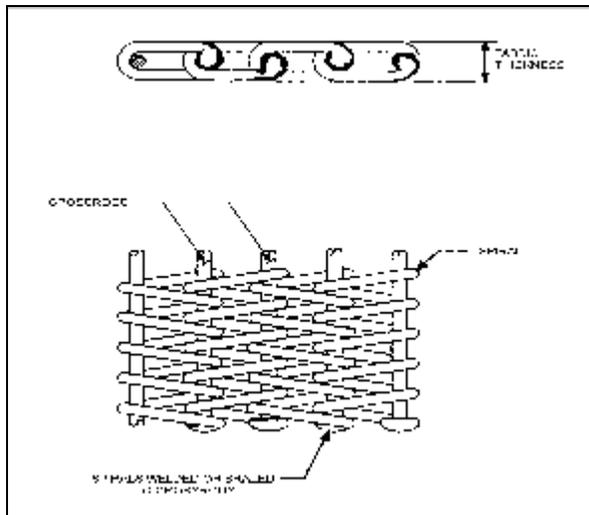
qq. Counterweight is a weight used to supplement the weight of the machine in providing stability for lifting working loads. (7-1-97)

rr. Crane is a machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine. Cranes whether fixed or mobile are driven manually or by power. (7-1-97)

ss. Crawler Crane consists of a rotating superstructure with power plant, operating machinery, and boom, mounted on a base, equipped with crawler treads for travel. Its function is to hoist and swing loads at various radii. (7-1-97)

tt. Cross Rod is a wire used to join spirals of metal mesh to form a complete fabric. (See Figure 281.02-D). (7-1-97)

FIGURE 281.02-D



head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes. (7-1-97)

uu. Derrick Bullwheel is a horizontal ring or wheel, fastened to the foot of a derrick, for the purpose of turning the derrick by means of ropes leading from this wheel to a powered drum. (7-1-97)

xx. Drag Brake is a brake which provides retarding force without external control. (7-1-97)

yy. Drift Point is a point on a travel motion controller which releases the brake while the motor is not energized. This allows for coasting before the brake is set. (7-1-97)

zz. Drum is the cylindrical member around which the ropes are wound for raising or lowering the load. (7-1-97)

aaa. Dynamic is a method of controlling crane motor speeds when in the overhauling condition to provide a retarding force. (7-1-97)

bbb. Dynamic (loading) is loads introduced into the machine or its components by forces in motion. (7-1-97)

ccc. Emergency Stop Switch is a manually or automatically operated electric switch to cut off electric power independently of the regular operating controls. (7-1-97)

ddd. Equalizer is a device which compensates for unequal length or stretch of a rope. (7-1-97)

eee. Exposed is to be capable of being contacted inadvertently. Applied to hazardous objects not adequately guarded or isolated. (7-1-97)

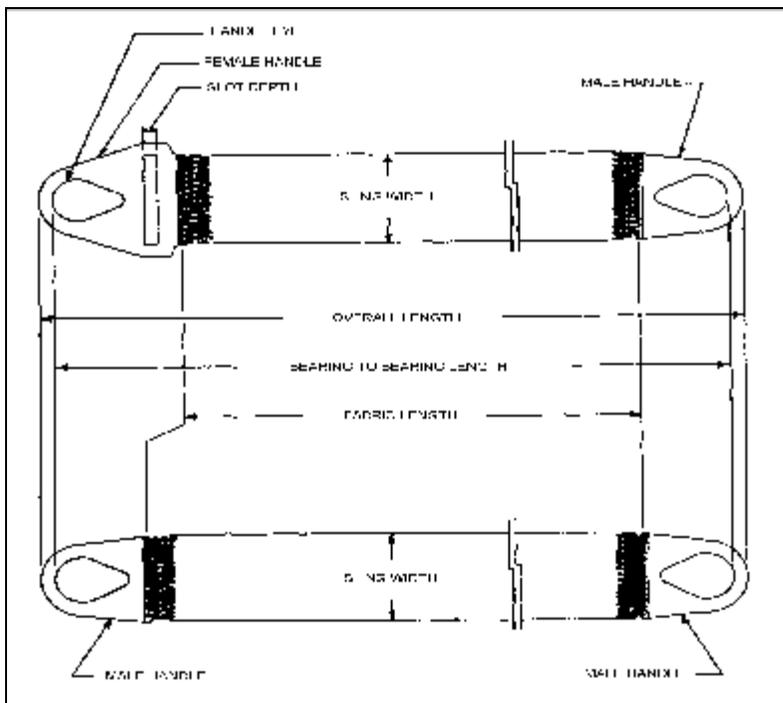
fff. Eye is a loop formed at the end of a rope by securing the dead end to the live end at the base of the loop. (7-1-97)

ggg. Fabric (Metal mesh) is the flexible portion of a metal mesh sling consisting of a series of transverse coils and cross rods. (See Figure 281.02-D.) (7-1-97)

hhh. Fail-Safe is a provision designed to automatically stop or safely control any motion in which a malfunction occurs. (7-1-97)

iii. Female Handle (choker) is a handle with a handle eye and slot of such dimension as to permit passage of a male handle thereby allowing the use of a metal mesh sling in a choker hitch. (See Figure 281.02-E). (7-1-97)

FIGURE 281.02-E



jjj. Fiddle Block is a block consisting of two (2) sheaves in the same plane held in place by the same cheek plates. (7-1-97)

kkk. Floor-Operated Crane is a crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform. (7-1-97)

lll. Foot Bearing or Foot Block (Sill Block) is the lower support on which the mast rotates. (7-1-97)

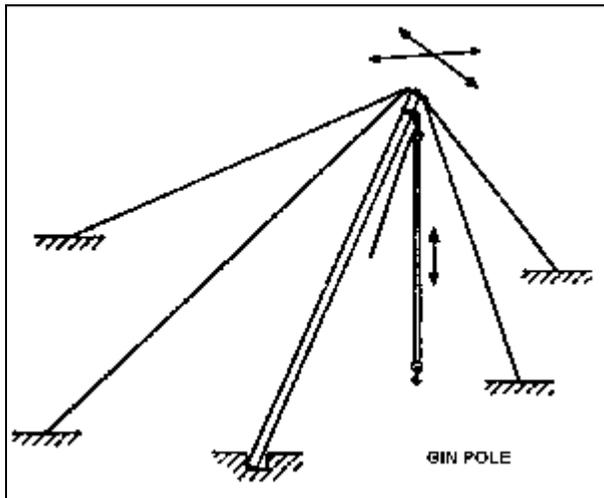
mmm. Footwalk is the walkway with handrail, attached to the bridge or trolley for access purposes. (7-1-97)

nnn. Gantry (A-frame) is a structure frame, extending above the superstructure, to which the boom support ropes are reeved. (7-1-97)

ooo. Gantry Crane is a crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two (2) or more legs running on fixed rails or other runway. (7-1-97)

ppp. Gin Pole Derrick is a derrick without a boom. Its guys are so arranged from its top as to permit leaning the mast in any direction. The load is raised and lowered by ropes reeved through sheaves or blocks at the top of the mast. (See Figure 281.02-F.) (7-1-97)

FIGURE 281.02-F



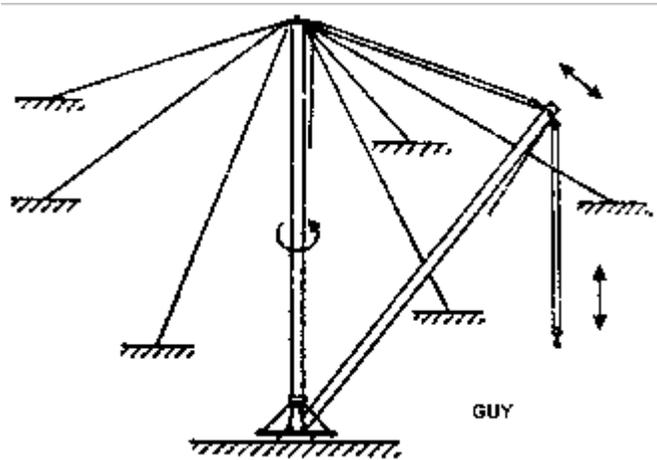
qqq. Gudgeon Pin is a pin connecting the mast cap to the mast allowing rotation of the mast. (7-1-97)

rrr. Guy is a rope used to steady or secure the mast or other member in the desired position. (7-1-97)

sss. Guy Derrick is a fixed derrick consisting of a mast capable of being rotated, supported in a vertical position by guys, and a boom whose bottom end is hinged or pivoted to move in a vertical plane with a reeved rope between the head of the mast and the boom point for raising

and lowering the boom, and a reeved rope from the boom point for raising and lowering the load. (See Figure 281.02-G.) (7-1-97)

FIGURE 281.02-G



ttt. Handle is a terminal fitting to which metal mesh fabric is attached. (See Figure 281.02-E). (7-1-97)

uuu. Handle Eye is an opening in a handle of a metal mesh sling shaped to accept a hook, shackle or other lifting device. (See Figure 281.02-E). (7-1-97)

vvv. Hitch is a sling configuration whereby the sling is fastened to an object or load, either directly to it or around it. (7-1-97)

www. Hoist is an apparatus which may be a part of a crane, exerting a force for lifting or lowering. (7-1-97)

xxx. Hoist Chain is the load bearing chain in a hoist. NOTE: Chain properties do not conform to those shown in ANSI B30.9, Safety Code for Slings. (7-1-97)

yyy. Hoist Motion is that motion of a crane which raises and lowers a load. (7-1-97)

zzz. Holding Brake is a brake that automatically prevents motion when power is off. (7-1-97)

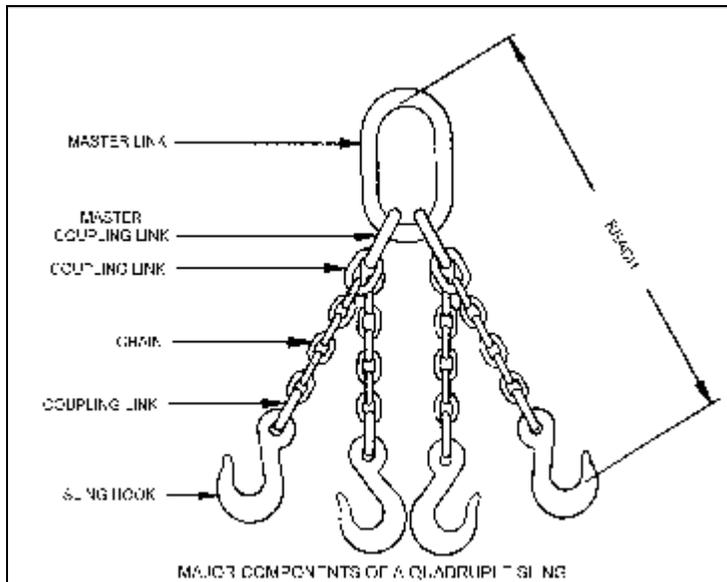
aaaa. Hot Metal Handling Crane is an overhead crane used for transporting or pouring molten material. (7-1-97)

bbbb. Jib is an extension attached to the boom point to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset to various angles. (7-1-97)

cccc. Limit Switch is a switch which is operated by some part or motion of a power-driven machine or equipment to alter the electric circuit associated with the machine or equipment. (7-1-97)

dddd. Link is a single ring of a chain. (See Figure 281.02-H). (7-1-97)

FIGURE 281.02-H



eeee. Load is the total superimposed weight on the load block or hook. (7-1-97)

ffff. Load (working) is the external load, in pounds, applied to the crane/derrick, including the weight of load attaching equipment such as load blocks, shackles, and slings. (7-1-97)

gggg. Load Block is the assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope. (7-1-97)

hhhh. Load Block (upper) is the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended from the boom point. (7-1-97)

iiii. Load Block (lower) is the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes. (7-1-97)

jjjj. Load Hoist is a hoist drum and rope reeving system used for hoisting and lowering loads. (7-1-97)

kkkk. Load Ratings are crane ratings in pounds established by the manufacturer in accordance with sub-section 281.12.c of this section. (7-1-97)

llll. Magnet is an electromagnetic device carried on a crane hook to pick up loads magnetically. (7-1-97)

mmmm. Main Hoist is the hoist mechanism provided for lifting the maximum rated load. (7-1-97)

- nnnn.** Main Switch is a switch controlling the entire power supply to the crane. (7-1-97)
- oooo.** Male Handle (Triangle) means a handle with a handle eye. (See Figure 281.02-E). (7-1-97)
- pppp.** Man Trolley is a trolley having an operator's cab attached thereto. (7-1-97)
- qqqq.** Mast is the upright member of the derrick. (7-1-97)
- rrrr.** Mast Cap (spider) is the fitting at the top of the mast to which the guys are connected. (7-1-97)
- ssss.** Master Coupling Link is an alloy steel welded coupling link used as an intermediate link to join alloy steel chain to master links. (See Figure 281.02-G). (7-1-97)
- tttt.** Master Link or Gathering Ring is a forged or welded steel link used to support all members (legs) of an alloy steel chain sling or wire rope sling (See Figure 281.02-G). (7-1-97)
- uuuu.** Master Switch is a switch which dominates the operation of contractors, relays, or other remotely operated devices. (7-1-97)
- vvvv.** Mechanical is a method of control by friction. (7-1-97)
- wwww.** Mechanical Coupling Link is a non-welded, mechanically closed steel link used to attach master links, hooks, etc., to alloy steel chain. (7-1-97)
- xxxx.** Outriggers are extendable or fixed metal arms, attached to the mounting base, which rests on supports at the outer ends. (7-1-97)
- yyyy.** Overhead Crane is a crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure. (7-1-97)
- zzzz.** Power-Operated Crane is a crane whose mechanism is driven by electric, air, hydraulic, or internal combustion means. (7-1-97)
- aaaaa.** Proof Load is the load applied in performance of a proof test. (7-1-97)
- bbbbbb.** Proof Test is a nondestructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling. (7-1-97)
- cccc.** Pulpit-Operated Crane is a crane operated from a fixed operator station not attached to the crane. (7-1-97)
- dddd.** Rated Capacity or Working Load Limit is the maximum working load permitted by the provisions of this section. (7-1-97)

eeee. Rated Load is the maximum load for which a crane or individual hoist is designed and built by the manufacturer and shown on the equipment nameplate(s). (7-1-97)

ffff. Reach is the effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component. (7-1-97)

gggg. Reeving is a rope system in which the rope travels around drums and sheaves. (7-1-97)

hhhh. Regenerative is a form of dynamic braking in which the electrical energy generated is fed back into the power system. (7-1-97)

iiii. Remote-Operated Crane is a crane controlled by an operator not in a pulpit or in the cab attached to the crane, by any method other than pendant or rope control. (7-1-97)

jjjj. Rope refers to wire rope, unless otherwise specified. (7-1-97)

kkkk. Running Sheave is a sheave which rotates as the load block is raised or lowered. (7-1-97)

llll. Runway is an assembly of rails, beams, girders, brackets, and framework on which the crane or trolley travels. (7-1-97)

mmmm. Safety Hook is a hook with a latch to prevent slings or load from accidentally slipping off the hook. (7-1-97)

nnnn. Selvage Edge is the finished edge of synthetic webbing designed to prevent unraveling. (7-1-97)

oooo. Semi-gantry Crane is a gantry crane with one end of the bridge rigidly supported on one (1) or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway. (7-1-97)

pppp. Shearing Derrick is a derrick without a boom and similar to a breast derrick. The mast, wide at the bottom and narrow at the top, is hinged at the bottom and has its top secured by a multiple reeved guy to permit handling loads at various radii by means of load tackle suspended from the mast top. (7-1-97)

qqqq. Side Loading is a load applied at an angle to the vertical plane of the boom. (7-1-97)

rrrr. Side Pull is that portion of the hoist pull acting horizontally when the hoist lines are not operated vertically. (7-1-97)

ssss. Sill is a member connecting the foot block and stiff-leg or a member connecting the lower ends of a double member mast. (7-1-97)

tttt. Sling is an assembly which connects the load to the material handling equipment. (7-1-97)

uuuuu. Sling Manufacturer is a person or organization that assembles sling components into their final form for sale to users. (7-1-97)

vvvvv. Spiral is a single transverse coil that is the basic element from which metal mesh is fabricated. (See Figure 281.02-D). (7-1-97)

wwwww. Span is the horizontal distance center to center of runway rails. (7-1-97)

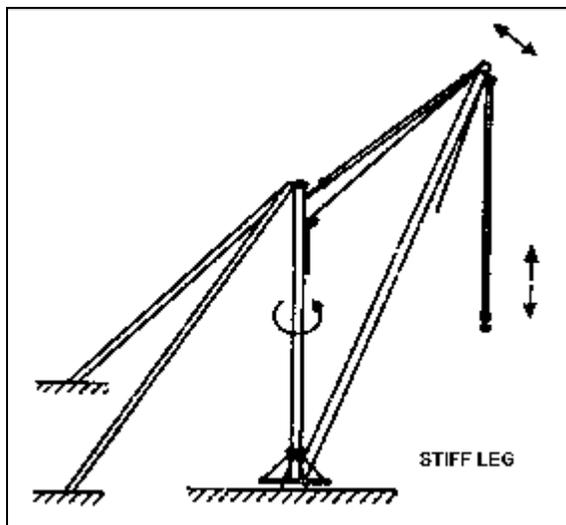
xxxxx. Standby Derrick is a derrick not in regular service which is used occasionally or intermittently as required. (7-1-97)

yyyyy. Standby Crane is a crane which is not in regular service but which is used occasionally or intermittently as required. (7-1-97)

zzzzz. Standing (Guy) Rope is a supporting rope which maintains a constant distance between the points of attachment to the two (2) components connected by the rope. (7-1-97)

aaaaa. Stiff Leg Derrick is a derrick similar to a guy derrick except that the mast is supported or held in place by two (2) or more stiff members, called stiff-legs, which are capable of resisting either tensile or compressive forces. Sills are generally provided to connect the lower ends of the stiff-legs to the foot of the mast. (See Figure 281.02-I.) (7-1-97)

FIGURE 281.02-I



bbbbbb. Still Leg is a rigid member supporting the mast at the head. (7-1-97)

ccccc. Structural Competence is the ability of the machine and its components to withstand the stresses imposed by applied loads. (7-1-97)

dddddd. Stop is a device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy absorbing ability. (7-1-97)

eeeeee. Storage Bridge Crane is a gantry type crane of long span usually used for bulk storage of material; the bridge girders or trusses are rigidly or non-rigidly supported on one or more legs. It may have one or more fixed or hinged cantilever ends. (7-1-97)

ffffff. Strand Laid Endless Sling Mechanical Joint is a wire rope sling made endless from one length or rope with the ends joined by one or more metallic fittings. (7-1-97)

gggggg. Strand Laid Grommet-hand Tucked is an endless wire rope sling made from one length of strand wrapped six times around a core formed by hand tucking the ends of the strand inside the six (6) wraps. (7-1-97)

hhhhhh. Strand Laid Rope is a wire rope made with strands (usually six (6) or eight (8)) wrapped around a fiber core, wire strand core, or independent wire rope core (IWRC). (7-1-97)

iiiiii. Superstructure is the rotating upper frame structure of the machine and the operating machinery mounted thereon. (7-1-97)

jjjjjj. Swing is the rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation. (7-1-97)

kkkkkk. Swing Mechanism is the machinery involved in providing rotation of the superstructure. (7-1-97)

llllll. Switch is a device for making, breaking, or for changing the connections in an electric circuit. (7-1-97)

mmmmmm. Tackle is an assembly of ropes and sheaves arranged for hoisting and pulling. (7-1-97)

nnnnnn. Transit is the moving or transporting of a crane from one job site to another. (7-1-97)

oooooo. Travel is the functions of the machine moving from one location to another, on a job site. (7-1-97)

pppppp. Travel Mechanism is the machinery involved in providing travel. (7-1-97)

qqqqqq. Trolley is the unit which travels on the bridge rails and carries the hoisting mechanism. (7-1-97)

rrrrrr. Trolley Travel is the trolley movement at right angles to the crane runway. (7-1-97)

ssssss. Trolley Truck is the unit consisting of a frame, wheels, bearings, and axles which supports the bridge girders or trolleys. (7-1-97)

tttttt. Truck Crane consists of a rotating superstructure with power plant, operating machinery and boom, mounted on an automotive truck equipped with a power plant for travel. Its function is to hoist and swing loads at various radii. (7-1-97)

uuuuuu. Vertical Hitch is a method of supporting a load by a single, vertical part or leg of the sling. (7-1-97)

vvvvvv. Wall Crane is a crane having a jib with or without trolley and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall of columns. (7-1-97)

wwwwww. Wheelbase is the distance between centers of front and rear axles. For a multiple axle assembly the axle center for wheelbase measurement is taken as the mid-point of the assembly. (7-1-97)

xxxxxx. Wheel Mounted Crane (Wagon Crane) consists of a rotating superstructure with power plant, operating machinery and boom, mounted on a base or platform equipped with axles and rubber-tired wheels for travel. The base is usually propelled by the engine in the superstructure, but it may be equipped with a separate engine controlled from the superstructure. Its function is to hoist and swing loads at various radii. (7-1-97)

yyyyyy. Whipline (auxiliary hoist) is a separate hoist rope system of lighter load capacity and higher speed than provided by the main hoist. (7-1-97)

zzzzzz. Winch Head is a power driven spool for handling of loads by means of friction between fiber or wire rope and spool. (7-1-97)

03. General Requirements: (7-1-97)

a. Storage of material shall not create a hazard. Bags, containers, bundles, etc., stored in tiers shall be stacked, blocked, interlocked and limited in height so that they are stable and secure against sliding or collapse. (7-1-97)

b. Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage. Vegetation control will be exercised when necessary. (7-1-97)

c. Proper drainage shall be provided. (7-1-97)

d. Clearance signs to warn of clearance limits shall be provided. (7-1-97)

e. Fire aisles, access to stairways, and fire equipment shall be kept clear. (7-1-97)

f. Cranes may be modified and re-rated provided such modifications and the supporting structure are checked thoroughly for the new rated load by a qualified engineer or the equipment manufacturer. The crane shall be tested in accordance with sub-section 281.06. of this section.

New rated load shall be displayed in accordance with sub-section 281.03.b. of this section. (7-1-97)

g. The rated load of the crane shall be plainly marked on each side of the crane, and if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block and this marking shall be clearly legible from the ground or floor. (7-1-97)

h. Minimum clearance of three (3) inches overhead and two (2) inches laterally shall be provided and maintained between crane and obstructions in conformity with Specification No. 61, Crane Manufacturers Association of America, Inc., Thomas Circle N. W., Washington, D. C. 20005. (7-1-97)

i. Where passageways or walkways are provided obstructions shall not be placed so that safety of personnel will be jeopardized by movements of the crane. An unobstructed aisle not less than three feet wide shall be maintained for travel of the operator except in such cases where the control handles are hung from the trolleys of traveling cranes. (7-1-97)

j. If the runways of two (2) cranes are parallel and there are no intervening walls, of structure, there shall be adequate clearance provided and maintained between the two (2) bridges. (7-1-97)

k. Only designated trained personnel shall be permitted to operate a crane covered by this section. (7-1-97)

l. The handles of control ropes shall be distinctly different in contour so that, without looking, the operator will know which is the hoisting and which is the lowering handle. The direction of all movements of the crane shall be clearly indicated in some manner so that the operator can easily become familiar with them. (7-1-97)

m. The general arrangement of the cab and the location of control and protective equipment shall be such that all operating handles are within convenient reach of the operator when facing the area to be served by the load hook, or while facing the direction of travel of the cab. The arrangement shall allow the operator a full view of the load hook in all positions. (7-1-97)

n. The cab shall be located to afford a minimum of three (3) inches clearance from all fixed structures within its area of possible movement. (7-1-97)

o. The clearance of the cab above the working floor or passageway shall be not less than seven (7) feet. (7-1-97)

p. Access to the cab and/or bridge walkway of a crane shall be by a conveniently placed fixed ladder, stairs, or platform, requiring no step over any gap exceeding twelve (12) inches. Fixed ladders shall be in conformance with the American National Standard Safety Code for Fixed Ladders, ANSI A14.3. The employer shall insure that hands are free from encumbrances while personnel are using ladders. Articles which are too large to be carried in pockets or belts shall be lifted and lowered by hand line. (7-1-97)

q. A carbon dioxide, dry-chemical, or equivalent hand fire extinguisher shall be kept in the crane cab. The employer shall insure that operators are familiar with the operation and care of fire extinguishers provided. (7-1-97)

r. There shall be a light in the crane cab that is sufficient to enable the operator to see clearly enough to perform his work. (7-1-97)

s. If sufficient headroom is available on cab-operated cranes, a footwalk shall be provided on the drive side along the entire length of the bridge of all cranes having the trolley running on the top of the girders. To give sufficient access to the opposite side of the trolley, there shall be provided either a footwalk mounted on the trolley, a suitable footwalk or platform in the building, or a footwalk on the opposite side of the crane at least twice the length of the trolley. (7-1-97)

t. Footwalks shall be located to give a headroom not less than seventy-eight (78) inches. In no case shall head room be less than forty-eight (48) inches. Footwalks shall be of rigid construction and designed to sustain a distributed load of at least fifty (50) pounds per square foot. Footwalks shall have an anti-slip walking surface. NOTE: Wood will meet this requirement. Footwalks shall be continuous and permanently secured. Footwalks shall have a clear passageway at least eighteen (18) inches wide except opposite the bridge motor, where they shall be not less than fifteen (15) inches. The inner edge shall extend at least to the line of the outside edge of the lower cover plate or flange of the girder. (7-1-97)

u. Toe boards and handrails shall be in compliance with sub-section 070.16. of this standard. (7-1-97)

v. Where required cranes shall be provided with ladders or stairways extending from the ground to the footwalk or cab platform. Stairways shall be equipped with rigid and substantial metal handrails. Walking surfaces shall be of an anti-slip type. Ladders and stairways shall be permanently and securely fastened in place and shall be constructed in compliance with sub-sections 071 and 072 of this standard. (7-1-97)

w. Trolley stops shall be provided at the limits of travel of the trolley. Stops shall be fastened to resist forces applied when contacted. A stop engaging the tread of the wheel shall be of a height at least equal to the radius of the wheel. (7-1-97)

x. Traveling cranes shall be provided with bumpers or other automatic means providing equivalent effect, unless the crane travels at a slow rate of speed and has a faster deceleration rate due to the use of sleeve bearings, or is not operated near the ends of bridge and trolley travel, or is restricted to a limited distance by the nature of the crane operation and there is no hazard of striking any object in this limited distance or is used in similar operating conditions. The bumpers shall be capable of stopping the crane (not including the lifted load) at an average rate of deceleration not to exceed three (3) feet/second/second when traveling in either direction at twenty (20) percent of the rated load speed. The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least forty (40) percent of rated load speed. The bumpers shall be so mounted that there is no direct shear on bolts. Bumpers shall be

so designed and installed as to minimize parts falling from the crane in case of breakage. (7-1-97)

y. A trolley shall be provided with bumpers or other automatic means of equivalent effect, unless the trolley travels at a slow rate of speed, or is not operated near the ends of the bridge and trolley travel, or is restricted to a limited distance of the runway and there is no hazard of striking any object in this limited distance, or is used in similar operating conditions. The bumpers shall be capable of stopping the trolley (not including the lifted load) at an average rate of deceleration not to exceed four-point-seven (4.7) feet/second/second when traveling in either direction at one-third (1/3) of the rated load speed. When more than one (1) trolley is operated on the same bridge, each shall be equipped with bumpers or equivalent on their adjacent ends. Bumpers or equivalent shall be designed and installed to minimize parts falling from the trolley in case of age. (7-1-97)

z. Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the truck wheels. (7-1-97)

aa. If hoisting ropes that run near enough to other parts to make fouling or chafing possible, shall have guards installed to prevent this condition. A guard shall be provided to prevent contact between bridge conductors and hoisting ropes. (7-1-97)

bb. Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components which might constitute a hazard under normal conditions shall be guarded. Guards shall be securely fastened. Each guard shall be capable of supporting without permanent distortion the weight of a two-hundred (200) pound person unless the guard is located where it is impossible for a person to step on it. (7-1-97)

cc. Each independent hoisting unit of a crane shall be equipped with at least one (1) self-setting brake, hereafter referred to as a holding brake, applied directly to motor shaft or some part of the gear train. Holding brakes for hoist motors shall have not less than the following percentage of the full load hoisting torque at the point where the brake is applied: (7-1-97)

i. One-hundred-twenty-five (125) percent when used with a control braking means other than mechanical; (7-1-97)

ii. One-hundred (100) percent when used in conjunction with a mechanical control braking means; (7-1-97)

iii. Or one-hundred (100) percent each if two (2) holding brakes are provided; (7-1-97)

iv. Holding brakes on hoists shall have ample thermal capacity for the frequency of operation required by the service. Holding brakes on hoists shall be applied automatically when power is removed. Where necessary, holding brakes shall be provided with adjustment means to compensate for wear. The wearing surface of all holding-brake drums or discs shall be smooth. Each independent hoisting unit of a crane handling hot metal and having power control braking means shall be equipped with at least two holding brakes. (7-1-97)

dd. Each independent hoisting unit of a crane, except worm-gear hoists, the angle of whose worm is such as to prevent the load from accelerating in the lowering direction shall, in addition to a holding brake, be equipped with control braking means to prevent over speeding. A power control braking means such as regenerative dynamic or Counter torque braking, or a mechanically controlled braking means shall be capable of maintaining safe lowering speeds of rated loads. The control braking means shall have ample thermal capacity for the frequency of operation required by service. (7-1-97)

ee. Foot operated brakes for trolleys and bridges shall not require an applied force of more than seventy (70) pounds to develop manufacturer's rated brake torque. Brakes may be applied by mechanical, electrical, pneumatic, hydraulic, or gravity means. Where necessary, brakes shall be provided with adjustment means to compensate for wear. The wearing surface of all brake drums or discs shall be smooth. All foot-brake pedals shall be constructed so that the operator's foot will not easily slip off the pedal. Foot-operated brakes shall be equipped with automatic means for positive release when pressure is released from the pedal. Brakes for stopping the motion of the trolley or bridge shall be of sufficient size to stop the trolley or bridge within a distance in feet equal to ten (10) percent of full load speed in feet per minute when traveling at full speed with full load. If holding brakes are provided on the bridge or trolley(s), they shall not prohibit the use of a drift point in the control circuit. Brakes on trolleys and bridges shall have ample thermal capacity for the frequency of operation required by the service to prevent impairment of functions from overheating. (7-1-97)

ff. On cab-operated cranes with cab on trolley, a trolley brake shall be required as specified under sub-section 281.03.z. of this section. A drag brake may be applied to hold the trolley in a desired position on the bridge and to eliminate creep with the power off. (7-1-97)

gg. On cab-operated cranes with cab on bridge, a bridge brake is required as specified under sub-section 281.03.z. of this section. On cab-operated cranes with cab on trolley, a bridge brake of the holding type shall be required. On all floor, remote, and pulpit-operated crane bridge drives, a brake or non-coasting mechanical drive shall be provided. (7-1-97)

hh. Wiring and equipment shall comply with section 150 of this standard and the National Electrical Code. The control circuit voltage shall not exceed six-hundred (600) volts for a.c. or d.c. current. The voltage at pendant push buttons shall not exceed one-hundred-fifty (150) volts for a.c. and three-hundred (300) volts for d.c. Where multiple conductor cable is used with a suspended push button station, the station shall be supported in a manner that will protect the electrical conductors against strain. Pendant control boxes shall be constructed to prevent electrical shock and shall be clearly marked for identification of functions. (7-1-97)

ii. Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions. Electric equipment shall be protected from dirt, grease, oil, and moisture. Guards for live parts shall be substantial and so located that they cannot be accidentally deformed so as to make contact with the live parts. (7-1-97)

jj. Cranes not equipped with spring-return controllers or momentary contact push buttons shall be provided with a device which will disconnect all motors from the line on failure of power and

will not permit any motor to be restarted until the controller handle is brought to the "OFF" position, or a reset switch or button is operated. (7-1-97)

kk. Lever operated controllers shall be provided with a notch or latch which in the "OFF" position prevents the handle from being inadvertently moved to the "ON" position. An off detent or spring return arrangement is acceptable. (7-1-97)

ll. The controller operating handle shall be located within convenient reach of the operator. (7-1-97)

mm. As far as practicable, the movement of each controller handle shall be in the same general directions as the resultant movements of the load. (7-1-97)

nn. The control for the bridge and trolley travel shall be so located that the operator can readily face the direction of travel. (7-1-97)

oo. For floor-operated cranes, the controller or controllers if rope operated, shall automatically return to the "OFF" position when released by the operator. (7-1-97)

pp. Push buttons in pendant stations shall return to the "OFF" position when pressure is released by the crane operator. (7-1-97)

qq. Automatic cranes shall be so designated that all motions shall fail-safe if any malfunction of operation occurs. (7-1-97)

rr. Remote-operated cranes shall function so that if the control signal for any crane motion becomes ineffective, the crane motion shall stop. (7-1-97)

ss. Enclosures for resistors shall have openings to provide adequate ventilation, and shall be installed to prevent the accumulation of combustible matter near hot parts. Resistor units shall be supported so as to be free as possible from vibration. Provision shall be made to prevent broken resistor parts or molten metal falling upon the operator or from the crane. (7-1-97)

tt. The power supply to the runway conductors shall be controlled by a switch or circuit breaker located on a fixed structure, accessible from the floor, and arranged to be locked in the open position. On cab-operated cranes, a switch or circuit breaker of the enclosed type with provision for locking in the open position shall be provided in the leads from the runway conductors. A means of opening this switch or circuit breaker shall be located within easy reach of the operator. On floor-operated cranes, a switch or circuit breaker of the enclosed type, with provision for locking in the open position, shall be provided in the leads from the runway conductors. This disconnect shall be mounted on the bridge or footwalk near the runway collectors. One (1) of the following types of floor operated disconnects shall be provided: nonconductive rope attached to the main disconnect switch; an under-voltage trip for the main circuit breaker operated by an emergency stop button in the pendant push button station; or a main line contactor operated by a switch or push button on the pendant push button station. (7-1-97)

uu. The hoisting motion of all electric traveling cranes shall be provided with an over-travel limit switch in the hoisting direction. (7-1-97)

vv. All cranes using a lifting magnet shall have a magnet circuit switch of the enclosed type with provision for locking in the open position. Means for discharging the inductive load of the magnet shall be provided. (7-1-97)

ww. Conductors of the open type mounted on the crane runway beams or overhead shall be so located or so guarded that persons entering or leaving the cab or crane footwalk normally could not come into contact with them. (7-1-97)

xx. If a service receptacle is provided in the cab or on the bridge of cab-operated cranes, it shall be a grounded three (3) prong type permanent receptacle, not exceeding three-hundred (300) volts. (7-1-97)

yy. When repairing runways, repairmen shall place rail stops and warning signs or signals so as to protect both ends of the section to be repaired. Repairmen shall take care to prevent loose parts from falling or being thrown upon the floor beneath. (7-1-97)

04. Rigging: (7-1-97)

a. Whenever used in connection with work, employment, occupations or uses to which these standards are applicable, wire rope shall not be subjected to loads in excess of one-fifth (1/5) the breaking load as given in the schedule of the cable manufacturer. Except as required in Standard for Material Hoists. (7-1-97)

b. When cables deteriorate through rust, wear, broken wires, undue strain or other conditions to the extent of fifteen (15) percent of their original strength, use of cables shall be discontinued. (7-1-97)

c. The strap or steel ribbon type of cable shall not be used in the suspension of scaffolding. (7-1-97)

d. There shall be not less than monthly inspection of all wire rope in use, and all wire rope must be inspected before put into use. (7-1-97)

e. The following methods of fastening and attaching wire rope shall be adhered to. The end of wire rope to be set into socket fittings held securely with molten babbitt or zinc (not lead). The wires of the cable shall be frayed out and each wire bent toward the outside of socket, so that the end of each wire projects well into the depth of the socket. This method of fastening cables should be left in the hands of an experienced workman in this kind of work. Thimbles spliced into rope and the splice securely wrapped. Thimbles inserted and held in place by at least a three bolt clamp or three (3) U-bolt clips. Clamps shall be of standard size for the sizes of the cable in use. For temporary work, by passing rope at least twice around large objects such as a post, avoiding sharp points and carrying the end back several feet and securing it by clamps, clips or lashing to the cable. (7-1-97)

f. Whenever hemp rope is used, it shall be first grade long fiber Manila hemp rope. Rope shall not be used to support loads in excess of the rating for hemp and Manila rope. Supporting ropes shall be double lashed at each point of suspension. Where supporting ropes are brought over sharp corners of steel, stone, or other material liable to cut the rope, or are in any other way subject to abrasion, they shall be protected at such points by the use of bagging, wooden blocks, or other protective padding. Rope knots shall have their loose and free ends lashed to the standing part in order to prevent their becoming untied. All ropes shall be inspected before use. Rope badly frayed, rotted, exposed to the action of acid or caustic, or otherwise defective and unsafe, shall be condemned and destroyed to avoid all possibility of future use by mistake. (7-1-97)

g. A thorough inspection of all ropes shall be made at least once a month and a full written, dated, and signed report of rope condition kept on file where readily available to appointed personnel. Any deterioration, resulting in appreciable loss of original strength, such as described below, shall be carefully noted and determination made as to whether further use of the rope would constitute a safety hazard: (7-1-97)

i. Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires; (7-1-97)

ii. A number of broken outside wires and the degree of distribution or concentration of such broken wires; (7-1-97)

iii. Worn outside wires, corroded or broken wires at end connections; corroded, cracked, bent, worn, or improperly applied end connections; (7-1-97)

iv. And severe kinking, crushing, cutting, or un-stranding. (7-1-97)

v. Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited or with saddles. Particular care shall be taken to inspect ropes at these locations. Particular care shall be taken in the inspection of non rotating rope. (7-1-97)

h. All rope which has been idle for a period of a month or more due to shutdown or storage of a crane on which it is installed shall be given a thorough inspection before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by an appointed person whose approval shall be required for further use of the rope. A written and dated report of the rope condition shall be available for inspection. (7-1-97)

i. All rope slings shall be inspected thoroughly and regularly at intervals of not more than one month, and when not in use, shall be stored in a dry place. Rope slings shall be protected with pads or blocks when wrapped around sharp edges of structural shapes casting, etc. Slings shall not be used in single strand slip-noose form. Hemp rope shall not be used as slings for handling objects contaminated with acid. Hand ropes (guide ropes) shall not be attached to slings but to hoisting tackle, or (only when necessary) attached to the object handled. All slings shall be of sufficient strength for handling the imposed loads. Double slings shall be used on all horizontal

loads over twelve (12) feet in length, and the distance between the points where slings are attached shall be sufficient to prevent the load from tipping up endwise. Spreaders shall be used where there is a danger of sling ends or hitches slipping together. Defective and unsafe slings shall be destroyed in order to avoid the possibility of their being used by mistake. (7-1-97)

j. Guy wires and ropes shall be of sufficient strength to carry the load imposed upon them and shall be securely fastened in place. (7-1-97)

k. Wherever rope is permanently fastened by a single wrap to a metal object less in diameter or shortest measurement than three (3) times the diameter of the rope, a galvanized thimble (of size intended for the rope) shall be inserted between the object and the loop of the rope. (7-1-97)

l. Blocks and falls shall be carefully inspected before being used. Blocks shall be of substantial construction and maintained in good condition while in use. Blocks shall fit the sizes of ropes they carry and shall not chafe or abrade the ropes running through them. (7-1-97)

m. If at any time, any three (3) foot length of chain is found to have stretched one-third (1/3) the length of a link, it shall be discarded. The practice of placing bolts or nails between two (2) links to shorten chains is prohibited. Splicing broken chains by inserting a bolt between two links with the heads of the bolt and the nut sustaining the load, or passing one link through another and inserting a bolt or nail to hold it, is prohibited. Wherever annealing of chains is attempted, it shall be done in properly equipped annealing furnaces and under the direct supervision of a competent person thoroughly versed in heat treating. (7-1-97)

n. Cables shall be periodically inspected. A copy of the report of the inspections of each running cable shall be filed in a place readily accessible to the Department, or authorized representative. (7-1-97)

o. Whenever any sling is used, the following practices shall be observed: (7-1-97)

i. Slings that are damaged or defective shall not be used; (7-1-97)

ii. Slings shall not be shortened with knots or bolts or other makeshift devices; (7-1-97)

iii. Sling legs shall not be kinked; (7-1-97)

iv. Slings shall not be loaded in excess of their rated capacities; (7-1-97)

v. Slings used in a basket hitch shall have the loads balanced to prevent slippage; (7-1-97)

vi. Slings shall be securely attached to their loads; (7-1-97)

vii. Slings shall be padded or protected from the sharp edges of their loads; (7-1-97)

viii. And suspended loads shall be kept clear of all obstructions. (7-1-97)

ix. All employees shall be kept clear of loads about to be lifted and of suspended loads. (7-1-97)

x. Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load. (7-1-97)

xi. Shock loading is prohibited. (7-1-97)

xii. A sling shall not be pulled from under a load when the load is resting on the sling. (7-1-97)

p. Each day before being used, the sling and all fastenings and attachments shall be inspected for damage or defects by a competent person designated by the employer. Additional inspections shall be performed during sling use, where service conditions warrant. Damaged or defective slings shall be immediately removed from service. (7-1-97)

q. Alloy steel chain slings shall have permanently affixed durable identification stating size, grade, rated capacity and reach. Hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used or the sling shall not be used in excess of the rated capacity of the weakest component. Makeshift links or fasteners formed from bolts or rods, or other such attachments, shall not be used. A thorough periodic inspection of alloy steel chain slings in use shall be made on a regular basis, to be determined on the basis of: frequency of sling use; severity of service conditions; nature of lifts being made; and experience gained on the service life of slings used in similar circumstances. Such inspections shall in no event be at intervals greater than once every twelve (12) months. The employer shall make and maintain a record of the most recent month in which each alloy steel chain sling was thoroughly inspected, and shall make such record available for examination by the Department. The thorough inspection of alloy steel chain slings shall be performed by a competent person designated by the employer, and shall include a thorough inspection for wear, defective welds, deformation and increase in length. Where such defects or deterioration are present, the sling shall be immediately removed from service. The employer shall ensure that before use, each new, repaired, or reconditioned alloy steel chain sling, including all welded components in the sling assembly, shall be proof tested by the sling manufacturer or equivalent entity, in accordance with Paragraph 5.2 of the American Society of Testing and Materials Specification A391-65 (ANSI G61.1). The employer shall retain a certificate of proof test and shall make it available for examination by the Department. Alloy steel chain slings shall not be used with loads in excess of the rated capacities prescribed in Table 281.04-A. Slings not included in this table shall be used only in accordance with the manufacturer's recommendations. Alloy steel chain slings shall be permanently removed from service if they are heated above one-thousand (1000) degrees Fahrenheit. When exposed to service temperatures in excess of six-hundred (600) degrees Fahrenheit maximum working load limits permitted in Table 281.04-A shall be reduced in accordance with the chain or sling manufacturer's recommendations. Worn or damaged alloy steel chain slings or attachments shall not be used until repaired. When welding or heat testing is performed, slings shall not be used unless repaired, reconditioned, and proof tested by the sling manufacturer or an equivalent entity. Mechanical coupling links or low carbon steel repair links shall not be used to repair broken lengths of chain. If the chain size at any point of any links is less than that stated in Table 281.04-B, the sling shall be removed from service. Alloy steel chain sling with cracked or

deformed master links, coupling links or other components shall be removed from service. Slings shall be removed from service if hooks are cracked, have been opened more than fifteen (15) percent of the normal throat opening measured at the narrowest point or twisted more than ten (10) degrees from the plane of the unbent hook. (7-1-97)

TABLE 280.04-A				
RATED CAPACITY (WORKING LOAD LIMIT), FOR ALLOY STEEL CHAIN SLINGS* RATED CAPACITY (WORKING LOAD LIMIT), POUNDS				
Part 1--Double Slings				
Chain Size Inches	Single Branch Sling - 90 Degree Loading	30 Degree 60 Degree	Double Sling Vertical Angle ¹ 45 Degree Horizontal Angle ² 45 Degree	60 Degree 30 Degree
1/4	3,250	5,650	4,555	3,250
3/8	6,600	11,400	9,300	6,600
1/2	11,250	19,500	15,900	11,250
5/8	16,500	28,500	23,300	16,500
3/4	23,000	39,800	32,500	23,000
7/8	28,750	49,800	40,600	28,450
1	38,750	67,100	54,800	38,750
1 1/8	44,500	77,000	63,000	44,500
1 1/4	57,500	99,500	81,000	57,500
1 3/8	67,000	116,000	94,000	67,000
1 1/2	80,000	138,000	112,500	80,000
1 3/4	100,000	172,000	140,000	100,000
TABLE 280.04-A - Part 2--Triple and Quadruple Slings				
Chain Size Inches	Single Branch Sling - 90 Degree	30 Degree 60 Degree	Triple and Quadruple Sling ³ Vertical Angle ¹	60 Degree 30 Degree

	Loading		45 Degree Horizontal Angle ² 45 Degree	
1/4	3,250	8,400	6,800	4,900
3/8	6,600	17,000	14,000	9,900
1/2	11,250	29,000	24,000	17,000
5/8	16,500	43,000	35,000	24,500
3/4	23,000	59,500	48,500	34,500
7/8	28,750	74,500	61,000	43,000
1	38,750	101,000	82,000	58,000
1 1/8	44,500	115,500	94,500	66,500
1 1/4	57,500	149,000	121,500	86,000
1 3/8	67,000	174,000	141,000	100,500
1 1/2	80,000	207,000	169,000	119,500
1 3/4	100,000	258,000	210,000	150,000
¹ Rating of multileg slings adjusted for angle of loading measured as the included angle between the inclined leg and the vertical as shown in Figure 329.10-C				
² Rating of multileg slings adjusted for angle of loading between the inclined leg and the horizontal plane of the load as shown in Figure 329.10-C				
³ Quadruple sling rating is the same as triple sling because normal lifting practice may not distribute load uniformly to all 4 legs.				

TABLE 280.04-B	
MINIMUM ALLOWABLE CHAIN SIZE AT ANY POINT OF LINK	
Chain Size, Inches	Minimum Allowable Chain Size, Inches
1/4	13/64

3/8	19/64
1/2	25/64
5/8	31/64
3/4	19/32
7/8	45/64
1	13/16
1 1/8	29/32
1 1/4	1
1 3/8	1 3/32
1 1/2	1 3/16
1 3/4	1 13/32

r. Wire rope slings shall not be used with loads in excess of the rated capacities shown in Table 281.04-C through Table 281.04-N. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations. Cable laid and six (6) x nineteen (19) and six (6) x thirty-seven (37) slings shall have a minimum clear length of wire rope ten (10) times the component rope diameter between splices sleeves, or end fittings. Braided slings shall have a minimum clear length of wire rope forty (40) times the component rope diameter between the loops or end fittings. Cable laid grommets, strand laid grommets and endless slings shall have a minimum circumferential length of ninety-six (96) times their body diameter. Fiber core wire rope slings of all grades shall be permanently removed from service if they are exposed to temperatures in excess of two-hundred (200) degrees Fahrenheit. When non-fiber core wire rope slings of any grade are used at temperatures above four-hundred (400) degrees Fahrenheit or below minus-sixty (-60) degrees Fahrenheit or recommendations of the sling manufacturer regarding use at that temperature shall be followed. Welding of end attachments, except covers to thimbles, shall be performed prior to the assembly of the sling. All welded end attachments shall not be used unless proof tested by the manufacturer or equivalent entity at twice their rated capacity prior to initial use. The employer shall retain a certificate of the proof test, and make it available for examination by the Department. Wire rope slings shall be immediately removed from service if any of the following conditions are present: (7-1-97)

i. Ten (10) randomly distributed broken wires in one rope lay, or five (5) broken wires in one strand in one (1) rope lay; (7-1-97)

ii. Wear or scraping of one-third (1/3) the original diameter of outside individual wires; (7-1-97)

iii. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure; (7-1-97)

iv. Evidence of heat damage; end attachments that are cracked, deformed or worn; (7-1-97)

v. Hooks that have been opened more than fifteen (15) percent of the normal throat opening measured at the narrowest point or twisted more than ten (10) degrees from the plane of the unbent hook; (7-1-97)

vi. Or corrosion of the rope or end attachments. (7-1-97)

TABLE 280.04-C										
RATED CAPACITIES FOR SINGLE LEG SLINGS 6 X 19 AND 6 X 37 CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH FIBER CORE (FC)										
Rope Dia. Const (inches)		Rated Capacities, Tons (2,000 lbs)								
		Vertical			Choker			Vertical Basket*		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6 x 19	0.49	0.51	0.55	0.37	0.38	0.41	0.99	1.0	1.1
5/16	6 x 19	0.76	0.79	0.85	3.57	0.59	0.64	1.5	1.6	1.7
3/8	6 x 19	1.1	1.1	1.2	0.80	0.85	0.91	2.1	2.2	2.4
7/16	6 x 19	1.4	1.5	1.6	1.1	1.1	1.2	2.9	3.0	3.3
1/2	6 x 19	1.8	2.0	2.1	1.4	1.5	1.6	3.7	3.9	4.3
9/16	6 x 19	2.3	2.5	2.7	1.7	1.9	2.0	4.6	5.0	5.4
5/8	6 x 19	2.8	3.1	3.3	2.1	2.3	2.5	5.6	6.2	6.7
3/4	6 x 19	3.9	4.4	4.8	2.9	3.3	3.6	7.8	8.8	9.5
7/8	6 x 19	5.1	5.9	6.4	3.9	4.5	4.8	10.0	12.0	13.0
1	6 x 19	6.7	7.7	8.4	5.0	5.8	6.3	13.0	15.0	17.0

1 1/8	6 x 19	8.4	9.5	10.0	6.3	7.1	7.9	17.0	19.0	21.0
1 1/4	6 x 37	9.8	11.0	12.0	7.4	8.3	9.2	20.0	22.0	25.0
1 3/8	6 x 37	12.0	13.0	15.0	8.9	10.0	11.0	24.0	27.0	30.0
1 1/2	6 x 37	14.0	16.0	17.0	10.0	12.0	13.0	28.0	32.0	35.0
1 5/8	6 x 37	16.0	18.0	21.0	12.0	14.0	15.0	33.0	37.0	41.0
1 3/4	6 x 37	19.0	21.0	24.0	14.0	16.0	18.0	38.0	43.0	48.0
2	6 x 37	25.0	28.0	31.0	18.0	21.0	23.0	49.0	55.0	62.0

TABLE 281.04-D

**RATED CAPACITIES FOR SINGLE LEG SLINGS 6 X 19 AND 6 X 37
CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH
INDEPENDENT WIRE ROPE CORE (IWRC)**

Rope Dia. Const (inches)		Rated Capacities, Tons (2,000 lbs)								
		Vertical			Choker			Vertical Basket*		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6 x 19	0.53	0.56	0.59	0.40	0.42	0.44	1.0	1.1	1.2
5/16	6 x 19	0.81	0.87	0.92	0.61	0.62	0.69	1.6	1.7	1.8
3/8	6 x 19	1.1	1.2	1.3	0.86	0.93	0.98	2.3	2.5	2.6
7/16	6 x 19	1.5	1.7	1.8	1.2	1.3	1.3	3.1	3.4	3.5
1/2	6 x 19	2.0	2.2	2.3	1.5	1.6	1.7	3.9	4.4	4.6

9/16	6 x 19	2.5	2.7	2.9	1.8	2.1	2.2	4.9	5.5	5.8
5/8	6 x 19	3.0	3.4	3.6	2.2	2.5	2.7	6.0	6.8	7.2
3/4	6 x 19	4.2	4.9	5.1	3.1	3.6	3.8	8.4	9.7	10.0
7/8	6 x 19	5.5	6.6	6.9	4.1	4.9	5.2	11.0	13.0	14.0
1	6 x 19	7.2	8.5	9.0	5.4	6.4	6.7	14.0	17.0	18.0
1 1/8	6 x 19	9.0	10.0	11.0	6.8	7.8	8.5	18.0	21.0	23.0
1 1/4	6 x 37	10.0	12.0	13.0	7.9	9.2	9.9	21.0	24.0	26.0
1 3/8	6 x 37	13.0	15.0	16.0	9.6	11.0	12.0	25.0	29.0	32.0
1 1/2	6 x 37	15.0	17.0	19.0	11.0	13.0	14.0	30.0	35.0	38.0
1 5/8	6 x 37	18.0	20.0	22.0	13.0	15.0	17.0	35.0	41.0	44.0
1 3/4	6 x 37	20.0	24.0	26.0	15.0	18.0	19.0	41.0	47.0	51.0
2	6 x 37	26.0	30.0	33.0	20.0	23.0	25.0	53.0	61.0	66.0

HT = Hand Tucked Splice and Hidden Tuck Splice, for hidden tuck splice (IWRC) use value in HT columns.

MS = Mechanical Splice.

S = Swaged or Zinc Poured Socket. *These values only apply when the D/d ratio for HT slings is 10 or greater and for MS and S slings is 20 or greater where:

D = Diameter of curvature around which the body of the sling is bent.

d = Diameter of rope.

TABLE 281.04-E

**RATED CAPACITIES FOR SINGLE LEG SLINGS CABLE LAID ROPE - MECHANICAL SPLICE ONLY 7 X 7 X 7 & 7 X 7 X 19 CONSTRUCTIONS
GALVANIZED AIRCRAFT GRADE ROPE 7 X 6 X 19 IWRC CONSTRUCTION
IMPROVED PLOW STEEL GRADE ROPE**

Rope		Rated Capacities, Tons (2,000 lb)		
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket ¹
1/4	7 x 7 x 7	0.50	0.38	1.0
3/8	7 x 7 x 7	1.1	0.81	2.0
1/2	7 x 7 x 7	1.8	1.4	3.7
5/8	7 x 7 x 7	2.8	2.1	5.5
3/4	7 x 7 x 7	3.8	2.9	7.6
5/8	7 x 7 x 19	2.9	2.2	5.8
3/4	7 x 7 x 19	4.1	3.0	8.1
7/8	7 x 7 x 19	5.4	4.0	11.0
1	7 x 7 x 19	6.9	5.1	14.0
1 1/8	7 x 7 x 19	8.2	6.2	16.0
1 1/4	7 x 7 x 19	9.9	7.4	20.0
3/4	7 x 7 x 19 IWRC	3.8	2.8	7.6
7/8	7 x 7 x 19 IWRC	5.0	3.8	10.0
1	7 x 7 x 19 IWRC	6.4	4.8	13.0
1 1/8	7 x 7 x 19 IWRC	7.7	5.8	15.0
1 1/4	7 x 7 x 19 IWRC	9.2	6.9	18.0
1 5/16	7 x 7 x 19 IWRC	10.0	7.5	20.0
1 3/8	7 x 7 x 19 IWRC	11.0	8.2	22.0
1 1/2	7 x 7 x 19 IWRC	13.0	9.6	26.0

¹These values only apply when the D/d ratio is 10 or greater where:

D = Diameter of curvature around which the body of the sling is bent.

d = Diameter of rope.

TABLE 281.04-F

RATED CAPACITIES FOR SINGLE LEG SLINGS 8-PART AND 6-PART BRAIDED ROPE 6 X 7 AND 6 X 19 CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE 7 X 7 CONSTRUCTION GALVANIZED AIRCRAFT GRADE ROPE

Component Ropes		Rated Capacities, Tons (2,000 lb)					
Diameter (inches)	Construction	Vertical		Choker		Basket Vertical to 30 ¹	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6 x 7	0.42	0.32	0.32	0.24	0.74	0.55
1/8	6 x 7	0.76	0.57	0.57	0.42	1.3	0.98
3/16	6 x 7	1.7	1.3	1.3	0.94	2.9	2.2
3/32	7 x 7	0.51	0.39	0.38	0.29	0.89	0.67
1/8	7 x 7	0.95	0.71	0.71	0.53	1.6	1.2
3/16	7 x 7	2.1	1.5	1.5	1.2	3.6	2.7
3/16	6 x 19	1.7	1.3	1.3	0.98	3.0	2.2
1/4	6 x 19	3.1	2.3	2.3	1.7	5.3	4.0
5/16	6 x 19	4.8	3.6	3.6	2.7	8.3	6.2
3/8	6 x 19	6.8	5.1	5.1	3.8	12.0	8.9
7/16	6 x 19	9.3	6.9	6.9	5.2	16.0	12.0
1/2	6 x 19	12.0	9.0	9.0	6.7	21.0	15.0
9/16	6 x 19	15.0	11.0	11.0	8.5	26.0	20.0
5/8	6 x 19	19.0	14.0	14.0	10.0	32.0	24.0
3/4	6 x 19	27.0	20.0	20.0	15.0	46.0	35.0
7/8	6 x 19	36.0	27.0	27.0	20.0	62.0	47.0
1	6 x 19	47.0	35.0	35.0	26.0	81.0	61.0

¹These values only apply when the D/d ratio is 20 or greater where:

D = Diameter of curvature around which the body of the sling is bent.

d = Diameter of component rope.

TABLE 281.04-G

**RATED CAPACITIES FOR 2-LEG & 3-LEG BRIDLE SLINGS 6 X 19 AND 6 X 37
CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH FIBER CORE
(FC)**

Part 1--2-Leg Bridle Slings

Rope		Rated Capacities, Tons (2,000 lb)					
		2-Leg Bridle Slings					
Dia. (inches)	Constr.	Vert 30 degrees		45 degree Angle		Vert 60 degrees	
		Horz 60 degrees				Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	0.85	0.88	0.70	0.72	0.49	0.51
5/16	6 X 19	1.3	1.4	1.1	1.1	0.76	0.79
3/8	6 X 19	1.8	1.9	1.5	1.6	1.1	1.1
7/16	6 X 19	2.5	2.6	2.0	2.2	1.4	1.5
1/2	6 X 19	3.2	3.4	2.6	2.8	1.8	2.0
9/16	6 X 19	4.0	4.3	3.2	3.5	2.3	2.5
5/8	6 X 19	4.8	5.3	4.0	4.4	2.8	3.1
3/4	6 X 19	6.8	7.6	5.5	6.2	3.9	4.4
7/8	6 X 19	8.9	10.0	7.3	8.4	5.1	5.9
1	6 X 19	11.0	13.0	9.4	11.0	6.7	7.7
1 1/8	6 X 19	14.0	16.0	12.0	13.0	8.4	9.5
1 1/4	6 X 37	17.0	19.0	14.0	16.0	9.8	11.0
1 3/8	6 X 37	20.0	23.0	17.0	19.0	12.0	13.0

1 1/2	6 X 37	24.0	27.0	20.0	22.0	14.0	16.0
1 5/8	6 X 37	28.0	32.0	23.0	26.0	16.0	18.0
1 3/4	6 X 37	33.0	37.0	27.0	30.0	19.0	21.0
2	6 X 37	43.0	48.0	35.0	39.0	25.0	28.0

TABLE 280.14-G

Part 2--3-Leg Bridle Slings

Rope		Rated Capacities, Tons (2,000 lb)					
		3-Leg Bridle Slings					
Dia. (inches)	Constr..	Vert 30 degrees		45 degree Angle		Vert 60 degrees	
		Horz 60 degrees				Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	1.3	1.3	1.0	1.1	0.74	0.76
5/16	6 X 19	2.0	2.0	1.6	1.7	1.1	1.2
3/8	6 X 19	2.8	2.9	2.3	2.4	1.6	1.7
7/16	6 X 19	3.7	4.0	3.0	3.2	2.1	2.3
1/2	6 X 19	4.8	5.1	3.9	4.2	2.8	3.0
9/16	6 X 19	6.0	6.5	4.9	5.3	3.4	3.7
5/8	6 X 19	7.3	8.0	5.9	6.5	4.2	4.6
3/4	6 X 19	10.0	11.0	8.3	9.3	5.8	6.6
7/8	6 X 19	13.0	15.0	11.0	13.0	7.7	8.9
1	6 X 19	17.0	20.0	14.0	16.0	10.0	11.0
1 1/8	6 X 19	22.0	24.0	18.0	20.0	13.0	14.0
1 1/4	6 X 37	25.0	29.0	21.0	23.0	15.0	17.0
1 3/8	6 X 37	31.0	35.0	25.0	28.0	18.0	20.0
1 1/2	6 X 37	36.0	41.0	30.0	33.0	21.0	24.0
1 5/8	6 X 37	43.0	48.0	35.0	39.0	25.0	28.0

1 3/4	6 X 37	49.0	56.0	40.0	45.0	28.0	32.0
2	6 X 37	64.0	72.0	52.0	59.0	37.0	41.0

TABLE 281.04-H

RATED CAPACITIES FOR 2-LEG & 3-LEG BRIDLE SLINGS 6 X 19 AND 6 X 37 CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH INDEPENDENT WIRE ROPE CORE (IWRC)

Part 1--2-Leg Bridle Slings

Rope		Rated Capacities, Tons (2,000 lb)					
		2-Leg Bridle Slings					
Dia. (inches)	Constr..	Vert 30 degrees		45 degree Angle		Vert 60 degrees	
		Horz 60 degrees				Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	0.92	0.97	0.75	0.79	0.53	0.56
5/16	6 X 19	1.4	1.5	1.1	1.2	0.81	0.87
3/8	6 X 19	2.0	2.1	1.6	1.8	1.1	1.2
7/16	6 X 19	2.7	2.9	2.2	2.4	1.5	1.7
1/2	6 X 19	3.4	3.8	2.8	3.1	2.0	2.2
9/16	6 X 19	4.3	4.8	3.5	3.9	2.5	2.7
5/8	6 X 19	5.2	5.9	4.2	4.8	3.0	3.4
3/4	6 X 19	7.3	8.4	5.9	6.9	4.2	4.9
7/8	6 X 19	9.6	11.0	7.8	9.3	5.5	6.6
1	6 X 19	12.0	15.0	10.0	12.0	7.2	8.5
1 1/8	6 X 19	16.0	18.0	13.0	15.0	9.0	10.0
1 1/4	6 X 37	18.0	21.0	15.0	17.0	10.0	12.0
1 3/8	6 X 37	22.0	25.0	18.0	21.0	13.0	15.0
1 1/2	6 X 37	26.0	30.0	21.0	25.0	15.0	17.0
1 5/8	6 X 37	31.0	35.0	25.0	29.0	18.0	20.0

1 3/4	6 X 37	35.0	41.0	29.0	33.0	20.0	24.0
2	6 X 37	46.0	53.0	37.0	43.0	26.0	30.0

TABLE 281.04-H

Part 2--3-Leg Bridle Slings

Rope		Rated Capacities, Tons (2,000 lb)					
		3-Leg Bridle Slings					
Dia. (inches)	Constr..	Vert 30 degrees		45 degree Angle		Vert 60 degrees	
		Horz 60 degrees				Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	1.4	1.4	1.1	1.2	0.79	0.84
5/16	6 X 19	2.1	2.3	1.7	1.8	1.2	1.3
3/8	6 X 19	3.0	3.2	2.4	2.6	1.7	1.9
7/16	6 X 19	4.0	4.4	3.3	3.6	2.3	2.5
1/2	6 X 19	5.1	5.7	4.2	4.6	3.0	3.3
9/16	6 X 19	6.4	7.1	5.2	5.8	3.7	4.1
5/8	6 X 19	7.8	8.8	6.4	7.2	4.5	5.1
3/4	6 X 19	11.0	13.0	8.9	10.0	6.3	7.3
7/8	6 X 19	14.0	17.0	12.0	14.0	8.3	9.9
1	6 X 19	19.0	22.0	15.0	18.0	11.0	13.0
1 1/8	6 X 19	23.0	27.0	19.0	22.0	13.0	16.0
1 1/4	6 X 37	27.0	32.0	22.0	26.0	16.0	18.0
1 3/8	6 X 37	33.0	38.0	27.0	31.0	19.0	22.0
1 1/2	6 X 37	39.0	45.0	32.0	37.0	23.0	26.0
1 5/8	6 X 37	46.0	53.0	38.0	43.0	27.0	31.0
1 3/4	6 X 37	53.0	61.0	43.0	50.0	31.0	35.0
2	6 X 37	68.0	79.0	56.0	65.0	40.0	46.0

TABLE 280.14-I

RATED CAPACITIES FOR 2-LEG & 3-LEG BRIDLE SLINGS CABLE LAID ROPE - MECHANICAL SPLICE ONLY 7 X 7 X 7 AND 7 X 7 X 19 CONSTRUCTIONS GALVANIZED AIRCRAFT GRADE ROPE 7 X 6 X 19 IWRC CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE

Part 1--2-Leg Bridle Slings

Rope		Rated Capacities, Tons (2,000 lb)		
		2-Leg Bridle Slings		
Dia. (inches)	Constr..	Vert 30 degrees	45 degree	Vert 60 degrees
		Horz 60 degrees	Angle	Horz 30 degrees
1/4	7 x 7	0.87	0.71	0.50
3/8	7 x 7	1.9	1.5	1.1
1/2	7 x 7	3.2	2.6	1.8
5/8	7 x 7	4.8	3.9	2.8
3/4	7 x 7	6.6	5.4	3.8
5/8	7 x 7 x 19	5.0	4.1	2.9
3/4	7 x 7 x 19	7.0	5.7	4.1
7/8	7 x 7 x 19	9.3	7.6	5.4
1	7 x 7 x 19	12.0	9.7	6.9
1 1/8	7 x 7 x 19	14.0	12.0	8.2
1 1/4	7 x 7 x 19	17.0	14.0	9.9
3/4	7 x 7 x 19 IWRC	6.6	5.4	3.8
7/8	7 x 7 x 19 IWRC	8.7	7.1	5.0
1	7 x 7 x 19 IWRC	11.0	9.0	6.4
1 1/8	7 x 7 x 19	13.0	11.0	7.7

	IWRC			
1 1/4	7 x 7 x 19 IWRC	16.0	13.0	9.2
1 5/16	7 x 7 x 19 IWRC	17.0	14.0	10.0
1 3/8	7 x 7 x 19 IWRC	19.0	15.0	11.0
1 1/2	7 x 7 x 19 IWRC	22.0	18.0	13.0

TABLE 281.04-I

Part 2--3-Leg Bridle Slings

Rope		Rated Capacities, Tons (2,000 lb)		
		3-Leg Bridle Slings		
Dia. (inches)	Constr..	Vert 30 degrees Horz 60 degrees	45 degree Angle	Vert 60 degrees Horz 30 degrees
1/4	7 x 7	1.3	1.1	0.75
3/8	7 x 7	2.8	2.3	1.6
1/2	7 x 7	4.8	3.9	2.8
5/8	7 x 7	7.2	5.9	4.2
3/4	7 x 7	9.9	8.1	5.7
5/8	7 x 7 x 19	7.5	6.1	4.3
3/4	7 x 7 x 19	10.0	8.6	6.1
7/8	7 x 7 x 19	14.0	11.0	8.1
1	7 x 7 x 19	18.0	14.0	10.0
1 1/8	7 x 7 x 19	21.0	17.0	12.0
1 1/4	7 x 7 x 19	26.0	21.0	15.0
3/4	7 x 7 x 19 IWRC	9.9	8.0	5.7

7/8	7 x 7 x 19 IWRC	13.0	11.0	7.5
1	7 x 7 x 19 IWRC	17.0	13.0	9.6
1 1/8	7 x 7 x 19 IWRC	20.0	16.0	11.0
1 1/4	7 x 7 x 19 IWRC	24.0	20.0	14.0
1 5/16	7 x 7 x 19 IWRC	26.0	21.0	15.0
1 3/8	7 x 7 x 19 IWRC	28.0	23.0	16.0
1 1/2	7 x 7 x 19 IWRC	33.0	27.0	19.0

TABLE 281.04-J

RATED CAPACITIES FOR 2-LEG AND 3-LEG BRIDLE SLINGS 8-PART AND 6-PART BRAIDED ROPE 6 X 7 AND 6 X 19 CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE 7 X 7 CONSTRUCTION GALVANIZED AIRCRAFT GRADE ROPE

Part 1--2-Leg Bridle Slings

Component		Rated Capacities, Tons (2,000 lb)					
Rope		2-Leg Bridle Slings					
Dia. (Inches)	Constr..	Vert 30 degree		45 degree Angle		Vert 60 degree	
		Horz 60 degree				Horz 30 degree	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6 x 7	0.74	0.55	0.60	0.45	0.42	0.32
1/8	6 x 7	1.3	0.98	1.1	0.80	0.76	0.57
3/16	6 x 7	2.9	2.2	2.4	1.8	1.7	1.3
3/32	7 x 7	0.89	0.67	0.72	0.55	0.51	0.39
1/8	7 x 7	1.6	1.2	1.3	1.0	0.95	0.71

3/16	7 x 7	3.6	2.7	2.9	2.2	2.1	1.5
3/16	6 x 19	3.0	2.2	2.4	1.8	1.7	1.3
1/4	6 x 19	5.3	4.0	4.3	3.2	3.1	2.3
5/16	6 x 19	8.3	6.2	6.7	5.0	4.8	3.6
3/8	6 x 19	12.0	8.9	9.7	7.2	6.8	5.1
7/16	6 x 19	16.0	12.0	13.0	9.8	9.3	6.9
1/2	6 x 19	21.0	15.0	17.0	13.0	12.0	9.0
9/16	6 x 19	26.0	20.0	21.0	16.0	15.0	11.0
5/8	6 x 19	32.0	24.0	26.0	20.0	19.0	14.0
3/4	6 x 19	46.0	35.0	38.0	28.0	27.0	20.0
7/8	6 x 19	62.0	47.0	51.0	38.0	36.0	27.0
1	6 x 19	81.0	61.0	66.0	50.0	47.0	35.0

TABLE 281.04-J

Part 2--3-Leg Bridle Slings

Component		Rated Capacities, Tons (2,000 lb)					
Rope		3-Leg Bridle Slings					
Dia. (Inches)	Constr..	Vert 30 degree		45 degree Angle		Vert 60 degree	
		Horz 60 degree				Horz 30 degree	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6 x 7	1.1	0.83	0.90	0.68	0.64	0.48
1/8	6 x 7	2.0	1.5	1.6	1.2	1.1	0.85
3/16	6 x 7	4.4	3.3	3.6	2.7	2.5	1.9
3/32	7 x 7	1.3	1.0	1.1	0.82	0.77	0.58
1/8	7 x 7	2.5	1.8	2.0	1.5	1.4	1.1
3/16	7 x 7	5.4	4.0	4.4	3.3	3.1	2.3
3/16	6 x 19	4.5	3.4	3.7	2.8	2.6	1.9

1/4	6 x 19	8.0	6.0	6.5	4.9	4.6	3.4
5/16	6 x 19	12.0	9.3	10.0	7.6	7.1	5.4
3/8	6 x 19	18.0	13.0	14.0	11.0	10.0	7.7
7/16	6 x 19	24.0	18.0	20.0	15.0	14.0	10.0
1/2	6 x 19	31.0	23.0	25.0	19.0	18.0	13.0
9/16	6 x 19	39.0	29.0	32.0	24.0	23.0	17.0
5/8	6 x 19	48.0	36.0	40.0	30.0	28.0	21.0
3/4	6 x 19	69.0	52.0	56.0	42.0	40.0	30.0
7/8	6 x 19	94.0	70.0	76.0	57.0	54.0	40.0
1	6 x 19	122.0	91.0	99.0	74.0	70.0	53.0

TABLE 281.04-K

RATED CAPACITIES FOR STRAND LAID GROMMET - HAND TUCKED IMPROVED PLOW STEEL GRADE ROPE

ROPE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket ¹
1/4	7 x 19	0.85	0.64	1.7
5/16	7 x 19	1.3	1.0	2.6
3/8	7 x 19	1.9	1.4	3.8
7/16	7 x 19	2.6	1.9	5.2
1/2	7 x 19	3.3	2.5	6.7
9/16	7 x 19	4.2	3.1	8.4
5/8	7 x 19	5.2	3.9	10.0
3/4	7 x 19	7.4	5.6	15.0
7/8	7 x 19	10.0	7.5	20.0

1	7 x 19	13.0	9.7	26.0
1 1/8	7 x 19	16.0	12.0	32.0
1 1/4	7 x 37	18.0	14.0	37.0
1 3/8	7 x 37	22.0	16.0	44.0
1 1/2	7 x 37	26.0	19.0	52.0

¹These values only apply when the D/d ratio is 5 or greater where:

D = Diameter of curvature around which rope is bent.

d = Diameter of rope.

TABLE 281.04-K

RATED CAPACITIES FOR CABLE LAID GROMMET - HAND TUCKED 7 X 6 X 7 AND 7 X 6 X 19 CONSTRUCTIONS IMPROVED PLOW STEEL GRADE ROPE 7 X 7 X 7 CONSTRUCTION GALVANIZED AIRCRAFT GRADE ROPE

CABLE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket ¹
3/8	7 X 6 X 7	1.3	0.95	2.5
9/16	7 X 6 X 7	2.8	2.1	5.6
5/8	7 X 6 X 7	3.8	2.8	7.6
3/8	7 X 7 X 7	1.6	1.2	3.2
9/16	7 X 7 X 7	3.5	2.6	6.9
5/8	7 X 7 X 7	4.5	3.4	9.0
5/8	7 X 6 X 19	3.9	3.0	7.9
3/4	7 X 6 X 19	5.1	3.8	10.0
15/16	7 X 6 X 19	7.9	5.9	16.0
1 1/8	7 X 6 X 19	11.0	8.4	22.0

1 5/16	7 X 6 X 19	15.0	11.0	30.0
1 1/2	7 X 6 X 19	19.0	14.0	39.0
1 11/16	7 X 6 X 19	24.0	18.0	49.0
1 7/8	7 X 6 X 19	30.0	22.0	60.0
2 1/4	7 X 6 X 19	42.0	31.0	84.0
2 5/8	7 X 6 X 19	56.0	42.0	112.0

¹These values only apply when the D/d ratio is 5 or greater where:

D = Diameter of curvature around which cable body is bent.

d = Diameter of cable body.

TABLE 281.04-M

**RATED CAPACITIES FOR STRAND LAID ENDLESS SLINGS -
MECHANICAL JOINT IMPROVED PLOW STEEL GRADE
ROPE**

ROPE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket ¹
1/4	6 x 19 IWRC	0.92	0.69	1.8
3/8	6 x 19 IWRC	2.0	1.5	4.1
1/2	6 x 19 IWRC	3.6	2.7	7.2
5/8	6 x 19 IWRC	5.6	4.2	11.0
3/4	6 x 19 IWRC	8.0	6.0	16.0
7/8	6 x 19 IWRC	11.0	8.1	21.0
1	6 x 19 IWRC	14.0	10.0	28.0
1 1/8	6 x 19 IWRC	18.0	13.0	35.0
1 1/4	6 x 37 IWRC	21.0	15.0	41.0

1 3/8	6 x 37 IWRC	25.0	19.0	50.0
1 1/2	6 x 37 IWRC	29.0	22.0	59.0

¹These values only apply when the D/d ratio is 5 or greater where:

D = Diameter of curvature around which rope is bent.

d = Diameter of rope body.

TABLE 281.04-N

**RATED CAPACITIES FOR CABLE LAID ENDLESS SLINGS -
MECHANICAL JOINT 7 X 7 X 7 AND 7 X 7 X 19
CONSTRUCTIONS GALVANIZED AIRCRAFT GRADE ROPE 7
X 6 X 19 IWRC CONSTRUCTION IMPROVED PLOW STEEL
GRADE ROPE**

CABLE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket ¹
1/4	7 x 7 x 7	0.83	0.62	1.6
3/8	7 x 7 x 7	1.8	1.3	3.5
1/2	7 x 7 x 7	3.0	2.3	6.1
5/8	7 x 7 x 7	4.5	3.4	9.1
3/4	7 x 7 x 7	6.3	4.7	12.0
5/8	7 x 7 x 19	4.7	3.5	9.5
3/4	7 x 7 x 19	6.7	5.0	13.0
7/8	7 x 7 x 19	8.9	6.6	18.0
1	7 x 7 x 19	11.0	8.5	22.0
1 1/8	7 x 7 x 19	14.0	10.0	28.0
1 1/4	7 x 7 x 19	17.0	12.0	33.0
3/4	7 x 6 x 19 IWRC	6.2	4.7	12.0

7/8	7 x 6 x 19 IWRC	8.3	6.2	16.0
1	7 x 6 x 19 IWRC	10.0	7.9	21.0
1 1/8	7 x 6 x 19 IWRC	13.0	9.7	26.0
1 1/4	7 x 6 x 19 IWRC	16.0	12.0	31.0
1 3/8	7 x 6 x 19 IWRC	18.0	14.0	37.0
1 1/2	7 x 6 x 19 IWRC	22.0	16.0	43.0
¹ These values only apply when the D/d ratio is 5 or greater where: D = Diameter of curvature around which cable body is bent. d = Diameter of cable body.				

s. Each metal mesh sling shall have permanently affixed to it a durable marking that states the rated capacity for vertical basket hitch and choker hitch loadings. Handles shall have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing. Attachments of handles to fabric shall be joined so that: the rated capacity of the sling is not reduced; the load is evenly distributed across the width of the fabric; or sharp edges will not damage the fabric. Coatings which diminish the rated capacity of a sling shall not be applied. All new and repaired metal mesh slings, including handles, shall not be used unless proof tested by the manufacturer or equivalent entity at a minimum of one and one-half (1 1/2) times their rated capacity. Elastomer impregnated slings shall be proof tested before coating. Metal mesh slings shall not be used to lift loads in excess of their rated capacities as prescribed in Table 281.04-O. Slings not included in this table shall be used only in accordance with the manufacturer's recommendations. Metal mesh slings which are not impregnated with elastomers may be used in a temperature range from minus twenty (-20) degrees Fahrenheit to plus five-hundred-fifty (+550) degrees Fahrenheit without decreasing the working load limit. Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only in a temperature range from zero (0) degrees Fahrenheit to plus two-hundred (+200) degrees-Fahrenheit. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendations shall be followed. Metal mesh slings which are repaired shall not be used unless repaired by a metal mesh sling manufacturer or an equivalent entity. Once repaired, each sling shall be permanently marked or tagged, or a written record maintained, to indicate the date and nature of the repairs and the person or organization that performed the repairs. Records of repairs shall be made available for examination by the Department. Metal mesh slings shall be immediately removed from service if any of the following conditions are

present: a broken weld or broken brazed joint along the sling edge; reduction in wire diameter of twenty-five (25) percent due to abrasion or fifteen (15) percent due to corrosion; lack of flexibility due to distortion of the fabric; distortion of the female handle so that the depth of the slot is increased more than ten (10) percent; distortion of either handle so that the width of the eye is decreased more than ten (10) percent. A fifteen (15) percent reduction of the original cross sectional area of metal at any point around the handle eye. Distortion of either handle out of its plane. (7-1-97)

TABLE 281.04-O					
RATED CAPACITIES CARBON STEEL & STAINLESS STEEL METAL MESH SLINGS					
SLING WIDTH IN INCHES	EFFECT OF ANGLE ON RATED CAPACITIES IN BASKET HITCH				
	(Illus.)	(Illus.)	(Illus.)	(Illus.)	(Illus.)
	VERTICAL OR CHOKER	VERTICAL BASKET	30 deg Vert 60 deg Horz	45 deg Vert 45 deg Horz	60 deg Vert 30 deg Horz
Heavy Duty - 10 Ga 35 Spirals/Ft of sling width					
2	1,500	3,000	2,600	2,100	1,500
3	2,700	5,400	4,700	3,800	2,700
4	4,000	8,000	6,900	5,600	4,000
6	6,000	12,000	10,400	8,400	6,000
8	8,000	16,000	13,800	11,300	8,000
10	10,000	20,000	17,000	14,100	10,000
12	12,000	24,000	20,700	16,900	12,000
14	14,000	28,000	24,200	19,700	14,000
16	16,000	32,000	27,700	22,600	16,000
18	18,000	36,000	31,100	25,400	18,000
20	20,000	40,000	34,600	28,200	20,000
Medium Duty - 12 Ga 43 Spirals/Ft of sling width					
2	1,350	2,700	2,300	1,900	1,400
3	2,000	4,000	3,500	2,800	2,000

4	2,700	5,400	4,700	3,800	2,700
6	4,500	9,000	7,800	6,400	4,500
8	6,000	12,000	10,400	8,500	6,000
10	7,500	15,000	13,000	10,600	7,500
12	9,000	18,000	15,600	12,700	9,000
14	10,500	21,000	18,200	14,800	10,500
16	12,000	24,000	20,800	17,000	12,000
18	13,500	27,000	23,400	19,100	13,500
20	15,000	30,000	26,000	21,200	15,000
Light Duty - 14 Ga 59 Spirals/Ft of sling width					
2	900	1,800	1,600	1,300	900
3	1,400	2,800	2,400	2,000	1,400
4	2,000	4,000	3,500	2,800	2,000
6	3,000	6,000	5,200	4,200	3,000
8	4,000	8,000	6,900	5,700	4,000
10	5,000	10,000	8,600	7,100	5,000
12	6,000	12,000	10,400	8,500	6,000
14	7,000	14,000	12,100	9,900	7,000
16	8,000	16,000	13,900	11,300	8,000
18	9,000	18,000	15,600	12,700	9,000
20	10,000	20,000	17,300	14,100	10,000

t. Fiber rope slings made from conventional three (3) strand construction fiber rope shall not be used with loads in excess of the rated capacities prescribed in Tables 281.04-P through 281.04-S of this section. Fiber rope slings shall have a diameter of curvature meeting at least the minimums specified in Figure 281.02-B. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations. Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from minus twenty (-20) degrees Fahrenheit to plus one-hundred-eighty (+180) degrees Fahrenheit without decreasing the working load limit. For operations outside this temperature range and for wet frozen slings, the

sling manufacturer's recommendations shall be followed. Spliced fiber rope slings shall not be used unless they have been spliced in accordance with the following minimum requirements and in accordance with any additional recommendations of the manufacturer. In manila rope, eye splices shall consist of at least three (3) full tucks, and short splices shall consist of at least six (6) full tucks, three (3) on each side of the splice center lines. In synthetic fiber rope, eye splices shall consist of at least four (4) full tucks, and short splices shall consist of at least eight (8) full tucks, four (4) on each side of the center line. Strand end tails shall not be trimmed flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope under one (1) inch in diameter, the tail shall project at least six (6) rope diameters beyond the last full tuck. For fiber rope one (1) inch in diameter and larger, the tail shall project at least six (6) inches beyond the last full tuck. Where a projecting tail interferes with the use of the sling, the tail shall be tapered and spliced into the body of the rope using at least two (2) additional tucks (which will require a tail length of approximately six (6) rope diameters beyond the last full tuck). Fiber rope slings shall have a minimum clear length of rope between eye splices equal to ten (10) times the rope diameter. Knots shall not be used in lieu of splices. Clamps not designed specifically for fiber ropes shall not be used for splicing. For all eye splices, the eye shall be of such size to provide an included angle of not greater than sixty (60) degrees at the splice when the eye is placed over the load or support. Fiber rope slings shall not be used if end attachments in contact with the rope have sharp edges or projections. Natural and synthetic fiber rope slings shall be immediately removed from service if any of the following conditions are present: abnormal wear; powdered fiber between strands; broken or cut fibers; variations in the size or roundness of strands; discoloration or rotting; and distortion of hardware in the sling. Only fiber rope slings made from new rope shall be used. Use of repaired or reconditioned fiber rope slings is prohibited. (7-1-97)

TABLE 281.04-P

MANILA ROPE SLINGS

Part 1--Eye and Eye Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90	60	45	30
				Angle of Rope to Vertical			
0	30	45	60				
1/2	7.5	480	240	960	830	680	480
9/16	10.4	620	310	1,240	1,070	875	620
5/8	13.3	790	395	1,580	1,370	1,120	790

3/4	16.7	970	485	1,940	1,680	1,370	970
13/16	19.5	1,170	585	2,340	2,030	1,650	1,170
7/8	22.5	1,390	695	2,780	2,410	1,970	1,390
1	27.0	1,620	810	3,240	2,810	2,290	1,620
1 1/16	31.3	1,890	945	3,780	3,270	2,670	1,890
1 1/8	36.0	2,160	1,080	4,320	3,740	3,050	2,160
1 1/4	41.7	2,430	1,220	4,860	4,210	3,440	2,430
1 5/16	47.9	2,700	1,350	5,400	4,680	3,820	2,700
1 1/2	59.9	3,330	1,670	6,660	5,770	4,710	3,330
1 5/8	74.6	4,050	2,030	8,100	7,010	5,730	4,050
1 3/4	89.3	4,770	2,390	9,540	8,260	6,740	4,770
2	107.5	5,580	2,790	11,200	9,660	7,890	5,580
2 1/8	125.0	6,480	3,240	13,000	11,200	9,160	6,480
2 1/4	146.0	7,380	3,690	14,800	12,800	10,400	7,380
2 1/2	166.7	8,370	4,190	16,700	14,500	11,800	8,370
2 5/8	190.8	9,360	4,680	18,700	16,200	13,200	9,360

TABLE 281.04-P

Part 2--Endless Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90	60	45	30
				Angle of Rope to Vertical			
0	30	45	60				
1/2	7.5	865	430	1,730	1,500	1,220	865
9/16	10.4	1,120	560	2,230	1,930	1,580	1,120

5/8	13.3	1,420	710	2,840	2,460	2,010	1,420
3/4	16.7	1,750	875	3,490	3,020	2,470	1,750
13/16	19.5	2,110	1,050	4,210	3,650	2,980	2,110
7/8	22.5	2,500	1,250	5,000	4,330	3,540	2,500
1	27.0	2,920	1,460	5,830	5,050	4,120	2,920
1 1/16	31.3	3,400	1,700	6,800	5,890	4,810	3,400
1 1/8	36.0	3,890	1,940	7,780	6,730	5,500	3,890
1 1/4	41.7	4,370	2,190	8,750	7,580	6,190	4,370
1 5/16	47.9	4,860	2,430	9,720	8,420	6,780	4,860
1 1/2	59.9	5,990	3,000	12,000	10,400	8,480	5,990
1 5/8	74.6	7,290	3,650	14,600	12,600	10,300	7,290
1 3/4	89.3	8,590	4,290	17,200	14,900	12,100	8,590
2	107.5	10,000	5,020	20,100	17,400	14,200	10,000
2 1/8	125.0	11,700	5,830	23,300	20,200	16,500	11,700
2 1/4	146.0	13,300	6,640	26,600	23,000	18,800	13,300
2 1/2	166.7	15,100	7,530	30,100	26,100	21,300	15,100
2 5/8	190.8	16,800	8,420	33,700	29,200	23,800	16,800

TABLE 281.04-Q

NYLON ROPE SLINGS

Part 1--Eye and Eye Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90	60	45	30
				Angle of Rope to Vertical			
0	30	45	60				

1/2	6.5	635	320	1,270	1,100	900	635
9/16	8.3	790	395	1,580	1,370	1,120	790
5/8	10.5	1,030	515	2,060	1,780	1,460	1,030
3/4	14.5	1,410	705	2,820	2,440	1,990	1,410
13/16	17.0	1,680	840	3,360	2,910	2,380	1,680
7/8	20.0	1,980	990	3,960	3,430	2,800	1,980
1	26.0	2,480	1,240	4,960	4,300	3,510	2,480
1 1/16	29.0	2,850	1,430	5,700	4,940	4,030	2,850
1 1/8	34.0	3,270	1,640	6,540	5,600	4,620	3,270
1 1/4	40.0	3,710	1,860	7,420	6,430	5,250	3,710
1 5/16	45.0	4,260	2,130	8,520	7,380	6,020	4,260
1 1/2	55.0	5,250	2,630	10,500	9,090	7,420	5,250
1 5/8	68.0	6,440	3,220	12,900	11,200	9,110	6,440
1 3/4	83.0	7,720	3,860	15,400	13,400	10,900	7,720
2	95.0	9,110	4,560	18,200	15,800	12,900	9,110
2 1/8	109.0	10,500	5,250	21,000	18,200	14,800	10,500
2 1/4	129.0	12,400	6,200	24,800	21,500	17,500	12,400
2 1/2	149.0	13,900	6,950	27,800	24,100	19,700	13,900
2 5/8	168.0	16,000	8,000	32,000	27,700	22,600	16,000

TABLE 281.04-Q

Part 2--Endless Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING						
			Choker Hitch	BASKET HITCH					
				Angle of Rope to Horizontal					
				90	60	45	30		
				Angle of Rope to Vertical					

				0	30	45	60
1/2	6.5	1,140	570	2,290	1,980	1,620	1,140
9/16	8.3	1,420	710	2,840	2,460	2,010	1,420
5/8	10.5	1,850	925	3,710	3,210	2,620	1,850
3/4	14.5	2,540	1,270	5,080	4,400	3,590	2,540
13/16	17.0	3,020	1,510	6,050	5,240	4,280	3,020
7/8	20.0	3,560	1,780	7,130	6,170	5,040	3,560
1	26.0	4,460	2,230	8,930	7,730	6,310	4,460
1 1/16	29.0	5,130	2,570	10,300	8,890	7,260	5,130
1 1/8	34.0	5,890	2,940	11,800	10,200	8,330	5,890
1 1/4	40.0	6,680	3,340	13,400	11,600	9,450	6,680
1 5/16	45.0	7,670	3,830	15,300	13,300	10,800	7,670
1 1/2	55.0	9,450	4,730	18,900	16,400	13,400	9,450
1 5/8	68.0	11,600	5,800	23,200	20,100	16,400	11,600
1 3/4	83.0	13,900	6,950	27,800	24,100	19,700	13,900
2	95.0	16,400	8,200	32,800	28,400	23,200	16,400
2 1/8	109.0	18,900	9,450	37,800	32,700	26,700	18,900
2 1/4	129.0	22,300	11,200	44,600	38,700	31,600	22,300
2 1/2	149.0	25,000	12,500	50,000	43,300	35,400	25,000
2 5/8	168.0	28,800	14,400	57,600	49,900	40,700	28,800

TABLE 281.04-R

POLYESTER ROPE SLINGS

Part 1--Eye and Eye Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in	Vertical Hitch	EYE & EYE SLING	
			Choker Hitch	BASKET HITCH
				Angle of Rope to Horizontal

	Pounds			90	60	45	30
				Angle of Rope to Vertical			
				0	30	45	60
1/2	8.0	635	320	1,270	1,100	900	635
9/16	10.2	790	395	1,580	1,370	1,120	790
5/8	13.0	990	495	1,980	1,710	1,400	990
3/4	17.5	1,240	620	2,480	2,150	1,750	1,240
13/16	21.0	1,540	770	3,080	2,670	2,180	1,540
7/8	25.0	1,780	890	3,560	3,080	2,520	1,780
1	30.5	2,180	1,090	4,360	3,780	3,080	2,180
1 1/16	34.5	2,530	1,270	5,060	4,380	3,580	2,530
1 1/8	40.0	2,920	1,460	5,840	5,060	4,130	2,920
1 1/4	46.3	3,290	1,650	6,580	5,700	4,650	3,290
1 5/16	52.5	3,710	1,860	7,420	6,430	5,250	3,710
1 1/2	66.8	4,630	2,320	9,260	8,020	6,550	4,630
1 5/8	82.0	5,640	2,820	11,300	9,770	7,980	5,640
1 3/4	98.0	6,710	3,360	13,400	11,600	9,490	6,710
2	118.0	7,920	3,960	15,800	13,700	11,200	7,920
2 1/8	135.0	9,110	4,460	18,200	15,800	12,900	9,110
2 1/4	157.0	10,600	5,300	21,200	18,400	15,000	10,600
2 1/2	181.0	12,100	6,050	24,200	21,000	17,100	12,100
2 5/8	205.0	13,600	6,800	27,200	23,600	19,200	13,600

TABLE 281.04-R

Part 2--Endless Sling

Rope Diameter nominal in	Nominal Weight	Vertical Hitch	ENDLESS SLING	
			Choker	BASKET HITCH

Inches	per 100 ft. in Pounds		Hitch	Angle of Rope to Horizontal			
				90	60	45	30
				Angle of Rope to Vertical			
				0	30	45	60
1/2	8.0	1,140	570	2,290	1,980	1,620	1,140
9/16	10.2	1,420	710	2,840	2,460	2,010	1,420
5/8	13.0	1,780	890	3,570	3,090	2,520	1,780
3/4	17.5	2,230	1,120	4,470	3,870	3,160	2,230
13/16	21.0	2,770	1,390	5,540	4,800	3,920	2,770
7/8	25.0	3,200	1,600	6,410	5,550	4,530	3,200
1	30.5	3,920	1,960	7,850	6,800	5,550	3,920
1 1/16	34.5	4,550	2,280	9,110	7,990	6,440	4,550
1 1/8	40.0	5,260	2,630	10,500	9,100	7,440	5,260
1 1/4	46.3	5,920	2,960	11,800	10,300	8,380	5,920
1 5/16	52.5	6,680	3,340	13,400	11,600	9,450	6,680
1 1/2	66.8	8,330	4,170	16,700	14,400	11,800	8,330
1 5/8	82.0	10,200	5,080	20,300	17,600	14,400	10,200
1 3/4	98.0	12,100	6,040	24,200	20,900	17,100	12,100
2	118.0	14,300	7,130	28,500	24,700	20,200	14,300
2 1/8	135.0	16,400	8,200	32,800	28,400	23,200	16,400
2 1/4	157.0	19,100	9,540	38,200	33,100	27,000	19,100
2 1/2	181.0	21,800	10,900	43,600	37,700	30,800	21,800
2 5/8	205.0	24,500	12,200	49,000	42,400	34,600	24,500

TABLE 281.04-S

POLYPROPYLENE ROPE SLINGS

Part 1--Eye and Eye Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90	60	45	30
				Angle of Rope to Vertical			
				0	30	45	60
1/2	4.7	645	325	1,290	1,120	910	645
9/16	6.1	780	390	1,560	1,350	1,100	780
5/8	7.5	950	475	1,900	1,650	1,340	950
3/4	10.7	1,300	650	2,600	2,250	1,840	1,300
13/16	12.7	1,520	760	3,040	2,630	2,150	1,520
7/8	15.0	1,760	880	3,520	3,050	2,490	1,760
1	18.0	2,140	1,070	4,280	3,700	3,030	2,140
1 1/16	20.4	2,450	1,230	4,900	4,240	3,460	2,450
1 1/8	23.7	2,800	1,400	5,600	4,850	3,960	2,800
1 1/4	27.0	3,210	1,610	6,420	5,560	4,540	3,210
1 5/16	30.5	3,600	1,800	7,200	6,240	5,090	3,600
1 1/2	38.5	4,540	2,270	9,080	7,860	6,420	4,540
1 5/8	47.5	5,510	2,760	11,000	9,540	7,790	5,510
1 3/4	57.0	6,580	3,290	13,200	11,400	9,300	6,580
2	69.0	7,960	3,980	15,900	13,800	11,300	7,960
2 1/8	80.0	9,330	4,670	18,700	16,200	13,200	9,330
2 1/4	92.0	10,600	5,300	21,200	18,400	15,000	10,600
2 1/2	107.0	12,200	6,100	24,400	21,100	17,300	12,200
2 5/8	120.0	13,800	6,900	27,600	23,900	19,600	13,800

TABLE 281.04-S

Part 2--Endless Sling

Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90	60	45	30
				Angle of Rope to Vertical			
				0	30	45	60
1/2	4.7	1,160	580	2,320	2,010	1,640	1,160
9/16	6.1	1,400	700	2,810	2,430	1,990	1,400
5/8	7.5	1,710	855	3,420	2,960	2,420	1,710
3/4	10.7	2,340	1,170	4,680	4,050	3,310	2,340
13/16	12.7	2,740	1,370	5,470	4,740	3,870	2,740
7/8	15.0	3,170	1,580	6,340	5,490	4,480	3,170
1	18.0	3,850	1,930	7,700	6,670	5,450	3,860
1 1/16	20.4	4,410	2,210	8,820	7,640	6,240	4,410
1 1/8	23.7	5,040	2,520	10,100	8,730	7,130	5,040
1 1/4	27.0	5,780	2,890	11,600	10,000	8,170	5,780
1 5/16	30.5	6,480	3,240	13,000	11,200	9,170	6,480
1 1/2	38.5	8,170	4,090	16,300	14,200	11,600	8,170
1 5/8	47.5	9,920	4,960	19,800	17,200	14,000	9,920
1 3/4	57.0	11,800	5,920	23,700	20,500	16,800	11,800
2	69.0	14,300	7,160	28,700	24,800	20,300	14,300
2 1/8	80.0	16,800	8,400	33,600	29,100	23,800	16,800
2 1/4	92.0	19,100	9,540	38,200	33,100	27,000	19,100
2 1/2	107.0	22,000	11,000	43,900	38,000	31,100	22,000
2 5/8	120.0	24,800	12,400	49,700	43,000	35,100	24,800

u. Synthetic web slings shall be marked or coded to show the rated capacities for each type of hitch and type of synthetic web material. Synthetic webbing shall be of uniform thickness and width and selvage edges shall not be split from the webbing width. Fittings shall be: Of a minimum breaking strength equal to that of the sling; and free of all sharp edges that could in any way damage the webbing. Stitching shall be the only method used to attach end fittings to webbing and to form eyes. The thread shall be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling. Synthetic web slings shall not be used with loads in excess of the rated capacities specified in Tables 281.04-T through 281.04-V. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations. When synthetic web slings are used, the following precautions shall be taken: nylon web slings shall not be used where fumes, vapors, sprays, mists, or liquids of acids or phenolics are present; polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present; and web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists, or liquids of caustics are present. Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of one-hundred-eighty (180) degrees Fahrenheit. Polypropylene web slings shall not be used at temperatures in excess of two-hundred (200) degrees Fahrenheit. Synthetic web slings which are repaired shall not be used unless repaired by a sling manufacturer or an equivalent entity. Each repaired sling shall be proof tested by the manufacturer or equivalent entity to twice the rated capacity prior to its return to service. The employer shall retain a certificate of proof test and make it available for examination by the Department. Slings, including webbing and fittings, which have been repaired in a temporary manner shall not be used. Synthetic web slings shall be immediately removed from service if any of the following conditions are present: acid or caustic burns; melting or charring of any part of the sling surface; snags, punctures, tears, or cuts; broken or worn stitches; or distortion of fittings. (7-1-97)

TABLE 281.04-T						
RATED CAPACITY IN POUNDS SYNTHETIC WEB SLINGS 1,000 LBS. PER INCH OF WIDTH SINGLE PLY						
Part 1--Types I, II, III, & IV						
Sling Body Width Inches	Triangle - Choker Slings, Type I					
	Triangle - Triangle Slings, Type II					
	Eye & Eye with Flat Eye Slings, Type III					
	Eye & Eye with Twisted Eye Slings, Type IV					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	1,000	750	2,000	1,700	1,400	1,000
2	2,000	1,500	4,000	3,500	2,800	2,000

3	3,000	2,200	6,000	5,200	4,200	3,000
4	4,000	3,000	8,000	6,900	5,700	4,000
5	5,000	3,700	10,000	8,700	7,100	5,000
6	6,000	4,500	12,000	10,400	8,500	6,000

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-T

Part 2--Type V

Sling Body Width Inches	Endless Slings, Type V					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	1,600	1,300	3,200	2,800	2,300	1,600
2	3,200	2,600	6,400	5,500	4,500	3,200
3	4,800	3,800	9,600	8,300	6,800	4,800
4	6,400	5,100	12,800	11,100	9,000	6,400
5	8,000	6,400	16,000	13,900	11,300	8,000
6	9,600	7,700	19,200	16,600	13,600	9,600

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-T

Part 3--Type VI

Sling Body Width Inches	Return Eye Slings, Type VI					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	800	650	1,600	1,400	1,150	800

2	1,600	1,300	3,200	2,800	2,300	1,600
3	2,400	1,950	4,800	4,150	3,400	2,400
4	3,200	2,600	6,400	5,500	4,500	3,200
5	4,000	3,250	8,000	6,900	5,650	4,000
6	4,800	3,800	9,600	8,300	6,800	4,800

NOTES: 1. All angles shown are measured from the vertical.

2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-U

RATED CAPACITY IN POUNDS SYNTHETIC WEB SLINGS 1,200 LBS. PER INCH OF WIDTH SINGLE PLY

Part 1--Types I, II, III, & IV

Sling Body Width Inches	Triangle - Choker Slings, Type I					
	Triangle - Triangle Slings, Type II					
	Eye & Eye with Flat Eye Slings, Type III					
	Eye & Eye with Twisted Eye Slings, Type IV					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	1,200	900	2,400	2,100	1,700	1,200
2	2,400	1,800	4,800	4,200	3,400	2,400
3	3,600	2,700	7,200	6,200	5,100	3,600
4	4,800	3,600	9,600	8,300	6,800	4,800
5	6,000	4,500	12,000	10,400	8,500	6,000
6	7,200	5,400	14,400	12,500	10,200	7,200

NOTES: 1. All angles shown are measured from the vertical.

2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-U

Part 2--Type V

Sling Body Width Inches	Endless Slings, Type V					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	1,900	1,500	3,800	3,300	2,700	1,900
2	3,800	3,000	7,600	6,600	5,400	3,800
3	5,800	4,600	11,600	10,000	8,200	5,800
4	7,700	6,200	15,400	13,300	10,900	7,700
5	9,600	7,700	19,200	16,600	13,600	9,600
6	11,500	9,200	23,000	19,900	16,300	11,500

NOTES: 1. All angles shown are measured from the vertical.

2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-U

Part 3--Type VI

Sling Body Width Inches	Return Eye Slings, Type VI					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	950	750	1,900	1,650	1,350	950
2	1,900	1,500	3,800	3,300	2,700	1,900
3	2,850	2,250	5,700	4,950	4,050	2,850
4	3,800	3,000	7,600	6,600	5,400	3,800
5	4,750	3,750	9,500	8,250	6,750	4,750
6	5,800	4,600	11,600	10,000	8,200	5,800

NOTES: 1. All angles shown are measured from the vertical.

2. Capacities for intermediate width not shown may be obtained by

interpolation.

TABLE 281.04-V

RATED CAPACITY IN POUNDS SYNTHETIC WEB SLINGS 1,200 LBS. PER INCH OF WIDTH SINGLE PLY

Part 1--Types I, II, III, & IV

Sling Body Width Inches	Triangle - Choker Slings, Type I					
	Triangle - Triangle Slings, Type II					
	Eye & Eye with Flat Eye Slings, Type III					
	Eye & Eye with Twisted Eye Slings, Type IV					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	1,600	1,200	3,200	2,800	2,300	1,600
2	3,200	2,400	6,400	5,500	4,500	3,200
3	4,800	3,600	9,600	8,300	6,800	4,,800
4	6,400	4,800	12,800	11,100	9,000	6,400
5	8,000	6,000	16,000	13,800	11,300	8,000
6	9,600	7,200	19,200	16,600	13,600	9,600

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-V

Part 2--Type V

Sling Body Width Inches	Endless Slings, Type V					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	2,600	2,100	5,200	4,500	3,700	2,600
2	5,100	4,100	10,200	8,800	7,200	5,100

3	7,700	6,200	15,400	13,300	10,900	7,700
4	10,100	8,200	20,400	17,700	14,400	10,200
5	12,800	10,200	25,600	22,200	18,100	12,800
6	15,400	12,300	30,800	26,700	21,800	15,400

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 281.04-V

Part 3--Type VI

Sling Body Width Inches	Return Eye Slings, Type VI					
	Vert.	Choker	Vert. Basket	30 Basket	45 Basket	60 Basket
1	1,050	1,050	2,600	2,250	1,850	1,300
2	2,600	2,100	5,200	4,500	3,700	2,600
3	3,900	3,150	7,800	6,750	5,500	3,900
4	5,100	4,100	10,200	8,800	7,200	5,100
5	6,400	5,150	12,800	11,050	9,050	6,400
6	7,700	6,200	15,400	13,300	10,900	7,700

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

05. Hoisting Equipment: (7-1-97)

a. Sheave grooves shall be smooth and free from surface defects which could cause rope damage. (7-1-97)

b. Sheaves carrying ropes which can be momentarily unleded shall be provided with close-fitting guards or other suitable devices to guide the rope back into the groove when the load is applied again. (7-1-97)

c. The sheaves in the bottom block shall be equipped with close-fitting guards that will prevent ropes from becoming fouled when the block is lying on the ground with ropes loose. (7-1-97)

d. Pockets and flanges of sheaves used with hoist chains shall be of such dimensions that the chain does not catch or bind during operation. (7-1-97)

e. All running sheaves shall be equipped with means for lubrication. Permanently lubricated, sealed and/or shielded bearings meet this requirement. (7-1-97)

f. In using hoisting ropes, the crane manufacturer's recommendation shall be followed. The rated load divided by the number of parts of rope shall not exceed twenty (20) percent of the nominal breaking strength of the rope. (7-1-97)

g. Socketing shall be done in the manner specified by the manufacturer of the assembly. (7-1-97)

h. Rope shall be secured to the drum as follows: no less than two (2) wraps of rope shall remain on the drum when the hook is in its extreme low position. Rope end shall be anchored by a clamp securely attached to the drum, or by a socket arrangement approved by the crane or rope manufacturer. (7-1-97)

i. Rope clips attached with U-bolts shall have the U bolts on the dead or short end of the rope. Spacing and number of all types of clips shall be in accordance with Table 281.05-A. Clips shall be drop-forged steel in all sizes manufactured commercially. When a newly installed rope has been in operation for an hour, all nuts on the clip bolts shall be re-tightened. (7-1-97)

TABLE 281.05-A		
Diameter of rope	Number of Clips Required	Space Between Clips
1 1/2-inch	8	10-inches
1 3/8-inch	7	9-inches
1 1/4-inch	6	8-inches
1 1/8-inch	5	7-inches
1-inch	5	6-inches
7/8-inch	5	5 1/4-inches
3/4-inch	5	4 1/2-inches
3/8 to 5/8-inch	4	3-inches

(7-1-97)

j. Swaged or compressed fittings shall be applied as recommended by the rope or crane manufacturer. (7-1-97)

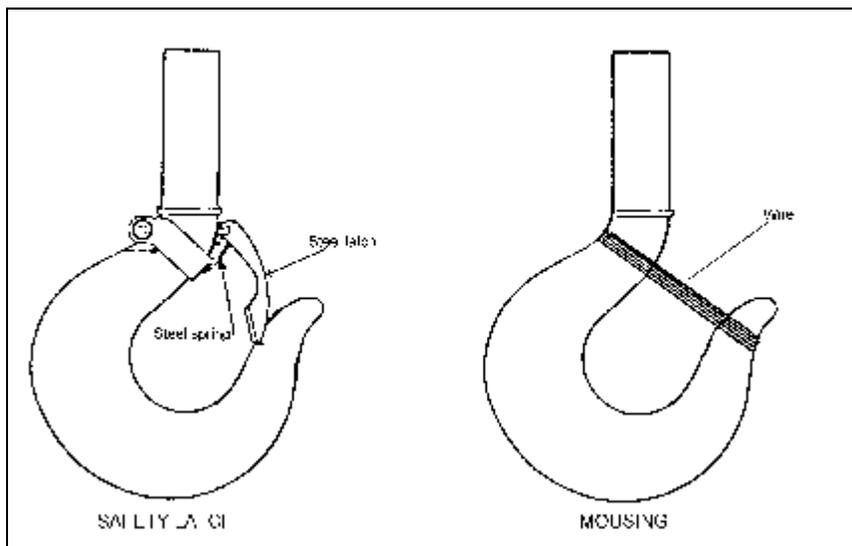
k. Wherever exposed to temperatures at which fiber cores would be damaged, rope having an independent wire-rope or wire-strand core or other temperature-damage resistant core shall be used. (7-1-97)

l. Replacement rope shall be the same size, grade, and construction as the original rope furnished by the crane manufacturer, unless otherwise recommended by a wire rope manufacturer due to actual working condition requirements. (7-1-97)

m. If a load is supported by more than one (1) part of rope, the tension in the parts shall be equalized. (7-1-97)

n. Hooks shall meet the manufacturer's recommendations and shall not be overloaded. Safety latch-type hooks shall be used or the hook shall be moused. (See Figure 281.05-A. (7-1-97)

FIGURE 281.05-A



06. Inspection and Maintenance of Cranes: (7-1-97)

a. Prior to initial use, all new and altered cranes shall be inspected to insure compliance with the provisions of these standards. (7-1-97)

b. Inspection procedure for cranes in regular service is divided into two (2) general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two (2) general classifications are herein

designated as frequent and periodic with respective intervals between inspections as defined below: frequent inspection - daily to monthly intervals; and periodic inspection one (1) to twelve (12) month intervals. (7-1-97)

c. The following items shall be inspected for defects at frequent intervals as defined in sub-section 280.16.b. of this section or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. All deficiencies such as herein listed shall be carefully examined and determination made as to whether they constitute a safety hazard: all functional operating mechanisms for maladjustment interfering with proper operation - Daily; deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic system - Daily; hooks with deformation or cracks - visual inspection daily; monthly inspection with signed reports. For hooks with cracks or having more than fifteen (15) percent in excess of normal throat opening or more than ten (10) degrees twist from the plane of the unbent hook shall be discarded immediately and not reused on any equipment subject to the provisions of this standard. Hoist or load attachment chains, including end connections, shall be inspected for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations. Visual inspection daily; monthly inspection with signed reports. Rope slings, including end connections, for excessive wear, broken wires, stretch, kinking or twisting - visual inspection daily; monthly inspection with signed report. All functional operating mechanisms for excessive wear of components. Rope reeving for noncompliance with manufacturer's recommendations. (7-1-97)

d. Complete inspections of the crane shall be performed at periodic intervals as generally defined in sub-section 281.06.b. of this section, depending upon its activity severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of sub-section 281.06.c. of this section and in addition, the following items. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard: (7-1-97)

i. Deformed, cracked, or corroded members; (7-1-97)

ii. Loose bolts or rivets; (7-1-97)

iii. Cracked or worn sheaves and drums; (7-1-97)

iv. Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices; (7-1-97)

v. Excessive wear on brake system parts, linings, pawls, and ratchets; load, wind, and other indicators over their full range, for any significant inaccuracies; (7-1-97)

vi. Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements; (7-1-97)

vii. Excessive wear of chain drive sprockets and excessive chain stretch. (7-1-97)

e. Magnetic particle or other suitable crack detecting inspection shall be performed at least once each year. (7-1-97)

f. Electric apparatus, shall be inspected for signs of pitting or any deterioration of controller contactors, limit switches and push button stations. (7-1-97)

g. A crane which has been idle for a period of one (1) month or more, but less than six (6) months, shall be given an inspection conforming with requirements of sub-section 281.06.c. of this section and sub-section 281.06.r. of this section before placing in service. (7-1-97)

h. A crane which has been idle for a period of over six (6) months shall be given a complete inspection conforming with requirements of sub-sections 281.06.c. and d. of this section and sub-section 281.06.r. of this of this section before placing in service. (7-1-97)

i. Standby cranes shall be inspected at least semi-annually in accordance with requirements of sub-section 281.06.c. of this section and sub-section 281.06.r. of this section. Standby cranes exposed to adverse environment should be inspected more frequently. (7-1-97)

j. Prior to initial use, all new and altered cranes shall be operationally tested to insure compliance with this section including the following functions: hoisting and lowering; trolley travel; bridge travel; and limit switches, locking and safety devices. (7-1-97)

k. 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. (7-1-97)

l. Prior to initial use all new, extensively repaired, and altered cranes shall be tested by or under the direction of an appointed or authorized person, confirming the load rating of the crane. The load rating shall not be more than eighty (80) percent of the maximum load sustained during the test. Test loads shall not be more than one-hundred-twenty-five (125) percent of the rated load unless otherwise recommended by the manufacturer. The test reports shall be placed on file where readily available to appointed personnel. (7-1-97)

m. A preventive maintenance program based on the crane manufacturer's recommendations shall be established. (7-1-97)

n. Before adjustments and repairs are started on the crane, the following precautions shall be taken: (7-1-97)

i. The crane to be repaired shall be run to a location where it will cause the least interference with other cranes and operations in the area; (7-1-97)

ii. All controllers shall be at the off position; (7-1-97)

iii. The main or emergency switch shall be open and locked in the open position; (7-1-97)

iv. Warning or out of order signs shall be placed on the crane, also on the floor beneath or on the hook where visible from the floor; (7-1-97)

v. Where other cranes are in operation on the same runway, rail stops or other suitable means shall be provided to prevent interference with the idle crane; (7-1-97)

vi. Where temporary protective rail stops are not available, or practical, a signalman should be placed at a visual vantage point for observing the approach of an active crane and warning its operator when reaching the limit of safe distance from the idle crane. (7-1-97)

o. After adjustments and repairs have been made, the crane shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed. (7-1-97)

p. Any unsafe conditions disclosed by the inspection requirements of this section shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done only by designated personnel. Adjustments shall be maintained to assure correct functioning of components. The following are examples: all functional operating mechanisms; limit switches; control systems; brakes; and power plants. (7-1-97)

q. Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples: accessory components, such as hooks, shall be carefully examined periodically and at the time of annual examination and inspection; cracked or deformed hooks shall be discarded immediately and not reused on any equipment subject to the provisions of this standard; load attachment chains and rope slings showing defects described in sub-section 280.14. of this section; all critical parts which are cracked, broken, bent, or excessively worn; and pendant control stations shall be kept clean and function labels kept legible. (7-1-97)

07. Operation of Cranes and Handling of Loads: (7-1-97)

a. Cranes shall not be loaded beyond their rated load except for test purposes as provided in sub-section 281.06.j. through 281.06.l. of this section. When loads which are limited by structural competence rather than by stability are to be handled, it shall be ascertained that the weight of the load has been determined within plus or minus ten (10) percent before it is lifted. (7-1-97)

b. The load shall be attached to the load block hook by means of slings or other approved devices. The hoist chain or hoist rope shall be free from kinks. The hoist rope shall not be wrapped around the load. Care shall be taken to make certain that the sling clears all obstacles. The load shall be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches. (7-1-97)

c. Before starting to hoist the following conditions shall be noted: hoist rope shall not be kinked; multiple part lines shall not be twisted around each other; and the hook shall be brought over the load in such a manner as to prevent swinging. (7-1-97)

d. During hoisting care shall be taken that: there is no sudden acceleration or deceleration of the moving load and the load does not contact any obstructions. (7-1-97)

- e.** Cranes/derricks shall not be used for side pulls except when specifically authorized by a responsible person who has determined that the stability of the crane is not thereby endangered and that various parts of the crane will not be over-stressed. (7-1-97)
- f.** While any employee is on the load or hook, there shall be no hoisting, lowering or traveling. Operators shall not permit anyone to ride on the load or hooks, unless using a lifeline or safety device approved by the Department. (7-1-97)
- g.** No person should be permitted to stand or pass under a load on the hook. The operator shall avoid carrying the load over people. (7-1-97)
- h.** The operator shall test the brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load a few inches and applying the brakes. (7-1-97)
- i.** Neither the load nor the boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums. (7-1-97)
- j.** When two (2) or more cranes are used to lift a load one designated person shall be in charge of the operation. This person shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made. (7-1-97)
- k.** The employer shall assure that the operator does not leave his position at the controls while the load is suspended. (7-1-97)
- l.** When starting the bridge and when the load or hook approaches near or over personnel, the warning signal shall be sounded. (7-1-97)
- m.** At the beginning of each operator's shift, the upper limit switch of each hoist shall be tried out under no load. Extreme care shall be exercised; the block shall be inched into the limit or run at slow speed. If the switch does not operate properly, the appointed person shall be immediately notified. (7-1-97)
- n.** The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control. (7-1-97)
- o.** The operator shall not move the load or crane unless the floor signals are clearly understood. The operator shall take care that the load does not swing so that the hook-person or floor-person are endangered, ensure that they are clear before hoisting or moving the load. When raising or lowering the load the operator shall ascertain that the load shall safely clear adjacent stockpiles or machinery. The operator shall not pick up a load greater than the capacity of the crane. In case of doubt contact the supervisor or designated person. (7-1-97)
- p.** Cranes shall be operated only by regular crane operators, authorized substitutes who have had adequate experience and training under the supervision of a competent operator, or by crane repairmen or inspectors. No person shall be permitted to operate a crane who cannot speak and read the English language, or who is under eighteen (18) years of age. No person shall be

permitted to operate a crane whose hearing or eyesight is impaired, or who may be suffering from heart disease or similar ailments. The operator shall be fully familiar with all crane rules and with the crane mechanism and its proper care. If adjustments or repairs are necessary, the operator shall report the same at once to the proper authority. The operator shall not eat, smoke, or read while actually engaged in the operation of the crane or operate the crane when physically unfit. (7-1-97)

q. The operator or someone especially designated shall properly lubricate all working parts of the crane. (7-1-97)

r. Cranes shall be kept clean. Necessary clothing and personal belongings shall be stored in such a manner as not to interfere with access or operation. Tools, oil cans, waste, extra fuses, and other necessary articles, shall be stored in the tool box or in such a manner as not to interfere with access or operation and shall not be permitted to lie loose in or about the cab. (7-1-97)

s. Whenever the operator finds the main or emergency switch open, the operator shall not close it, even when starting on regular duty, until it has been determined that no one is on or about the crane. The operator shall not oil or repair the crane unless the main switch is open. (7-1-97)

t. If the power goes off, the operator shall immediately throw all controllers to "OFF" position until the power is again available. (7-1-97)

u. Before closing the main switch the operator shall make sure that all controllers are in the "OFF" position. (7-1-97)

v. The operator shall recognize signals only from the person who is supervising the lift. Operating signals shall be as established in Figure 281.07-A. Whistle signals may be used where one crane only is in operation. (7-1-97)

FIGURE 281.07-A

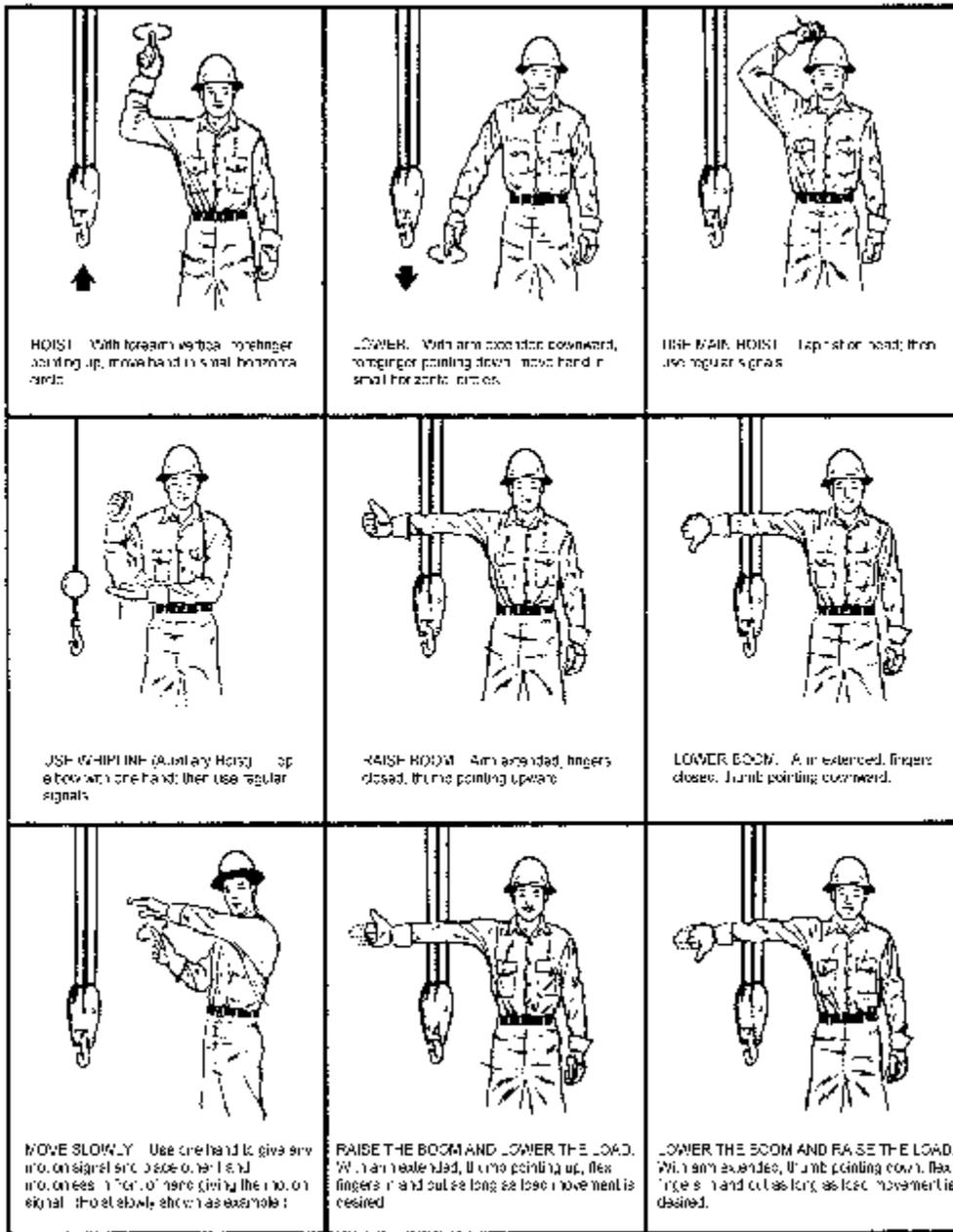


FIGURE 281.07-A

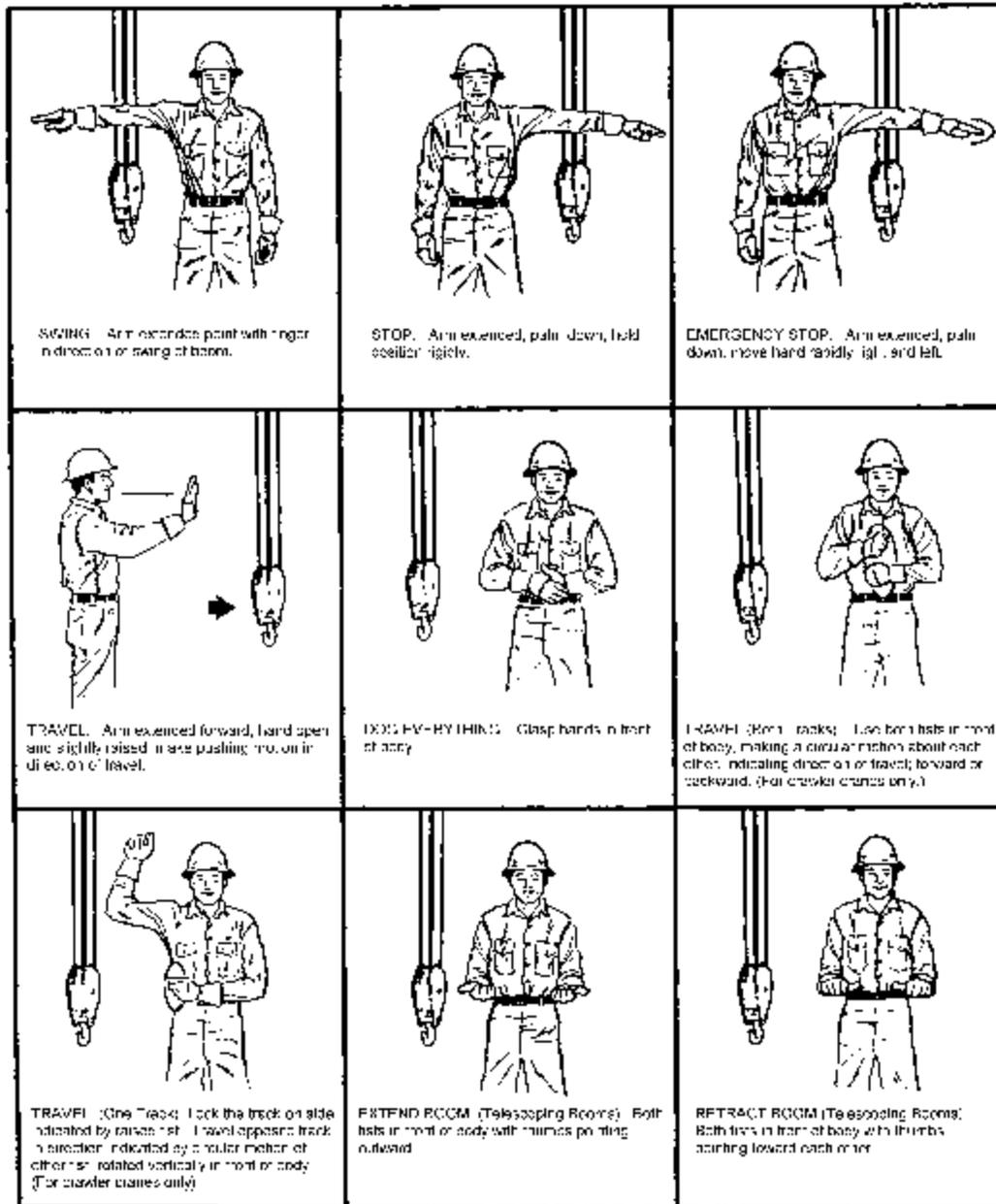
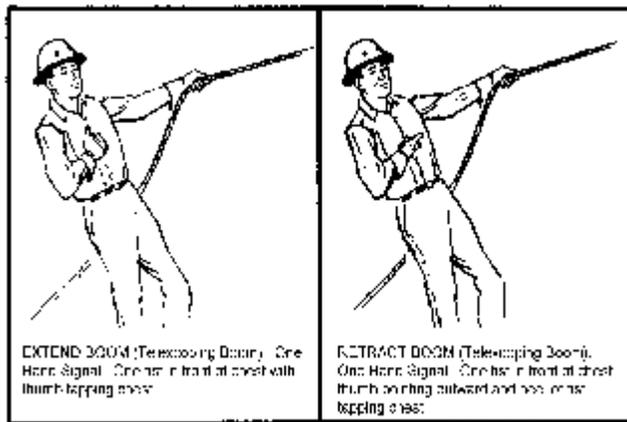


FIGURE 281.07-A



w. Bumping into runway stops or other cranes shall be avoided. When the operator is ordered to engage with or push other cranes, it shall be done with special care for the safety of persons on or below cranes. (7-1-97)

x. When lowering a load, the operator shall proceed carefully and make sure that the load is under safe control. (7-1-97)

y. When leaving the cage/cab, the operator shall throw all controllers to the "OFF" position and open the main switch. (7-1-97)

z. While a winch head is being used, the operator shall be within convenient reach of the power unit control lever. Ropes shall not be handled on a winch head without the knowledge of the operator. (7-1-97)

08. Chain and Electric Hoists: (7-1-97)

a. Chain and electric hoists shall be of what is known as all steel construction. No case iron shall be used in parts subject to tension except drums, bearings, or brake shoes. (7-1-97)

b. The chains shall be made of the best quality steel or iron with welded links. (7-1-97)

c. Chain and electric hoists shall have a factor of safety of at least five (5). (7-1-97)

d. Chain and electric hoists shall be equipped with an approved device which will automatically lock the load when hoisting is stopped. (7-1-97)

e. Electric hoists shall be provided with an approved limit stop to prevent the hoist block from traveling too far in case the operating handle is not released in time. (7-1-97)

09. Air Hoists: (7-1-97)

a. To prevent piston rod lock nuts from becoming loose and allowing rod to drop when supporting a load lock nut shall be secured to piston rod by a castellated nut and cotter-pin. (7-1-97)

b. A clevis or other means shall be used to prevent hoists cylinder becoming detached from hanger. (7-1-97)

10. Truck and Crawler Cranes: (7-1-97)

a. This Subsection applies to crawler cranes, and wheel mounted cranes of both truck and self-propelled wheel type, and any variations thereof which retain the same fundamental characteristics. This sub-section includes only cranes of the above types, which are basically powered by internal combustion engines or electric motors and which utilize drums and ropes. Cranes designed for automobile wreck clearances are excepted. The requirements of this standard are applicable only to machines when used as lifting cranes. (7-1-97)

b. All new crawler and truck cranes constructed and utilized on or after the effective date of these standards shall meet the design specifications of the American National Standard Safety Code for Crawler, Locomotive and Truck Cranes, ANSI B30.5. Crawler and truck cranes constructed prior to the effective date of these standards shall be modified to conform to those design specifications by December 31, 1973, unless it can be shown that the crane can not feasibly or economically be altered and that the crane substantially complies with the requirements of this section. Replacement parts shall be of equal or better quality than the original equipment and suitable for the purpose. Repairs or modifications shall be such as to render the equipment equal to or better than the original construction or design. (7-1-97)

c. The margin of stability for determination of load ratings, with booms of stipulated lengths at stipulated working radii for the various types of crane mountings is established by taking a percentage of the loads which will produce a condition of tipping or balance with the boom in the least stable direction, relative to the mounting. The load ratings shall not exceed the percentages for cranes in Table 281.10-A, with the indicated types of mounting under conditions stipulated in sub-section 281.09.d. of this section. (7-1-97)

TABLE 281.10-A	
Type of crane mounting:	Maximum load ratings (percent of tipping loads)
Locomotive, without outriggers;	85
Booms 60 ft. or less Booms	85

over 60 ft.	
Locomotive, using outriggers fully extended	80
Crawler, without outriggers	75
Crawler, using outriggers fully extended	85
Truck and wheel mounted without outriggers or using outriggers fully extended	85

(7-1-97)

d. Stipulations governing the application of the values in sub-section 281.10.c. of this section for crawler, truck, and wheel-mounted cranes shall be in accordance with Crane Load-Stability Test Code. Society of Automotive Engineers (SAE) J765. (7-1-97)

e. NOTE: Effectiveness of the preceding stability factors will be influenced by such additional factors as freely suspended loads, track, wind, or ground conditions, condition and inflation of rubber tires, boom lengths, proper operating speeds for existing conditions, and, in general, careful and competent operation. All of these shall be taken into account by the user. (7-1-97)

f. A chart indicating the manufacturer's rated capacity at all operating radii for all permissible boom lengths and jib lengths with alternate ratings for optional equipment affecting such ratings shall be posted in all mobile type cranes and shall be readily visible to the operator in his normal operating position. (7-1-97)

g. Inspections shall be as required in sub-section 281.06. of this section and the following: (7-1-97)

i. Deformed, cracked, or corroded members, in the crane structure and boom; (7-1-97)

- ii.** Loose bolts or rivets; (7-1-97)
- iii.** Cracked or worn sheaves and drums; (7-1-97)
- iv.** Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices; (7-1-97)
- v.** Excessive wear on brake and clutch system parts, linings, pawls, and ratchets; (7-1-97)
- vi.** Load, boom angle, and other indicators over their full range, for any significant inaccuracies; (7-1-97)
- vii.** Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements; (7-1-97)
- viii.** Excessive wear of chain-drive sprockets and excessive chain stretch; (7-1-97)
- ix.** Travel steering, braking, and locking devices, for malfunction; and excessively worn or damaged tires or treads. (7-1-97)
- h.** A crane which has been idle for a period of one month or more, but less than six (6) months, shall be given an inspection conforming with requirements of sub-section 281.06.c. and sub-section 281.04. before placing in service. (7-1-97)
- i.** A crane which has been idle for a period of six (6) months shall be given a complete inspection conforming with requirements of sub-section 281.06.c. and d. and sub-section 281.04. of this section before placing in service. (7-1-97)
- j.** Standby cranes shall be inspected at least semi- annually in accordance with requirements of sub-section 281.06.d. and sub-section 281.04. of this section. Such cranes which are exposed to adverse environment should be inspected more frequently. (7-1-97)
- k.** Written, dated, and signed inspection reports and records shall be made monthly on critical items in use such as brakes, crane hooks, and ropes. Records shall be made available to representatives of the Department. (7-1-97)
- l.** In addition to prototype tests and quality-control measure, the user of each new production crane shall require that it be tested and related data supplied by the manufacturer to the extent necessary to assure compliance with the operational requirements of this subsection including functions such as the following: (7-1-97)
 - i.** Load hoisting and lowering mechanism; boom hoisting and lowering mechanism; (7-1-97)
 - ii.** Swinging mechanism; (7-1-97)
 - iii.** Travel mechanism; and safety devices. (7-1-97)

Where the complete production crane is not supplied by one manufacturer, such tests shall be conducted at final assembly. No cranes shall be re-rated in excess of the original load ratings unless such rating changes are approved by the crane manufacturer or final assembler. Certified production crane test results shall be made available to representatives of the Department. (7-1-97)

m. Written reports of rated load tests shall be available showing test procedures and confirming the adequacy of repairs or alterations. Test loads shall not exceed one-hundred (100) percent of the rated load at any selected working radius. Where re-rating is necessary; crawler, truck, and wheel-mounted cranes shall be tested in accordance with SAE Recommended Practice, Crane Load Stability Test Code J765. Test reports shall be made available to representatives of the Department. (7-1-97)

n. Any unsafe conditions disclosed by the inspection requirements of this section shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done only by designated personnel. After adjustments and repairs have been made, the crane shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed. (7-1-97)

o. A thorough inspection of all ropes in use shall be made in accordance with the provisions of sub-section 281.06.r. and sub-section 281.06.s. of this section. (7-1-97)

p. Prior to moving the load the employer shall assure that: the crane is level and where necessary, blocked properly; the load is well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches; the hook shall be brought over the load in such a manner as to prevent swinging; and if there is a slack rope condition, it shall be determined that the rope is properly seated on the drum and in the sheaves. (7-1-97)

q. On truck mounted cranes, no loads shall be lifted over the front area except as approved by the crane manufacturer. (7-1-97)

r. Outriggers shall be used when the load to be handled at that particular radius exceeds the rated load without outriggers as given by the manufacturer for that crane. Where floats are used, they shall be securely attached to the outriggers. Wood blocks used to support outriggers shall: be strong enough to prevent crushing; be free from defects; and be of sufficient width and length to prevent shifting or toppling under load. (7-1-97)

s. In transit, the following additional precautions shall be exercised: the boom shall be carried in line with the direction of motion; the superstructure shall be secured against rotation, except when negotiating turns when there is an operator in the cab or the boom is supported on a dolly; and the empty hook shall be lashed or otherwise restrained so that it cannot swing freely. Before traveling a crane with load, a designated person shall be responsible for determining and controlling safety. Decisions such as position of load, boom location, ground support, travel route, and speed of movement shall be in accord with determinations of the designated person. A crane with or without load shall not be traveled with the boom so high that it may bounce back over the cab. (7-1-97)

t. When rotating the crane, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radii at which it can be controlled. A tag or restraint line shall be used when rotation of the load is hazardous. When a crane is to be operated at a fixed radius, the boom-hoist pawl or other positive locking device shall be engaged. (7-1-97)

u. If the load must remain suspended for any considerable length of time, the operator shall hold the drum from rotating in the lower direction by activating the positive controllable means of the operator's station. (7-1-97)

v. Cranes shall not be operated without the full amount of any ballast or counterweight in place as specified by the maker, but truck cranes that have dropped the ballast or counterweight may be operated temporarily with special care and only for light loads without the full ballast or counterweight in place. The ballast or counterweight in place specified by the manufacturer shall not be exceeded. (7-1-97)

w. Refueling with small portable containers shall be done with Underwriter's Laboratories or Factory Mutual Laboratories approved, or equivalent, safety type metal can equipped with an automatic closing cap and flame arrestor. Machines shall not be refueled with the engine running. (7-1-97)

x. A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the cab or on the crane. Operating and maintenance personnel shall be made familiar with the use and care of the fire extinguishers provided. (7-1-97)

y. Except where the electrical distribution and transmission lines have been de-energized and visibly grounded at point of work or where insulating barriers not a part of or an attachment to the crane have been erected to prevent physical contact with the lines, cranes shall be operated proximate to, under, over, by, or near power-lines only in accordance with section 151 of this standard. Cage-type boom guards, insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not operate to alter the requirements of this sub-section. Before the commencement of operations near electrical lines, the owners of the lines or their authorized representative shall be notified and provided with all pertinent information. The cooperation of the owner shall be requested. Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line. (7-1-97)

11. Derricks and A-Frames: (7-1-97)

a. This Subsection applies to guy, still-leg, breast, gin, pole, and A-frame derricks of the stationary type, capable of handling loads at variable reaches and powered by hoists through systems of rope reeving, used to perform lifting hook work, single or multiple line bucket work, grab, grapple, and magnet work. Derricks may be permanently installed or for temporary use as in construction work. The requirements of this Subsection also apply to any modification of these types derricks which retain their fundamental features, except for fleeting derricks. (7-1-97)

- b.** All new derricks constructed and installed on or after the effective date of this standard shall meet the design specifications of the American National Standard Institute Safety Code for Derricks, ANSI B30.6. Derricks constructed prior to December 31, 1971 shall be modified to conform to these design specifications by December 31, 1973 unless it can be shown that the derrick cannot feasibly or economically be altered and that the derrick substantially complies with the requirements of this section. (7-1-97)
- c.** Operating controls shall be marked or an explanation of the controls shall be posted in full view of the operator. Cranes or derricks having a movable working boom shall have a radius or boom angle indicator installed. This shall be located where the operator can readily read it while in his normal operating position. (7-1-97)
- d.** The top six (6) feet of the boom or jib shall be painted bright yellow. (7-1-97)
- e.** Only designated personnel shall be permitted to operate a derrick and shall meet the requirements of sub-section 281.07.o. of this section. (7-1-97)
- f.** For permanently installed derricks with fixed lengths of boom, guy, and mast rigging, a substantial, durable, and clearly legible rating chart shall be provided with each derrick and securely affixed where it is visible to personnel responsible for the safe operation of the equipment. The chart shall include the following data: manufacturer's approved load ratings at corresponding ranges of boom angle or operating radii; specific lengths of components on which the load ratings are based; and required parts for hoist reeving (size and construction of rope may be shown either on the rating chart or in the operating manual). For nonpermanent installations, the employer shall provide sufficient information from which capacity charts can be prepared for the particular installation. The capacity charts shall be located at the derricks or the job site office. (7-1-97)
- g.** Prior to initial use, all new and altered derricks shall be inspected to insure compliance with the provisions of this standard. (7-1-97)
- h.** Inspection procedure for derricks in regular service is divided into two (2) general classifications based upon the intervals at which inspection shall be performed. The intervals in turn are dependent upon the nature of the critical components of the derrick and the degree of their exposure to wear, deterioration, or malfunction. The two (2) general classifications are herein designated as frequent and period with respective intervals between inspections as defined below: frequent inspection - daily to monthly intervals and periodic inspection one (1) to twelve (12) month intervals, or as specified by the manufacturer. (7-1-97)
- i.** Items such as the following shall be inspected at frequent intervals for defects at intervals as defined in sub-section 281.11.h. of this section or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. Deficiencies shall be carefully examined for any safety hazard. All control mechanisms shall be inspected daily for adjustment, wear, and lubrication. All chords and lacing shall be inspected daily visually. Tension in guys and plumb of the mast shall be inspected daily. Inspection for deterioration or leakage in air or hydraulic systems shall be done daily. Derrick hooks shall be

inspected for deformations or cracks. Hooks with cracks or having more than fifteen (15) percent in excess of normal throat opening or more than ten (10) degree twist from the plane of the unbent hook shall be discarded immediately and not reused on any equipment subject to the provisions of this standard. Rope reeving shall be visually inspected for noncompliance with derrick manufacturer's recommendations. Hoist brakes, clutches, and operating levers shall be checked daily for proper functioning before beginning operations. Electrical apparatus shall be inspected for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation. (7-1-97)

j. Complete inspections of the derrick shall be performed at periodic intervals as defined in sub-section 281.11.h. of this section depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of sub-section 281.10.i. of this section and in addition, items such as the following. Deficiencies shall be carefully examined and a determination made as to whether they constitute a safety hazard: (7-1-97)

i. Bolts or rivets for tightness; (7-1-97)

ii. Parts such as pins, bearings, shafts, gears, sheaves, drums, rollers, locking and clamping devices, for wear, cracks, and distortion; (7-1-97)

iii. Structural members for deformations, cracks, and corrosion; gudgeon pin for cracks, wear and distortion each time the derrick is to be erected; (7-1-97)

iv. And power plants for proper performance and compliance with applicable safety requirements. (7-1-97)

Hooks shall have magnetic particle or other suitable crack detecting inspection should be performed at least once each year. Foundation or supports shall be inspected for continued ability to sustain the imposed loads. (7-1-97)

k. A derrick which has been idle for a period of one (1) month or more, but less than six (6) months shall be given an inspection conforming with requirements of sub-section 281.11.h. and Subsection 281.04. of this section before placing in service. A derrick which has been idle for a period of over six (6) months shall be given a complete inspection conforming with requirements of sub-sections 281.11.h and i. and sub-section 281.04. of this section before placing in service. Standby derricks shall be inspected at least semi-annually in accordance with requirements of sub-section 281.11.i. and sub-section 281.04. of this section. Those exposed to adverse environment should be inspected more frequently. Prior to initial use all new and altered derricks shall be tested to ensure compliance with this section, including the following functions: load hoisting and lowering; boom up and down; swing; and operation of clutches and brakes of hoist. (7-1-97)

l. All anchorages shall be approved by the appointed person. Rock and hairpin anchorages shall require special testing. (7-1-97)

m. A preventive maintenance program based on the derrick manufacturer's recommendations shall be established. (7-1-97)

n. Before adjustments and repairs are started on a derrick, the following precautions shall be taken: (7-1-97)

i. The derrick to be repaired shall be arranged so it will cause the least interference with other equipment and operations in the area; (7-1-97)

ii. All hoist drum dogs shall be engaged; the main or emergency switch shall be locked in the open position, if an electric hoist is used; (7-1-97)

iii. Warning or out of order signs shall be placed on the derrick and hoist; the repairs of booms or derricks shall either be made when the booms are lowered and adequately supported or safely tied off; (7-1-97)

iv. A good communication system shall be set up between the hoist operator and the appointed individual in charge of the derrick operations before any work on the equipment is started; (7-1-97)

v. And welding repairs shall be approved by an appointed person. (7-1-97)

After adjustments and repairs have been made, the derrick shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed. Any unsafe conditions disclosed by inspection shall be corrected before operation of the derrick is resumed. Adjustments shall be maintained to assure correct functioning of components. (7-1-97)

o. Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples of conditions requiring prompt repair or replacement: hooks showing defects described in sub-section 281.04. of this section shall be discarded; all critical parts which are cracked, broken, bent, or excessively worn; pitted or burned electrical contacts shall be corrected only by the replacement and in sets; controller parts should be lubricated as recommended by the manufacturer; and all replacement and repaired parts shall have at least the original safety factor. (7-1-97)

p. Derrick operation shall be directed only by the individual specifically designated for that purpose. (7-1-97)

q. No derrick shall be loaded beyond the rated load. When loads approach the maximum rating of the derrick, it shall be ascertained that the weight of the load has been determined within plus or minus ten (10) percent before it is lifted. A derrick shall not be used for side loading except when specifically authorized by a responsible person who has determined that the various structural components will not be over-stressed. Boom and hoisting rope systems shall not be twisted. (7-1-97)

r. The operator shall not be allowed to leave his position at the controls while the load is suspended. People shall not be permitted to stand or pass under a load on the hook. If the load must remain suspended for any considerable length of time, a dog, or pawl and ratchet, or other equivalent means, rather than the brake alone, shall be used to hold the load. (7-1-97)

s. Dogs, pawls, or other positive holding mechanism on the hoist shall be engaged. When not in use, the derrick boom shall: be laid down; be secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block; or be hoisted to a vertical position and secured to the mast. (7-1-97)

t. Exposed moving parts, such as gears, ropes, setscrews, projecting keys, chains, chain sprockets and reciprocating components which constitute a hazard under normal operating conditions shall be guarded. Guards shall be securely fastened. Each guard shall be capable of supporting without permanent distortion, the weight of a two-hundred (200) pound person unless the guard is located where it is impossible for a person to step on it. (7-1-97)

s. Hooks shall meet the manufacturer's recommendations and shall not be overloaded. Safety latch type hooks shall be used or the hooks shall be moused. (7-1-97)

t. A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the immediate vicinity of the derrick. Operating and maintenance personnel shall be familiar with the use and care of the fire extinguishers provided. (7-1-97)

u. Refueling with portable containers shall be done with Underwriters' Laboratory, Inc., (UL) or Factory Mutual Laboratories approved or equivalent, safety type metal containers equipped with automatic closing spout and flame arrester. Machines shall not be refueled with the engine running. (7-1-97)

v. Except where the electrical distribution and transmission lines have been de-energized and visibility grounded at point of work or where insulating barriers not a part of or an attachment to the derrick have been erected to prevent physical contact with the lines, derricks shall be operated proximate to, under, over, by, or near power-lines only in accordance with the provisions of section 151 of this standard. Cage-type boom guards, insulating links, or proximity warning devices may be used on derricks, but the use of such devices shall not operate to alter the requirements of above. Before the commencement of operations near electrical lines, the owners of the lines or their authorized representatives shall be notified and provided with pertinent information. The owner's cooperation shall be requested. Any overhead wire shall be considered to be an energized line until the owner of the line or their authorized representatives state that it is de-energized. (7-1-97)

w. All timbers for A-frames shall be of correct size, length, and condition to sustain the maximum contemplated loads. A-frame timbers shall be braced with two (2) spreaders spaced one-fourth (1/4) the length of the A-frame from each end. Cross bracing shall cross between the two (2) spreaders. Bracing material shall be not less than two-thirds (2/3) of the rated strength of the A-frame timbers. Tie rods (stay bolts) of not less than one and one-half (1 1/2) the diameter of the main A-frame timbers shall be used. Tie rods shall be placed directly above the upper

spreader and directly below the lower spreader. Ends of bolts shall be secured at each end with malleable washers and nuts. The base of the A-frame shall be securely anchored. Elevating type A-frames shall be set in pinion-type sockets. Pinion bases shall be securely anchored. Guy lines shall be of sufficient strength to carry the load imposed upon them and shall be securely fastened in place. (7-1-97)

12. Helicopter Hoisting Operations: (7-1-97)

a. Helicopter operations shall comply with all applicable regulations of the Federal Aviation Administration. (7-1-97)

b. Prior to each day's operation, a briefing shall be conducted. This briefing shall set forth the plan of operation for the pilot and ground personnel. Sufficient ground personnel shall be provided when required for safe helicopter loading and unloading operations. (7-1-97)

c. The load shall be properly slung. Tag lines shall be of a length that will not permit their being drawn up into rotors. Pressed sleeve, swedged eyes, or equivalent means shall be used for all freely suspended loads to prevent hand splices from spinning open or cable clamps from loosening. Hoist ropes or other gear, except for pulling lines or conductors that are allowed to pay out from a container or roll off a reel, shall not be attached to any fixed ground structure, or allowed to foul on any fixed structure. (7-1-97)

d. All electrically operated cargo hooks shall have the electrical activating device so designed and installed as to prevent inadvertent operation. In addition, these cargo hooks shall be equipped with an emergency mechanical control for releasing the load. The hooks shall be tested prior to each day's operation to determine that the release functions properly, both electrically and mechanically. (7-1-97)

e. Personal protective equipment for employees receiving the load shall consist of complete eye protection and hard hats secured by chin straps. Loose-fitting clothing likely to flap in the down-wash and thus be snagged on hoist line shall not be worn. (7-1-97)

f. Every practical precaution shall be taken to provide for the protection of the employees from flying objects in the rotor down-wash. All loose gear within one-hundred (100) feet of the place of lifting the load, depositing the load, and all other areas susceptible to rotor down-wash shall be secured or removed. Good housekeeping shall be maintained in all helicopter loading and unloading areas. (7-1-97)

g. The helicopter operator shall be responsible for size, weight, and manner in which loads are connected to the helicopter. The weight of an external load shall not exceed the manufacturer's rating. If, for any reason, the helicopter operator believes the lift can not be made safely, the lift shall not be made. (7-1-97)

h. Employees shall not perform work under hovering craft except for that limited period of time necessary to guide, secure and unhook loads, or to hook loads. Regardless of whether the hooking or unhooking of a load takes place on the ground or a flat roof, or other location in an

elevated work position in structural members, a safe means of access and egress, to include an un-programmed emergency escape route or routes, shall be provided for the employees who are hooking or unhooking loads. (7-1-97)

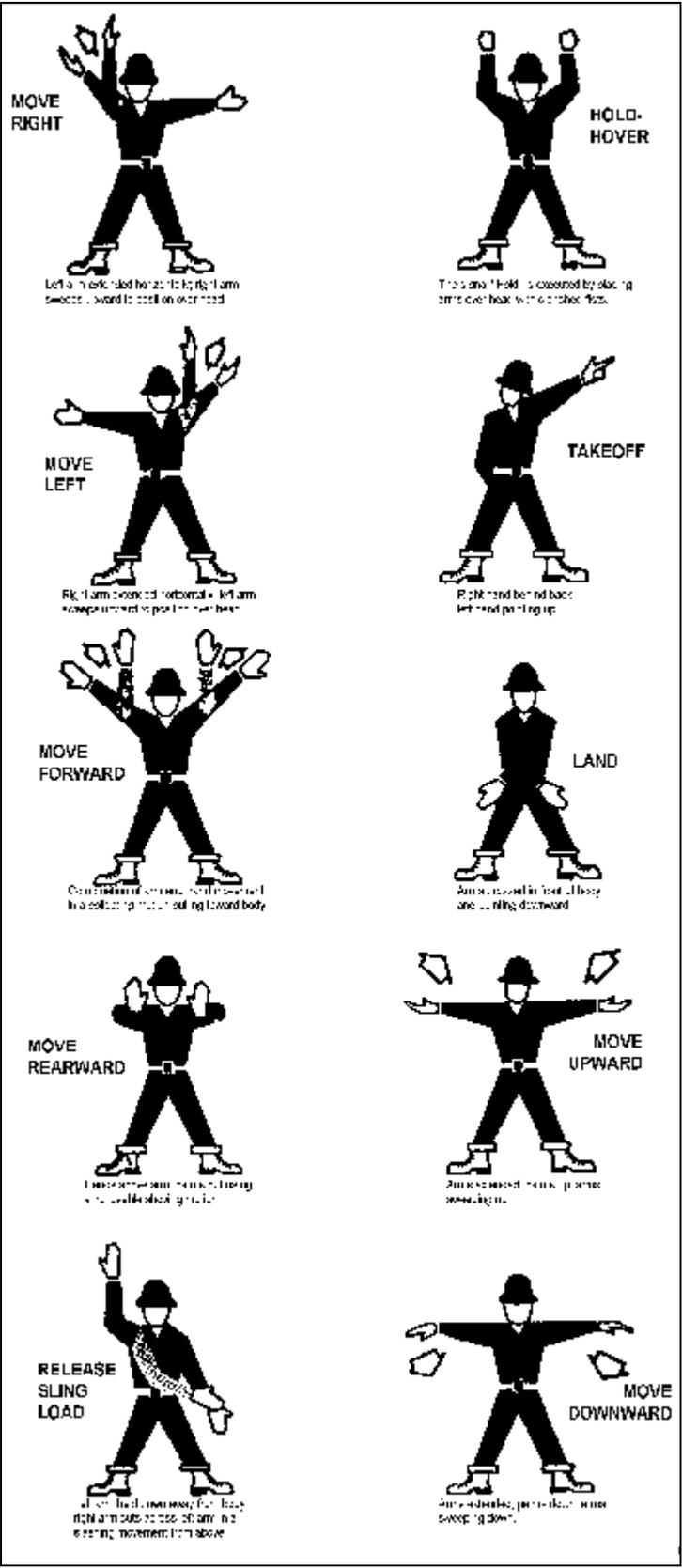
i. Static charge on the suspended load shall be dissipated with a grounding device before ground personnel touch the suspended load, or protective rubber gloves shall be worn by all ground personnel touching the suspended load. (7-1-97)

j. When visibility is reduced by dust or other conditions, ground personnel shall exercise special caution to keep clear of main and stabilizing rotors. Precautions shall also be taken by the employer to eliminate as far as practical reduced visibility. (7-1-97)

k. There shall be constant reliable communication between the pilot, and a designated employee of the ground crew who acts as a signalman during the period of loading and unloading. This signalman shall be distinctly recognizable from other ground personnel. Signal systems between aircrew and ground personnel shall be understood and checked in advance of hoisting the load. This applies to either radio or hand signal systems. Hand signals shall be as shown in Figure 281.12-A. (7-1-97)

281.12

FIGURE 281.12-A



l. No unauthorized person shall be allowed to approach within fifty (50) feet of the helicopter when the rotor blades are turning. Whenever approaching or leaving a helicopter with blades rotating, all employees shall remain in full view of the pilot and keep in a crouched position. Employees shall avoid the area from the cockpit or cabin rearward unless authorized by the helicopter operator to work there. (7-1-97)

m. Open fires shall not be permitted in an area that could result in such fires being spread by the rotor down-wash. (7-1-97)

282.--289. (RESERVED)