SAFETY OPERATING PRACTICES

for

Industrial Cranes, Hoists and Monorails

MANUAL FOR CRANE OPERATORS

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SAFE PRACTICES
For
Cranes, Hoists and Monorails

GENERAL

The purpose of this manual is to recommend to users of cranes, hoists, and monorails certain concepts of preventive inspection and maintenance, as well as specific safety suggestions, which will promote both of the above objectives.

Not all of the material presented will apply to any single crane, hoist, or monorail. However, the majority of the information applies to all types of lifting devices, and the reader is requested to bear with those items which do not specifically relate to his equipment.

It is understood that safety rules within individual companies vary. If a conflict exists between the material contained in this manual and the rules of a using company, the more stringent rules should take precedence.

Safety begins with a properly designed and manufactured crane, hoist, or monorail. However, when the crane of hoist enters service in the field, the manufacturer has no further direct control over its inspection, maintenance, or operation. For this reason, safety in the field must remain the responsibility of the user.

The following topics have been found by experience to affect safety and productivity, and each will be discussed individually.

PERSONNEL

It is assumed that personnel assigned to operate, maintain, inspect, or provide safe working conditions for cranes, hoists, or monorails are Competent, Experienced, and Licensed if required by law. Only properly designated persons should operate any crane, hoist, or monorail.

Minimum requirements for a competent crane, hoist, or monorail operator, in addition to a generally alert and safety conscious attitude, are as follows:

1) He must read and speak the English language fluently.

2) He must be at least 18 years of age and familiar with normal shop area practices and procedures.

3) He must have good hearing and vision (with or without correction) and must have good depth perception.

4) He must not be afflicted with known heart or other health conditions which might cause sudden loss of his ability to react.

5) He must have been carefully instructed in his duties.

6) He must have a substantial knowledge of the methods of hitching loads and be prepared to demonstrated such knowledge as a prerequisite of employment.

7) Before operating a crane, hoist, or monorail with which the operator is not familiar, he must read the instructions provided by the manufacture and note any special instructions, paying particular attention to the function and operation of each control.

NOTE

Each crane operator should be held directly responsible for the safe operation of the crane, hoist or monorail. Whenever there is any doubt as to safety, the operator should stop the crane and refuse to handle loads until safe conditions have be restored.

INSPECTION AND MAINTENANCE

GENERAL. It is recommended that a periodic inspection, lubrication, and maintenance schedule be established for cranes, hoists and monorails, and that this schedule be carefully followed. Such a procedure will prevent minor defects from becoming progressively more dangerous, as well as more costly to repair.

Due to wildly varying conditions under which nearly identical machines may operate, it is impossible for the manufacturer to state exact time intervals at which the above inspections and/or maintenance should be performed. All inspection, maintenance and lubrication intervals recommended in any publication represent minimum safe intervals for average conditions, since there is no substitute for experience or first hand knowledge of local operating conditions. Inspections are recommended for three basic purposed and intervals. Each is discussed in the following paragraphs.

DAILY. This inspection is to determine that the crane, hoist, or monorail is safe for immediate use. The inspection should be made at the beginning of each shift, and should include, but not necessarily be limited to, the following:

a) Be sure the crane or hoist is properly lubricated.

b) Inspect all brakes for proper adjustment. Check electric motor (holding) brakes by lifting a capacity or near capacity load a few inches off the ground and suspending it by the brake.

c) Operate each control to determine that it functions properly. Report any defect found to properly authorized supervision and notify the next operator of the defects at the change of shift.

d) Visually inspect each component of the crane, hoist, or monorail normally used in lifting the load, traveling, or lowering the load. This inspection should include, but again, not be limited to, such items as the following:

(1) Wire rope. Inspect for kinks or broken wire and replace seriously damaged rope immediately.
(2) All functional operating mechanisms such as sheaves, drums, and brakes, and all safety devices such as upper and lower limit switches.

WARNING

Limit switches are safety devices, not operating controls. Never actuate them unnecessarily during normal crane operation.

(3) The following general procedure should be used when checking limit switches.

(a) Always move the crane to an open area, away from personnel and equipment.

(b) Be sure no load is on the hoist lines.

(c) Slowly run the hook block up to about three (3) feet below the limit switch trip mechanism and stop the hoist motion completely.

(d) Proceed to raise the hook block slowly.

(e) If the limit switch does not operate at the point at which it should, lower the hook block out of contact with the limit switch trip mechanism and notify proper supervisory authority at once.

(4) Visually inspect the entire crane for signs of damage which might cause unsafe operation.

The above visual and operational checks will take only a few minutes at the beginning of each shift, and are absolutely necessary to insure safe operation.

It must be recognized that, while a crane, hoist, or monorail is designed and manufactured with a factor of safety, every machine begins to wear on the day it starts working. This process will inevitably continue until, at some future date, the machine will no longer be capable of its' original work load, unless all parts subject to wear or failure are regularly inspected and repaired or replaced.

The following monthly inspection is intended to determine the need for repairs required to keep the machine in approximately new condition, insofar as safety is involved.

NOTE

THE MONTHLY INSPECTION SHOULD NOT BE LIMITED TO THE ITEMS DETAILED BELOW. This inspection procedure is considered minimum. Knowledge of local conditions, age and condition of a particular machine, and the severity of operation, as well as the possible effects of failure, all combine to determine the degree of inspection required for continued safe operation.

MONTHLY. The results of the monthly inspection should be carefully recorded in a suitable log book, in full detail, and should be dated and signed by the inspector.

The purpose of the monthly inspection is to find and correct any wear, damage, or defect, which could affect the safe operation of the machine. This should include the items listed under the daily inspection as well as the following:

(a) Inspect the entire crane for structural damage.

(b) Inspect for cracked or worn sheaves, drums, wheels, and rails.

(c) Inspect for worn, cracked, or distorted components such as pins, bearings, shafts, and gears.

(d) Inspect for excessive wear on brake system parts, linings, pawls, and ratchets. Be sure pawls and ratchets operate correctly, are in good condition, and are properly lubricated. Check the condition of the fire extinguisher, if furnished.

(e) Inspect all motors, controls, and conductor systems, which might in any way affect the safety of the machine.

NOTE

At least annually, the crane hook should be inspected for cracks by the magnetic particle of other suitable crack testing inspection method, to determine that no cracks are discernible. A 15 per cent increase in the throat measurement of the hook or a 10 per cent bend in the hook shall be considered cause for replacement.

INSPECTION WHEN REQUIRED. The third type of inspection concerns individual incidents which apply sudden and unusual shock loads, unusual stress, or possible damage due to any cause. All such incidents which might affect the safe operation of the crane should be followed by an immediate and thorough inspection of the crane, using all necessary nondestructive test methods. All repairs found necessary should be made before the machine is returned to service.

SAFETY RECOMMENDATIONS

Careful compliance with the following recommendations will prevent the majority of common accidents to people or equipment.

1. Before leaving the control station of the crane, the following precautions must be observed:

   (a) Spot the crane at the approved location.

   (b) Lower the load to the ground.

   (c) Raise all hooks to the upper limit switch.

   (d) Place all controls in the OFF position.

   (e) Place the main power switch in the OFF position.

   (f) Make a visual check for any abnormal or dangerous condition.

   (g) Outdoor cranes must have the foot brake and anchor set securely so as to prevent movement caused by wind.

(h) Crane operators should never leave the crane during the work shift unless it is absolutely necessary. When necessary to leave, notify proper authority and properly secure the crane, hoist, or monorail.

NOTE

NEVER depend on a holding brake to suspend a load unless the operator is at the controls, alert, and in a position of readiness to handle the load.

2. An operator must not eat, read, sleep, or otherwise divert his attention while operating a crane. Practical jokes should be absolutely forbidden, and the use of alcohol or other intoxicants is not to be tolerated. An operator who is given a prescription drug by a physician should obtain written assurance that it will not prevent him from operating the crane, hoist, or monorail in safe manner, before returning to work.

3. The operator or person in charge should see that:

(a) Loads are well secured before being lifted and slings are adequate and properly arranged for the load.

(b) Slings are not kinked and the load is well secured and balanced.

(c) All loose items such as tools or chips are removed from both the load and crane or hoist before beginning the lift.

(d) The load does not contact any obstruction while lifting or traveling.

(e) Sudden starts and stops are avoided. Bumping into runway stops is prohibited.

(c)The hoist line is vertical before staring the lift, slack in the line is removed slowly, and that all workmen are clear before beginning the lift.

(d) No crane load, lifting magnet, grapple, or bucket, ever passes over the heads of workmen or in any way endangers their safety. Non-operating personnel should be warned, or told to leave the immediate area, when making lifts.

(e) No one rides the hook or bucket. The crane is not intended to be used as a passenger elevator.

(i) No one rides the crane while it is in operation except with the permission of the operator and in the operator's cab.

(j) ALL stop signals are obeyed, regardless of who gives them.

(k) Other than emergency stop signals, signals are accepted from only one person at a time, unless special arrangement are made in advance for a specific lift only.

(l) Standard crane signals are used and loads are not moved unless the Standard Signals are clearly given, see and understood. See Figure 1.

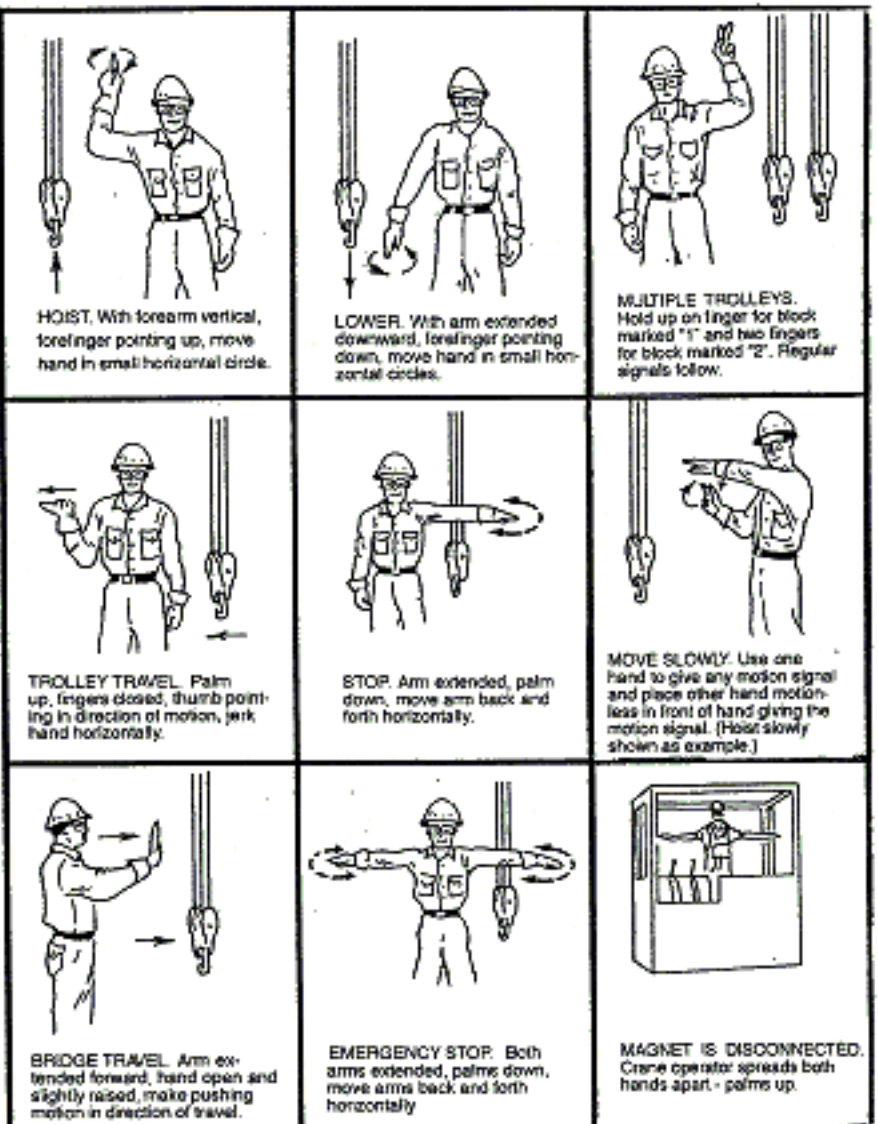


Figure 1. Standard Hand Signals (Courtesy ANSI)

4 The operator should test the holding brake by moving the controller to the OFF position when a load is first lifted, and when the load is only a few inches above its starting position, to assure the ability of the brakes to hold the load. If the load is held, the brake is operating properly. If the brake does not function properly, maintain control of the load using the hoist motor and lower it slowly to rest. Report the condition to the appropriate supervisor immediately and do not make any other lifts until the condition has been corrected.

5. Never get on or off a crane when it is in motion. Never attempt to adjust, repair, or lubricate moving machinery.

6. Keep the machine clean and in good working order. Oil or grease can cause serious fall, and dirt in working parts will cause excessive wear and consequent possible failure.

7. Lower the load to the ground before attempting any repairs or adjustments.

8. Always replace all protective guards and panels before operating the crane, hoist, or monorail.

9. Keep cables in good operating condition, paying particular attention to the following

   (a) A kinked cable is no longer safe. When a new cable has been installed , work light loads for a short period of time to allow the cable to adjust itself to work strains.

   (b) Be very careful to install cable clamps correctly.

   (c) Inspect all cables for kinked or broken wires on a regular basis, preferably daily.

10. Never exceed the rated capacity of the crane, hoist, or monorail. Be sure to include the weight of the blocks, hooks, and special handling devices when figuring the total weight of a load, and KNOW you are not exceeding capacity when preparing to lift a load.

11. Never use a crane for side pulling. It was not designed nor intended for such use. This practice may cause electrical as well as mechanical damage and will endanger personnel.

12 If a rope has been allowed to become slack, make sure that the rope is properly seated on the drum and in the sheaves before a load is lifted.

13 Never lower the block to a point where less than two full wraps remain on the drum. If all cable is removed from the drum, be sure it is rewound in the correct direction to prevent cable damage and to ensure correct operation of the hoist limit switches.

14. Never block out safety devices, such as limit switches, in order to allow operation of the crane in a manner not intended by the manufacturer.

15. Do not lift loads with excess sling hooks hanging loose. This is a very dangerous condition. Never allow any excess chain, hook, cable, sling, or any similar device to be suspended beneath the crane.

16. If electrical power fails, place all controllers in the OFF position and keep them there until power is restored. This will prevent sudden and unexpected movement when power is restored.

17. Never remove a DO NOT OPERATE card from a control without checking to see that it is safe to do so, even if you have placed the card yourself. Someone else may be depending on that card to prevent the crane from being operated.

18. Use fuses of specified size. Blown fuses are both a sign of trouble and the main protection afforded the electrical system.

19. NEVER contact another crane on the same runway if it is possible to avoid so doing. When this must be done, check first to see that all concerned are aware that it will be done and that they are properly warned. Then, contact the crane to be pushed at the slowest possible speed and push it at very slow speed. Never move or bump a crane, hoist, or monorail that has a warning flag or sign displayed.

20. While inspecting, repairing, cleaning, lubricating, or maintaining a crane, hoist, or monorail, a warning flag should be placed where it is readily visible to indicate that the crane, hoist, or monorail must not be moved. The main power switch must be locked in the OFF Position. When someone other than the operator is doing the work, the operator must remain at the controls, alert for possible danger to the workmen, unless specifically informed to the contrary by his supervisor.

21 In handling molten metal or other similarly hazardous material, the most rigid inspections of all load bearing items are required. Written records of the inspections required, showing date, name of inspector, and inspections performed are absolute essentials to safe operation. The latest test methods, including Magnaflux, X-ray, ultra-sound devices, and the various dye checks should be used to insure the safety of cranes, hoists, and monorails.

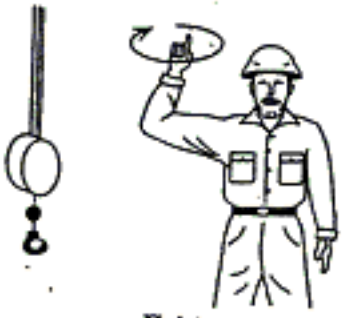
22. All overhead cab operated cranes must be equipped with warning bell or siren, which should be sounded when the crane is going to be moved and at any other time that safety requires.

23. Whenever the crane is being serviced, repaired, lubricated, or otherwise maintained, it must be moved to a position over an area where no one will be endangered by falling material. If this is not possible, the area beneath the crane must be roped off and personnel must be warned of the reason for the precaution, if possible.

24. Repairs and adjustments should be made only by properly designated and authorized personnel. When a crane is being repaired, the maintenance man assigned is in charge of all phases of crane movement and operation, and his instructions should ordinarily be obeyed without question. Only if his instructions are contrary to safe operating practices should the operator question them. Under these circumstances, the maintenance supervisor should be contacted at once for a decision.

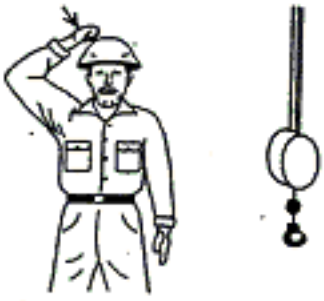
6.07: Hand Signals

(1) NIOSH Hand Signals for Crane Operation.

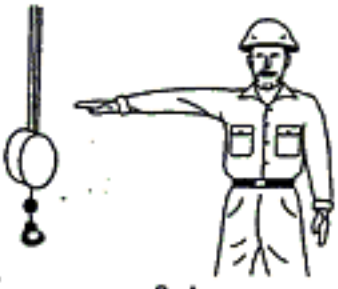


Hoist
With forearm vertical, forefinger pointing up, move hand in small horizontal circle.

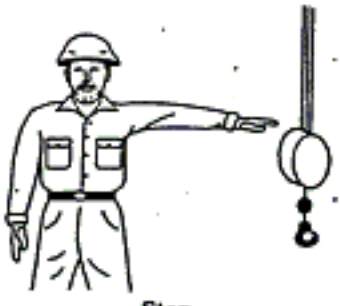
Lower
With arm extended downward, forefinger pointing down, move hand in small horizontal circle.



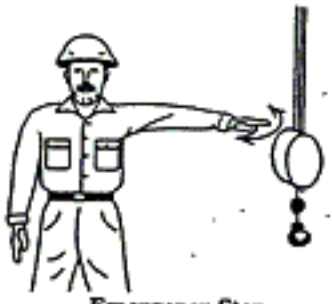
Use Main Hoist
Tap fist on head, then use regular signals



Swing
Arm extended point with finger in direction of swing of boom

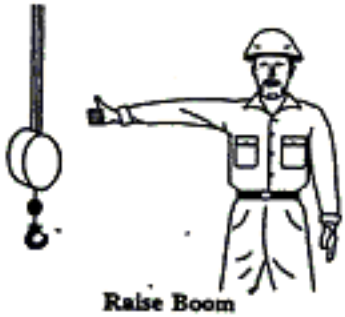


Stop
Arm extended, palm down, hold position rigidly



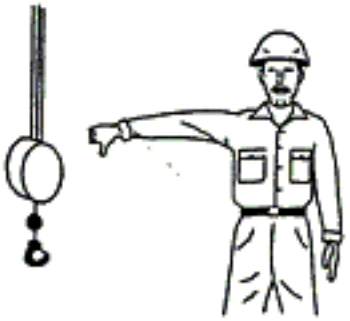
Emergency Stop
Arm extended, palm down, move hand rapidly right and left.

Use Whipline
(Auxiliary hoist) Tap elbow with one hand then use regular signals

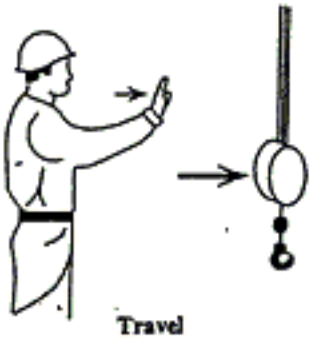


Raise Boom
Arm extended, fingers closed, thumb pointing upward.

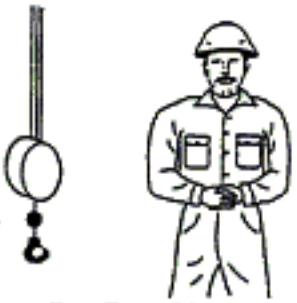
6.07: continued



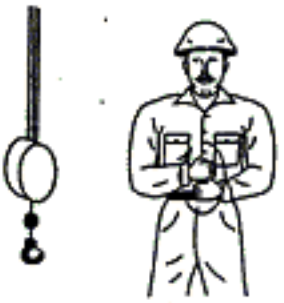
Lower Boom
Arm extended, fingers closed, thumb pointing downward



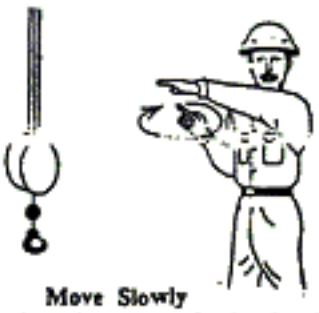
Travel
Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



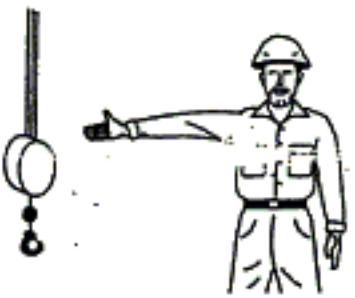
Dog Everything
Clasp hands in front of body



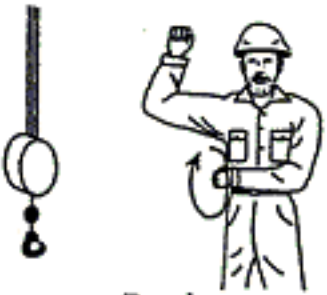
Travel
(Both tracks) use both fists in front of body, making circular motion about each other, indicating direction of travel, forward or backward (for crawler cranes only)



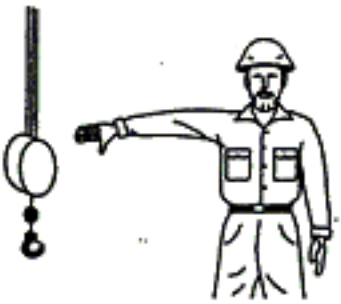
Move Slowly
Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal (as shown)



Raise The Boom And Lower The Load
With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired

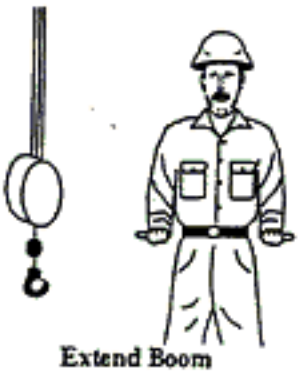


Travel
(one track) Lock the track on the side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, raised vertically in front of body (for crawler cranes only)

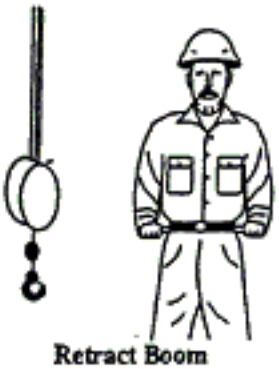


Lower The Boom And Raise The Load
With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired

6.07: continued



Extend Boom
(Telescoping Booms) Both fists in front of body with thumbs pointing outward

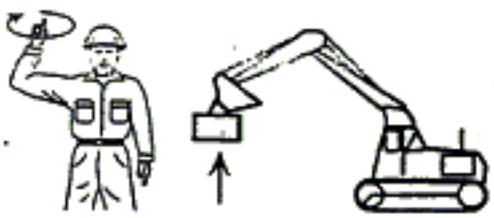


Retract Boom
(Telescoping Booms) Both fists in front of body with thumbs pointing toward each other.

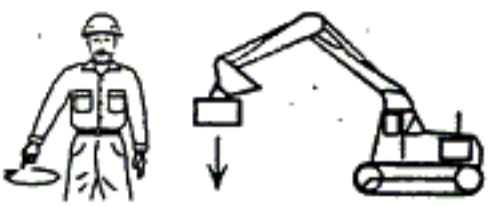
Retract Boom
(Telescoping Boom). One hand signal. One fist in front of chest, thumb pointing outward and heal of fist tapping chest

Extend Boom
(Telescoping Boom). One hand signal. One fist in front of chest with thumb tapping chest.

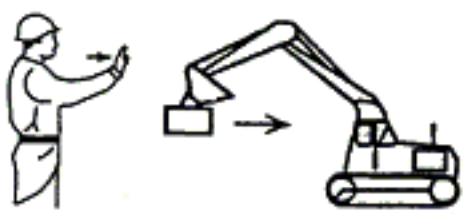
(2) SAE Crawler/Excavator Hand Signals.



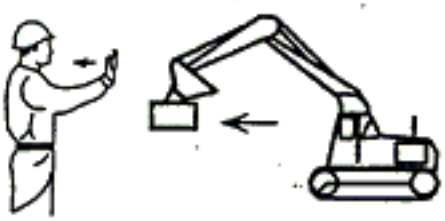
Raise Load Vertically
With forefinger vertical pointing up, move hand in small horizontal circular motion



Lower Load Vertically
With forefinger vertical pointing down, move hand in small horizontal circular motion



Move Load In Horizontally
With either arm extended, hand raised and open toward direction of movement, move hand in direction of required movement.



Move Load Out Horizontally
With either arm extended, hand raised and open toward direction of movement, move hand in direction of required movement.

Advice For Safe Use And Maintenance.

Using Your Chain Sling

1. Keep a record of all slings in stock (Record sheets are available at no charge to distributors.)
2. NEVER lift with knotted or twisted chains.
3. If shortening a chain sling is required, ALWAYS use a shortening hook or claw.
4. ALWAYS pad sharp edges of a lift to protect your chains.
5. The load should ALWAYS be secured in the bowl of the hook - NEVER on the tip of the hook.
6. ALWAYS verify that the capacity of the chain sling will accommodate the load considering the possibility of unequal loading and the sling angle. (If in doubt on the angle of lift, consult KWS' new pocket capacity card.)
7. The sling master link should be of sufficient width to seat properly in the bowl of the crane hook.
8. Avoid shock loading of chain slings as the result may be the same as overloading.
9. Don't leave slings on the floor. When not in use, hang them on a rack.
10. Make sure the object being lifted is not lagged, clamped or bolted to the floor.
11. Make sure crane is directly over the load.
12. When lifting a load in confined spaces, attach a rope or "Tag Line" to one or both ends of the load to control rotational movement.
13. Never permit anyone to ride the lifting hook or the load.
14. Make sure that all personnel stand clear while the lift is being made.
15. Never work under a suspended load unless the load has been adequately supported from the floor and all conditions approved by the supervisor in charge of the operation.

INSPECTION

1. Chain slings shall be inspected at least annually and more often depending on the frequency and severity of use. A record MUST be kept of all physical inspections and maintained until the next inspection.
2. Measure the overall reach and check against the reach shown on the ID tag. Reach = from bearing point of the top master link of the sling to bearing point of the bottom attachment. If the reach has lengthened, REMOVE THE SLING FROM SERVICE and determine the cause of the increase. Increase is normally due to overload or wear.
3. Regular wear inspection is required. (KWS wear gauges are available for this purpose.) If extreme wear is found, check the stock diameter to see if the sling should be removed from service.
4. Chain links that are bent, have cracks, scratches, corrosion pits, lifted fins, flashing or traverse markings can cause a sling to break or severely reduce the working load limit of the sling.
5. Inspect all sling attachments for gouges, distortion or elongated throat openings.

See Chart (page 3) for extreme temperatures and how this affects the working load limit.

Grade 80 alloy chain and fittings MUST NOT be used under acidic conditions.


Worn Links


Bent Links


Gouged Links


Stretched Links

DANGER INDICATORS

Inspect chain slings link by link. Remove sling from service if you find any of these conditions.


Minimum Safe Diameter

Chain size In Inches	Removal From Service Dimensions
7/32	13/64
9/32	1/4
3/8	11/32
1/2	15/32
5/8	37/64
3/4	23/32
7/8	25/32
1	59/64
1 1/4	1 1/8

Instructions For Assembling Clevis Chain Slings.

For Single leg slings, if the required length comes in the middle of a link, cut the next link.

For Double leg slings, measure the length of the chain required. Before cutting, count the links to assure there is an EVEN number of links so the hooks will hang correctly (hooks facing out).

For Triple or Quadruple leg slings, measure the length of the chain required. Before cutting, count the links to assure there is an ODD number of links so the hooks will be facing out.

Sling Requirements

1. A metal sling identification tag MUST be permanently affixed to each sling stating the serial number, size, reach, rated capacity at angle of lift and manufacturer.
2. A completed certificate of test MUST accompany each sling.
3. A nylon end user Warning Tag must be attached to a top link of each chain sling.

KWS, Inc. Grade 80 Working Load Limits in Pounds

KWS GRADE 80 CHAIN SIZE		SINGLE SLING	DOUBLE SLING			TRIPLE & QUAD SLING		
		90° Angle of Lift	60° Angle	45° Angle	30° Angle	60° Angle	45° Angle	30° Angle
(Inches)	(mm)							
7/32	6	2,100	3,600	3,000	2,100	5,450	4,450	3,150
1/4	7	3,500	6,100	4,900	3,500	9,100	7,400	5,200
3/8	10	7,100	12,300	10,000	7,100	18,400	15,100	10,600
1/2	13	12,000	20,800	17,000	12,000	31,200	25,500	18,000
5/8	16	18,100	31,300	25,600	18,100	47,000	38,400	27,100
3/4	20	28,300	49,000	40,000	28,300	73,500	60,000	42,400
7/8	22	34,200	59,200	48,400	34,200	88,900	72,500	51,300
1	26	47,700	82,600	67,400	47,700	123,900	101,200	71,500
1 1/4	32	72,300	125,200	102,200	72,300	187,800	153,400	108,400

Above working load limits apply only to normal conditions of use in straight configuration and equally loaded legs. For endless slings we recommend a W. L. L. of 75% of the above W. L. L. for the corresponding double leg sling. Design Factor 4:1

Never Exceed Published Working Load Limits.

Warning: Never exceed a sling angle of 30°!

CONVERSION FACTORS

CONVERT FROM:	MULTIPLY BY:	CONVERT TO:
Kilograms	2.204	Pounds
Metric Tons	2204.62	Pounds
Pounds	.453	Kilograms
Metric Tons	1000	Kilograms
U.S. Tons	.9072	Metric Tons
Metric Tons	1.102	U.S. Tons
Celsius	9/5 (THEN ADD 32)	Fahrenheit
Fahrenheit	5/9 (AFTER SUBTRACTING 32)	Celsius
Millimeters	.0394	Inches
Meters	3.28	Feet
Inches	25.4	Millimeters
Inches	2.54	Centimeters
Centimeters	.39	Inches
Feet	.30	Meters
Yards	.9144	Meters
Meters	1.09	Yards
Miles	1.61	Kilometers
Kilometers	.62	Miles

DECIMAL AND METRIC CONVERSION TABLE

FRACTIONAL EQUIVALENT (IN.)	DECIMAL EQUIVALENT (IN.)	METRIC EQUIVALENT (MM)	FRACTIONAL EQUIVALENT (IN.)	DECIMAL EQUIVALENT (IN.)	METRIC EQUIVALENT (MM)
1/64	.0156	.397	33/64	.5156	13.097
1/32	.0312	.794	17/32	.5312	13.494
3/64	.0469	1.191	35/64	.5469	13.891
1/16	.0625	1.588	9/16	.5625	14.288
5/64	.0781	1.984	37/64	.5781	14.684
3/32	.0938	2.381	19/32	.5938	15.081
7/64	.1094	2.778	39/64	.6094	15.478
1/8	.1250	3.175	5/8	.6250	15.875
9/64	.1406	3.572	41/64	.6406	16.272
5/32	.1562	3.969	21/32	.6562	16.669
11/64	.1719	4.366	43/64	.6719	17.065
3/16	.1875	4.762	11/16	.6875	17.462
13/64	.2031	5.159	45/64	.7031	17.859
7/32	.2188	5.556	23/32	.7188	18.256
15/64	.2344	5.953	47/64	.7344	18.653
1/4	.2500	6.350	3/4	.7500	19.050
17/64	.2656	6.747	49/64	.7656	19.447
9/32	.2812	7.144	25/32	.7812	19.844
19/64	.2969	7.541	51/64	.7969	20.241
5/16	.3125	7.938	13/16	.8125	20.638
21/64	.3281	8.334	53/64	.8281	21.034
11/32	.3438	8.731	27/32	.8438	21.431
23/64	.3594	9.128	55/64	.8594	21.828
3/8	.3750	9.525	7/8	.8750	22.225
25/64	.3906	9.922	57/64	.8906	22.622
13/32	.4062	10.319	29/32	.9062	23.019
27/64	.4219	10.716	29/64	.9219	23.416
7/16	.4375	11.112	15/16	.9375	23.812
29/64	.4531	11.509	61/64	.9531	24.209
15/32	.4688	11.906	31/32	.9688	24.606
31/64	.4844	12.303	63/64	.9844	25.003
1/2	.5000	12.700	1	1.0000	25.400