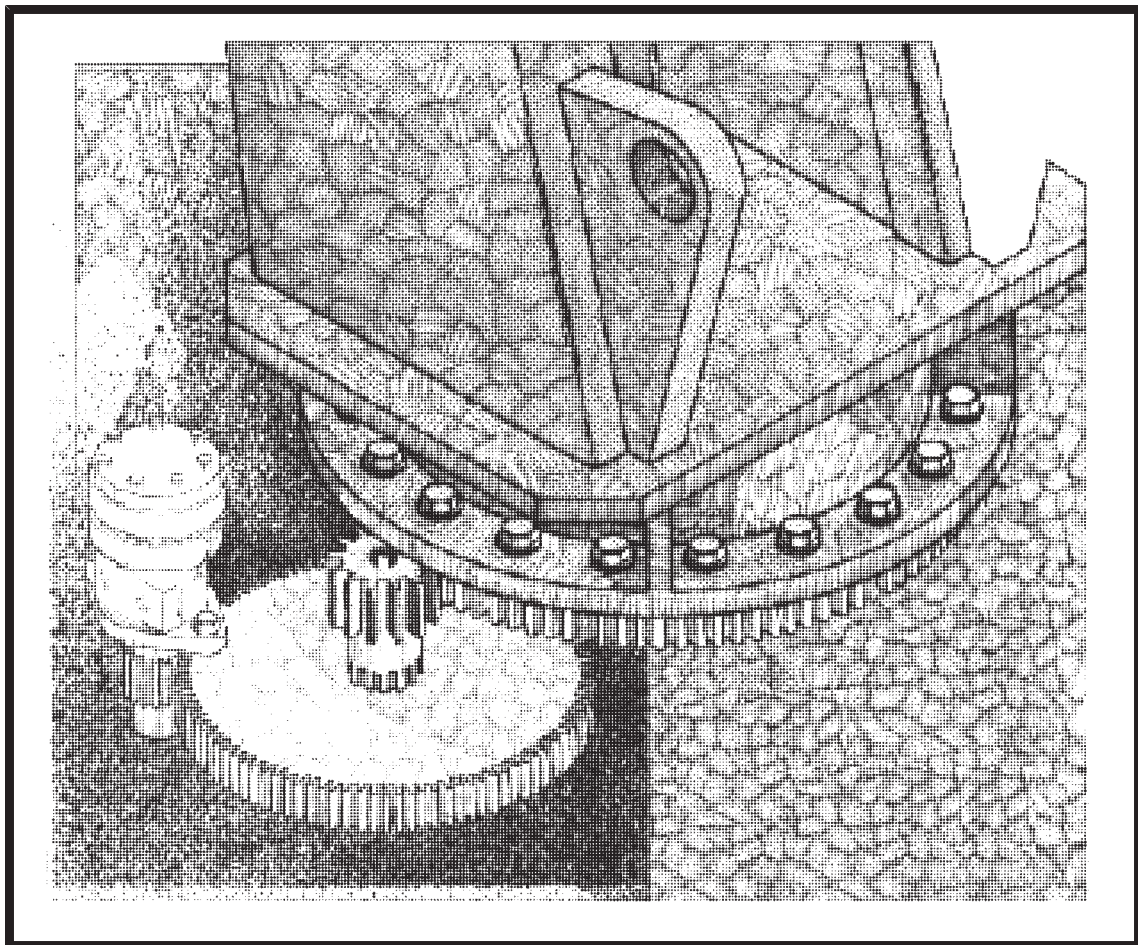




VOLUME 1

OPERATION, MAINTENANCE AND REPAIR



IOWA MOLD TOOLING CO., INC.

BOX 189, GARNER, IA 50438-0189

TEL: 641-923-3711

TECHNICAL SUPPORT FAX: 641-923-2424

MANUAL PART NUMBER 99900037

Iowa Mold Tooling Co., Inc. is an Oshkosh Truck Corporation company.

INTRODUCTION

This volume includes information that is common to all cranes and loaders manufactured by IMT. For specific information, refer to Volume 2, PARTS AND SPECIFICATIONS. Volume 2 contains information on Specifications, Crane Description, Installation and Parts which is specific to your model of crane. It is recommended that Volume 1, OPERATION, MAINTENANCE AND REPAIR be kept with the crane at all times.

This manual is provided to acquaint you with the operation of your IMT truck-mounted, hydraulic operated crane and to supply you with information necessary for proper equipment maintenance.

Before operation or the performance of any maintenance on your IMT crane, familiarize yourself with the OPERATOR'S CRANE SAFETY MANUAL, part number 99900313. It provides information critical to the safe operation and maintenance of your crane. Reference to the Safety Manual will be found throughout this manual as an aid in safe operation and maintenance.

Three means are used throughout this manual to gain the attention of operating and service personnel. They are NOTES, CAUTIONS and WARNINGS and are defined as follows:

NOTE

A NOTE IS USED TO EITHER CONVEY ADDITIONAL INFORMATION OR TO PROVIDE FURTHER EMPHASIS FOR A PREVIOUS POINT.

CAUTION

A CAUTION IS USED WHEN THERE IS THE STRONG POSSIBILITY OF DAMAGE TO THE EQUIPMENT OR PREMATURE EQUIPMENT FAILURE.

WARNING

A WARNING IS USED WHEN THERE IS THE POTENTIAL FOR PERSONAL INJURY OR DEATH.

It is the user's responsibility to maintain and operate this unit in a manner that will result in the safest working conditions possible.

In addition, it is the user's responsibility to be aware of existing Federal, State and Local codes and regulations governing the safe use and maintenance of this unit.

Warranty of this unit will be void on any part of the unit subjected to misuse due to overloading, abuse, lack of maintenance or unauthorized modifications. No warranty - verbal, written or implied - other than the official published IMT new machinery and equipment warranty will be valid with this unit.

**Read and familiarize yourself with the
IMT OPERATOR'S CRANE SAFETY MANUAL
before operating or performing any maintenance
on your crane.**

REVISIONS LIST

DATE	LOCATION	DESCRIPTION OF CHANGE
20030315 20061020	3A-1 THRU 3A-10 1-1 1A	REPLACED WITH UPDATED CYLINDER REPAIR INSTRUCTIONS NEW OWNERSHIP STATEMENT UPDATED DECAL DRAWINGS

MAINTENANCE AND REPAIR MANUAL

This manual is divided into specific sections in order to keep similar subject matter under one heading. There will however be instances when a particular subject may be presented in more than one section of the manual. This redundancy is necessary in providing comprehensive information.

This manual will also be subject to revisions and additions. As new or revised information is released, new pages will be available which will be identified in the upper-right-hand corner by a revision number and date. Any new pages released should be inserted into your manual in place of “old pages”.

New sections may also be provided. When received, they should be inserted into your manual in its proper numerical sequence.

REFERENCE TO SAFETY MANUAL

Throughout this manual, reference will be made to the IMT OPERATOR’S CRANE SAFETY MANUAL. These references will direct you to important information applicable to the relevant subject. Also, additional information may be contained in the reference box. A sample of this reference is shown below.

REFER TO SAFETY MANUAL

See Section X. SECTION TITLE, PARAGRAPH
A comment may appear here.

The term SAFETY MANUAL will be used throughout this manual and is to be construed as the IMT OPERATOR’S CRANE SAFETY MANUAL.

OTHER IMT PUBLICATIONS

Additional information is available which addresses specific topics which relate to crane installation, maintenance and repair. These are listed below and include their IMT part number and brief description. They may be ordered from IMT by contacting the Product Support Department at the following address:

IOWA MOLD TOOLING CO., INC.
BOX 189, GARNER, IA 50438-0189
TEL: 641-923-3711
TECHNICAL SUPPORT FAX: 641-923-2424

MINIMUM CHASSIS SPECIFICATIONS

For mounting of IMT Truck mounted cranes

Domestic Version - 99900765

Metric Version - 99900764

Instructions and calculations for determining suitable truck frame strength. Also minimum chassis specifications for most IMT cranes.

HYDRAULIC PUMP SELECTION GUIDE

99900698

An aid in the selection of hydraulic pumps for use with cranes and compressors.

CRANE LOG

99900686

Crane and Vehicle log for the recording of inspections, tests, maintenance, repairs and modifications for a one-year period.

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SECTION 1. OPERATION

1-1. GENERAL

The Crane is relatively simple to operate, however, prior to any work at job sites, the operator should thoroughly familiarize himself with the control operations, load limits and proper operating procedures and practices for the unit. In addition, simulated job operations should be performed by the operator before putting the unit to a task. The operator's understanding of emergency measure execution is essential; he should be prepared to take emergency action at any time.

REFER TO SAFETY MANUAL

Read and familiarize yourself with the IMT OPERATOR'S CRANE SAFETY MANUAL before operating or performing any maintenance on your crane.

1-2. VEHICLE CONTROLS

Power Take-Off (PTO) Manual Shift Control-

Transmission mounted manual PTO's are usually installed with the shifting control knob located near the steering column. Usually, to engage the PTO, the knob is pulled out. To disengage the PTO, the knob is pushed in. Consult the PTO instructions provided with your PTO.

ENGAGING THE PTO

1. Set the vehicle's parking brake.
2. Place the transmission in "Neutral".
3. Make certain the PTO lever is in the "OFF" position.
4. Start the vehicle's engine.
5. Fully depress the clutch.
6. Engage the PTO.
7. Release the clutch gradually.
8. Warm the engine to operating temperature.
9. Commence crane operation.

DISENGAGING THE PTO

1. Fully depress the vehicle's clutch pedal.
2. Disengage the PTO (OFF).
3. Release the clutch pedal gradually.

WARNING

Power Take-Off (PTO) must be disengaged prior to moving the carrier vehicle. Failure to do so may cause:

- Pump and PTO damage.
- Inadvertent operation of crane drive train, which could cause an accident.

Hand Brake - Securely set the hand brake prior to unit operation, if so equipped.

1-3. CRANE CONTROLS

IMT cranes may be equipped with dual control stations (one at each side of the vehicle), chair-mount control stations (located on the mast) or remote controls. All controls have decals which indicate operating directions for the function desired and are placed at the controls. A hand throttle control is located at the driver's side on the crane base and provides engine speed control. Figures A-1 through A-3 illustrate control decals used on most IMT cranes and loaders. Following are general operation guidelines - controls of your crane may differ.

ROTATION - Push lever for counterclockwise rotation and pull lever for clockwise rotation.

NOTE

On loaders and wallboard cranes, the crane rotation function is referred to as "swing". Push the lever for clockwise rotation and pull for counterclockwise rotation. The function designated "ROTATION" on wallboard cranes, controls the fork rotation and not crane rotation. To operate fork rotation, push for counterclockwise fork rotation and pull for clockwise fork rotation.

NOTE

The terms "INNER" and "MAIN" are interchangeable as are the terms "OUTER", "SECONDARY" and "STICK".

INNER BOOM - Push lever to lower and pull to raise.

NOTE

On those cranes equipped with horizontal control handles, lift the handle to raise the boom and lower the handle to lower the boom.

OUTER BOOM - Push lever to lower and pull lever to raise.

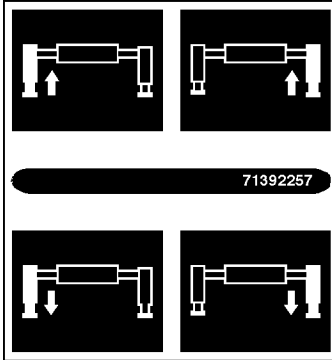
EXTENSION BOOM OPTION - Push lever to extend boom and pull lever to retract boom.

POWER DOWN STABILIZERS - Push lever to lower and pull to raise.

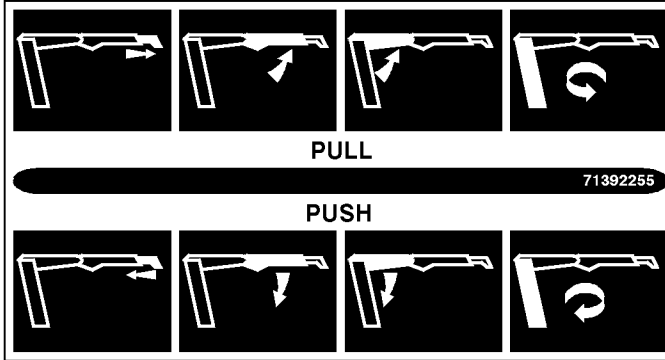
POWER OUT STABILIZERS (optional) - Push lever to extend and pull to withdraw.

WINCH (optional) - Push lever to lower the rope and pull lever to raise.

HAND THROTTLE - Pull knob to increase engine speed or push to decrease.



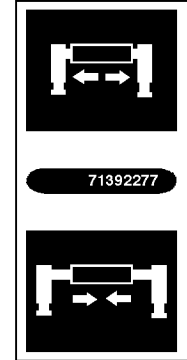
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PULL

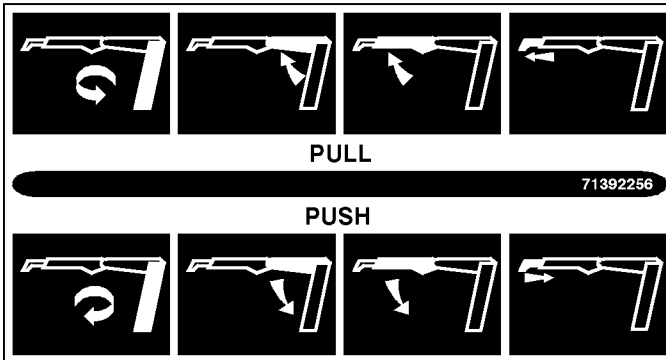
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PUSH



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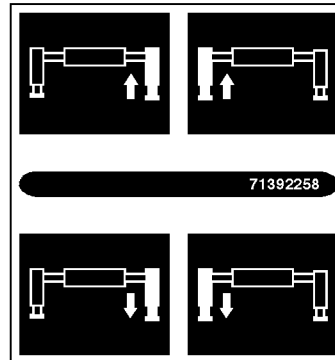
STREET-SIDE MANUAL CONTROLS (HORIZONTALLY MOUNTED HANDLES)



PULL

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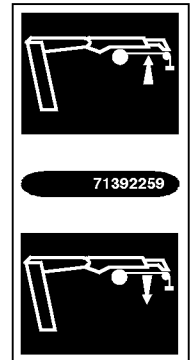
PUSH



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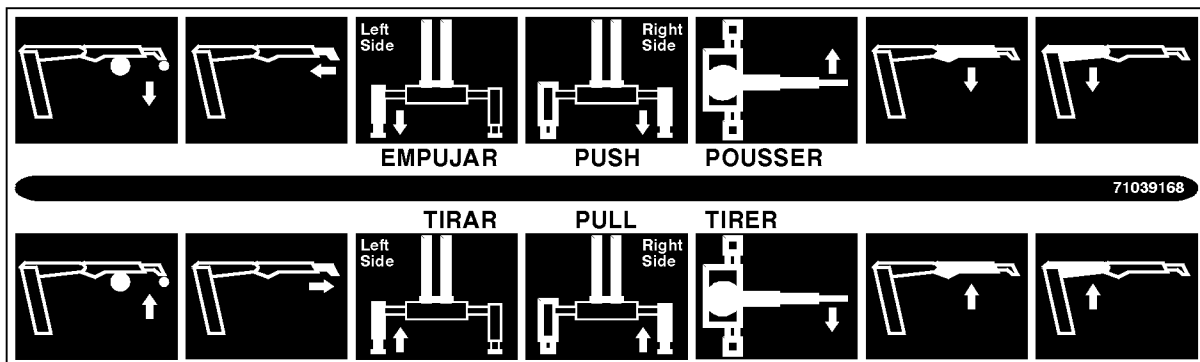
CURB-SIDE MANUAL CONTROLS (HORIZONTALLY MOUNTED HANDLES)

**OPTIONAL
POWER OUT
OUTRIGGER CONTROLS**



71392259

**OPTIONAL
WINCH CONTROLS**



EMPUJAR

PUSH

POUSSER

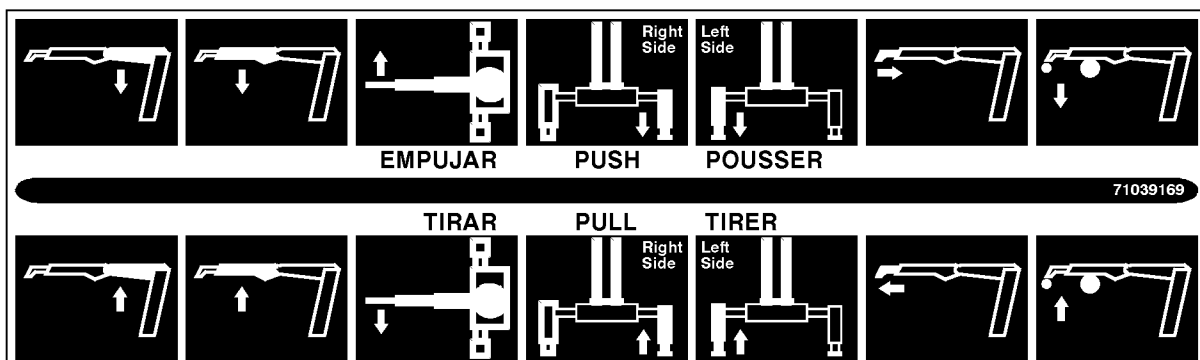
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TIRAR

PULL

TIRER

STREET-SIDE MANUAL CONTROLS (VERTICALLY MOUNTED HANDLES)



EMPUJAR

PUSH

POUSSER

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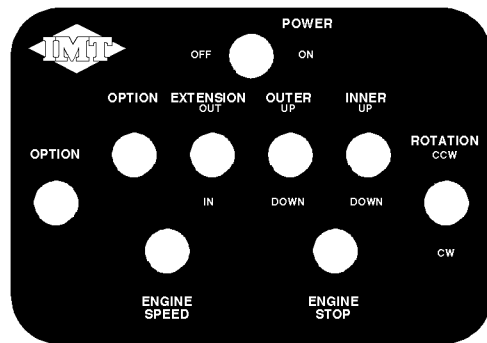
TIRAR

PULL

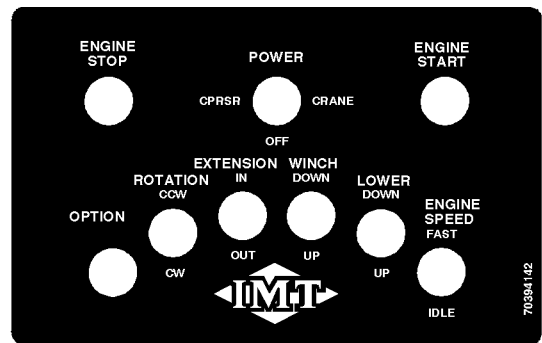
TIRER

CURB-SIDE MANUAL CONTROLS (VERTICALLY MOUNTED HANDLES)

Figure A-1. TYPICAL CRANE CONTROL DECALS



REMOTE CONTROL
ARTICULATING CRANE



REMOTE CONTROL
TELESCOPING CRANE

Figure A-2. TYPICAL REMOTE CONTROL DECALS

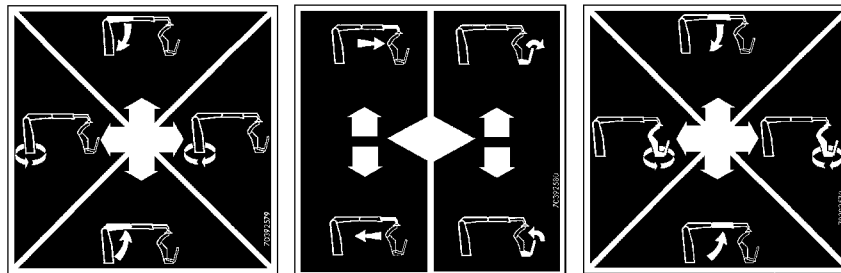


Figure A-3. TYPICAL WALLBOARD CRANE CONTROL DECAL

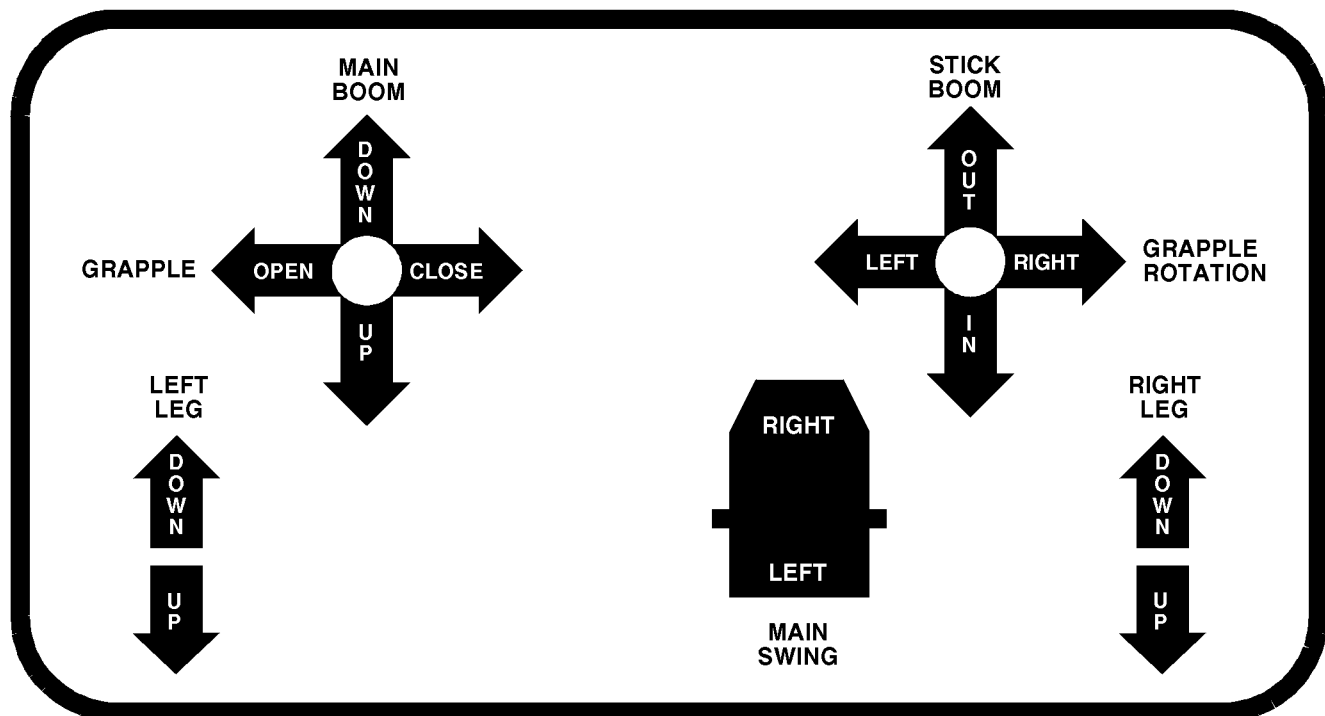


Figure A-4. TYPICAL LOADER CONTROL DECAL (TOE/HEEL)

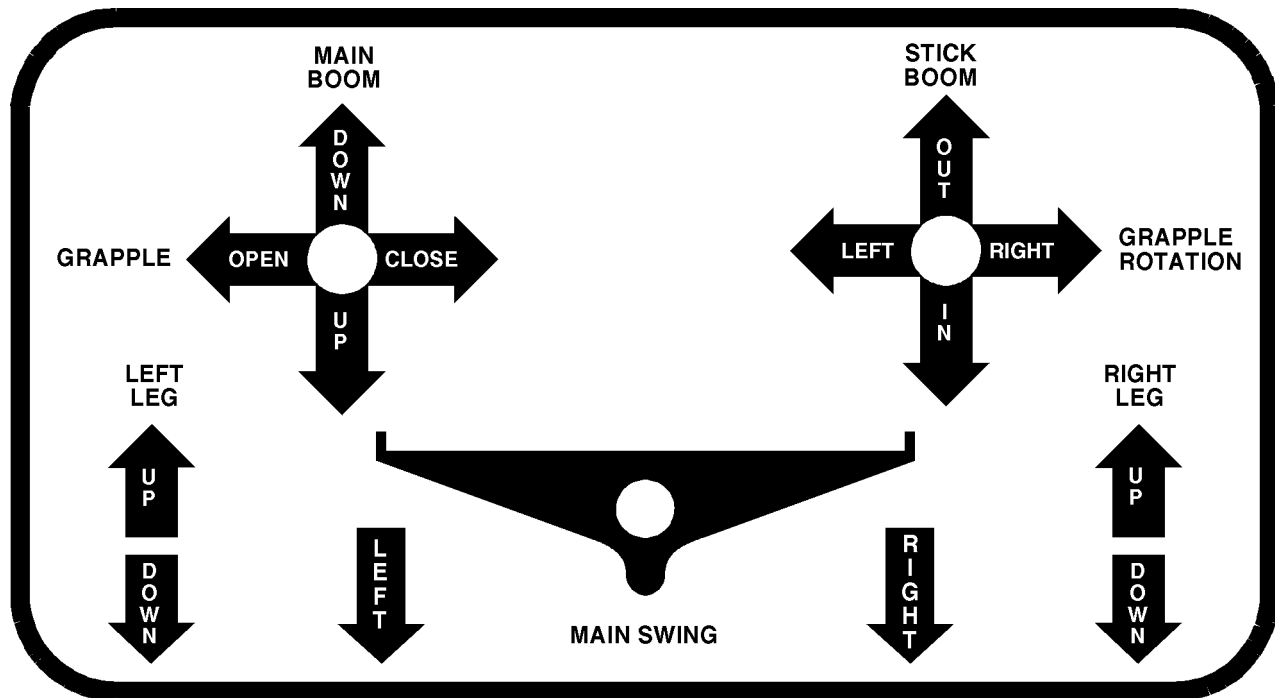


FIGURE A-5. TYPICAL LOADER CONTROL DECAL (TOE/TOE)

1-3-1. REMOTE CONTROLS

In addition to the standard manual controls, optional remote controls are available. Remote controls have the same operating characteristics and functions as the manual controls with the addition of an ENGINE STOP function which is a safety feature required on all cranes with remote controls that use a PTO driven pump. Depress and hold the switch to stop the vehicle's engine.

Most remote controls are proportional. Increasing the travel of the trigger, on the control handle, increases the flow of oil to the function, or functions, being operated. Increasing the flow of oil to a function will cause that function to operate more rapidly.

NOTE

THE MODEL 1014 AND 2015 CRANES OFFER REMOTE CONTROLS OPERATED BY TOGGLE SWITCHES WHICH SIGNAL EITHER AN 'ON' OR 'OFF' CONDITION, OPPOSED TO PROPORTIONAL CONTROL.

The function switches are on/off switches and provide no proportional control. The trigger of the remote control handle operates a potentiometer which increases or decreases voltage relative to the trigger position. This variation in voltage is sent to the valve driver which sends a signal to the flow control solenoid on the valvebank inlet. The voltage at the valvebank meters oil flow to the valve, proportional to the position of the trigger. The position of the trigger affects the flow to all functions simultaneously, thus it is not possible to operate one function proportionally while operating another function at full flow.

1-3-2. GENERAL THEORY OF OPERATION

HYDRAULIC PUMP

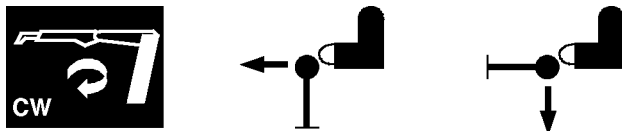
The hydraulic pump supplies hydraulic fluid, under pressure, to a directional control valve. The directional control valve is a four-way valve which regulates both the direction and rate of flow to the crane functions. If the hydraulic pump output should exceed the crane's system pressure setting while a load is being lifted, the pressure relief valve will open, venting any excess pressure directly back to the hydraulic reservoir, assuring system protection.

NOTE

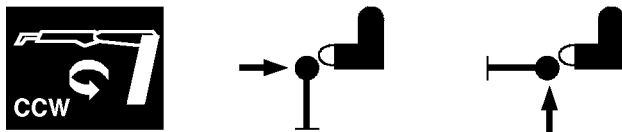
EACH OF THE FOLLOWING CRANE CONTROL FUNCTIONS IS ILLUSTRATED SHOWING THE FUNCTION, HANDLE OPERATION OF VERTICAL CONTROLS AND HANDLE OPERATION OF HORIZONTAL CONTROLS.

CRANE ROTATION

When the ROTATION valve lever is actuated as shown, the hydraulic fluid enters the rotation motor which is located on the crane base. The rotating torque is transmitted through the gear train which then rotates the crane in a clockwise direction.

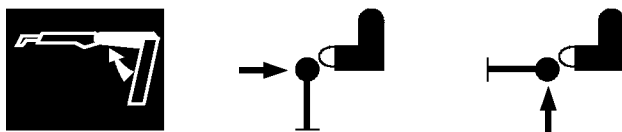


When the ROTATION valve lever is actuated as shown, the hydraulic fluid enters the rotation motor from the opposite direction which causes the crane to rotate in a counterclockwise direction.

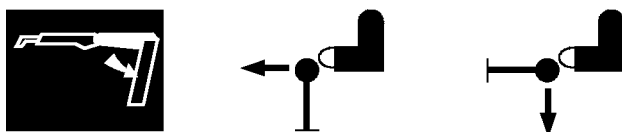


BOOM LIFT (INNER)

When the INNER BOOM valve lever is actuated as shown, the hydraulic fluid enters the inner boom cylinder (some cranes possess two inner cylinders). The cylinders extend as hydraulic fluid forces the rods to extend. The base end of the inner cylinder is attached to the mast assembly while the rod is attached to the inner boom which causes the boom to rise, carrying the outer and extension booms with it. This elevates the booms, providing lift.



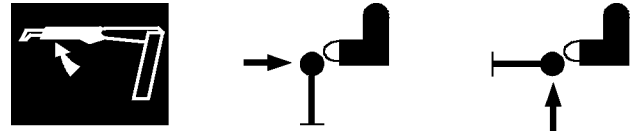
When the INNER BOOM valve lever is actuated as shown, the hydraulic fluid enters the inner cylinder, causing it to retract and lowering the boom assembly.



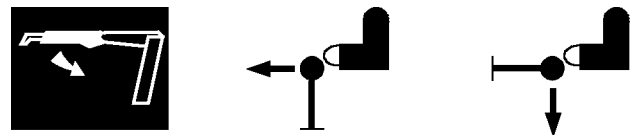
1-5

BOOM ARTICULATION (OUTER)

When the OUTER BOOM valve lever is actuated as shown, the hydraulic fluid enters the outer boom cylinder. The cylinder extends as hydraulic fluid forces the rod to extend. The base end of the outer cylinder is attached to the inner boom while the rod is attached to the outer boom which causes the outer boom to rise, carrying the extension booms with it.

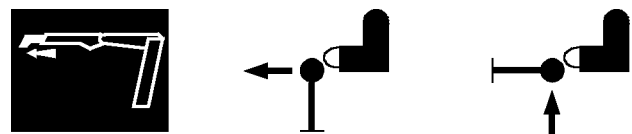


When the OUTER BOOM valve lever is actuated as shown, the hydraulic fluid enters the outer cylinder, causing it to retract and lowering the boom assembly.



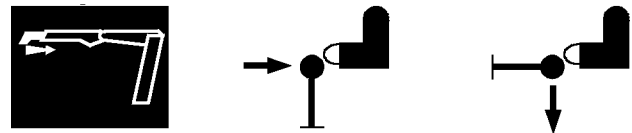
BOOM EXTENSION

When the EXTENSION BOOM valve lever is actuated as shown, the hydraulic fluid passes through the valve and follows the hoses to the extend port of the extension boom cylinder. This forces the cylinder rod out and extends the boom which is attached to the rod.



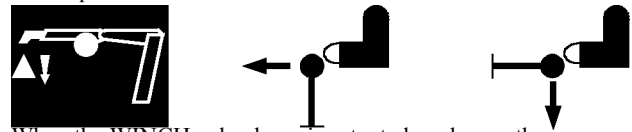
Some crane models utilize telescopic extension cylinders which will extend sequentially, thus extending multiple extension booms automatically.

When the EXTENSION BOOM valve lever is actuated as shown, the extension cylinder rod will retract, bringing the extension boom with it, and storing the extension boom within its carrier boom.

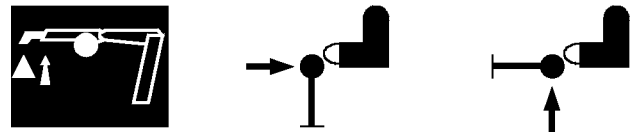


WINCH

When the WINCH valve lever is actuated as shown the hydraulic fluid follows the hoses to the hydraulic motor attached to the winch. The fluid builds up pressure against the motor port and winch brake. The winch brake is metered off and allows the hydraulic motor to turn, which rotates the winch, paying out wire rope which lowers the load.



When the WINCH valve lever is actuated as shown, the hydraulic fluid again builds up pressure against the motor port and winch brake but now retracts the wire rope and raises the load.



1-4. SAFETY FACTORS

The SAFETY MANUAL addresses most concerns in the safe operation of the unit. Volume 2, PARTS AND SPECIFICATIONS may present safety information specific to your model of crane.

REFER TO SAFETY MANUAL

Read and familiarize yourself with the IMT OPERATOR'S CRANE SAFETY MANUAL before operating or performing any maintenance on your crane.

1-4-1. LOAD LIMITS

The crane is designed to give satisfactory service if operated within maximum allowable load specifications stated on the unit's capacity placard (fastened to the mast of most units). The placard should be studied before lifting operations are started. Overloading may result in potentially serious safety hazards and shortened service life to the unit. Exceeding the stated load limit for a given radius of operation can cause tipping or structural failure. Know the weight of the load being lifted.

REFER TO SAFETY MANUAL

See Section 9. CAPACITY PLACARDS.
See Section 9A. CAPACITY ALERT SYSTEMS

PLAN YOUR LIFT:

- Know the weight of the load.
- Know the distance the load will travel.
- Know the height the load will attain.

1-4-2. EQUIPMENT INSPECTION

Before operating the unit, always perform the safety checks outlined below. These checks are vital to the detection of equipment malfunctions which may be potential safety hazards.

REFER TO SAFETY MANUAL

See Section 6. CRANE OPERATION
See Section 12. REFERENCE, PERIODIC VEHICLE INSPECTIONS and PERIODIC CRANE INSPECTIONS.

1-6

CHASSIS - Check oil level, battery and brakes.

TIRES - Check for proper inflation pressure, cuts, loose or missing wheel lugs.

SAFETY ACCESSORIES - Check for proper function, oil levels, leaks and malfunctions.

HYDRAULIC OIL RESERVOIR - Check for proper oil level, leaks and blockages.

WELDMENTS - Check visually for damage, especially cracks or breaks in welds.

CYLINDERS - Check for leakage and scored cylinder rods.

FASTENERS - Check pins, sheaves, nuts and bolts for breakage, excessive wear and tightness.

SHEAVES - Check for defects which could damage wire rope.

ROPES AND SLINGS - Check for frayed edges, broken strands, kinks, flat spots, discoloration and end attachments.

CRANE HOOKS - Check for the presence of a safety latch, twists, cracks, damage and wear.

COVERS AND GUARDS - Check for missing or improperly maintained covers and guards.

OPERATION PLACARDS AND SAFETY DECALS - Check for illegible or missing decals and placards.

ENGINE STOP SWITCH ON REMOTE OPERATED CRANES - Check for proper operation and the presence of corrosion.

WORK AREA - Check for hazards such as power lines, obstructions, etc.

This equipment check should be performed on a continuing basis, both at start-up and during operation.

Replace or repair any items needed prior to operation of the equipment. The checklist above is in addition to any other prescribed maintenance or repair procedures described elsewhere in this or other manuals relevant to the equipment.

1-4-3. WORK STATION POSITIONING

The best location for the working unit is on firm, level and dry pavement or ground close to the job. Overhead obstructions must be avoided.

Wheel chocks should be used when parking unit on a slope. If parking on a curbed roadway, turn the front wheels toward curb when parked with the truck downgrade, and away from curb with rear of truck downgrade. At the worksite, the vehicle should be parked with the grade. When cross-grade parking is necessary, restrict the load to compensate for the increased tipping risk.

REFER TO SAFETY MANUAL

See Section 6. CRANE OPERATION, CRANE SET-UP.

WARNING

THE PRESENCE OF ANY ELECTRICALLY CHARGED POWERLINES MUST BE AVOIDED. SEE SECTION 7, CRANE OPERATION NEAR POWERLINES IN THE SAFETY MANUAL BEFORE ATTEMPTING ANY CRANE OPERATION NEAR POWERLINES.

1-4-4. OPERATING RESTRICTIONS**REFER TO SAFETY MANUAL**

See Section 6. CRANE OPERATION. It is required that this Section be understood before operation of the crane.

1-5. ENGINE SPEED REGULATION

The delivery rate of the hydraulic pump determines the operating speed of the crane. In order for the crane to function at speeds stated in the Crane Specifications, the pump must operate at the speed required for the proper delivery rate (required pump speed). To determine the required pump speed, it is necessary to know the rated capacity of the pump, the pump speed required for the rated capacity and the required delivery rate for proper crane performance. See Figure A-5.

To determine the engine RPM necessary for required pump speed, the required pump speed is divided by the engine to PTO ratio (PTO ratio is generally specified as a percentage (%) of engine speed. See Figure A-6.

When the engine to PTO ratio and pump capacity are not known, the information may be obtained from your IMT dealer or from Iowa Mold Tooling Co., Inc., direct. To determine an unknown PTO ratio, it will be necessary to know the PTO and transmission model numbers as well as the make, model and year of the truck. When the ratio is obtained, compute the proper engine speed. To obtain the proper pump capacity, it is necessary to know the make and model of the pump. Once the information has been obtained, record the information below.

PUMP CAPACITY	ENGINE TO PTO RATIO

Efficient operation of the unit is dependent upon proper pump speed. When operation is too slow, always check the pump speed when diagnosing the cause. A tachometer with accurate calibration may be used to check engine speed.

C =	RATED PUMP CAPACITY
D =	DELIVERY RATE REQUIRED FOR PROPER CRANE PERFORMANCE
RPM =	PUMP SPEED REQUIRED FOR RATED PUMP CAPACITY
$\frac{D}{C} \times \text{RPM} = \text{REQUIRED PUMP SPEED}$	
EXAMPLE:	
$\frac{9 \text{ GPM}}{13 \text{ GPM}} \times 2000 \text{ RPM} = 1385 \text{ RPM}$	
REQUIRED PUMP SPEED	

**Figure A-6.
FORMULA - REQUIRED PUMP SPEED**

REQUIRED PUMP SPEED	=	REQUIRED ENGINE SPEED (RPM)
PTO RATIO (%)		
EXAMPLE:		
$\frac{1385}{.70}$	=	1980 RPM
(PTO RATIO OF 70%)		

Figure A-7. FORMULA - ENGINE RPM

1-6. LOAD LIFTING

Capacity placards are located near the operator's station. The structural capacities and permissible radii of operation stated on these placards should be carefully studied and strictly adhered to during unit operation.

NOTE

CAPACITY PLACARDS ARE INTENTIONALLY LOCATED NEAR THE OPERATOR TO ASSURE READY REFERENCE IN DETERMINING WHEN A LOAD CAN OR CANNOT BE HANDLED.

LOAD LIMIT INFORMATION ON THE CAPACITY PLACARD IS FORMULATED ON 85% OF TIPPING. "TIPPING REFERS TO THE CRANE ACTUALLY TIPPING WITH ITS OPPOSITE OUTRIGGER AND TIRES HAVING BROKEN CONTACT WITH THE SURFACE.

It must be understood that all load ratings are dependent upon compliance with the following:

1. The unit has been correctly installed on a factory approved truck.
2. A satisfactory stability test has been performed and the results are available to the operator.
3. The intended operation is to be carried out on level, solid footing with proper outrigger placement.

Each stated capacity is directly related to the radius of a given operation. The radius is measured from the load line to the centerline of rotation on the horizontal plane.

REFER TO SAFETY MANUAL

See SECTION 6, CAPACITY PLACARDS

1-7. STABILITY RATINGS

Capacity ratings project unit stability to no more than 85% of tipping, provided:

1. The vehicle on which the unit is mounted complies with factory requirement.
2. Factory installation instructions are followed when the unit is mounted on a vehicle.
3. Counterweight sufficient to supplement vehicle weight has been installed and meets factory specifications.
4. Tire inflation pressures meet requirements as stated in the SAFETY MANUAL, Section 12. REFERENCE DATA, Tire Load Limit Charts.
5. The outriggers are in use, making proper contact with firm, level footing.

WARNING

THE MINIMUM CURB WEIGHTS SHOWN IN THE SPECIFICATIONS IN VOLUME 2, PARTS AND SPECIFICATIONS DO NOT ENSURE THE UNIT WILL BE STABLE. ACTUAL STABILITY RATINGS WILL BE OBTAINED FROM THE INITIAL START-UP AND TESTING PROCEDURES.

Required axle weights for the crane mounted on a chassis meeting the minimum chassis requirements are shown in Volume 2, Specifications.

CAUTION

STABILITY FACTORS DO NOT TAKE THE FRONT AXLE LOAD RATING INTO CONSIDERATION. DUE TO THE CAPACITY RATING OF THE FRONT AXLE, THE LOADING 75° EITHER SIDE OF THE CENTERLINE OVER THE CAB MUST BE SEVERELY RESTRICTED.

REFER TO SAFETY MANUAL

See Section 9. CAPACITY PLACARDS, CRANE STABILITY.

1-8. ANTI TWO BLOCKING SYSTEM

WARNING

ANY ANTI TWO BLOCKING SYSTEM CONSISTS OF A SERIES OF MECHANICAL COMPONENTS AND CANNOT BE 100% FAILSAFE.

DO NOT CONSIDER THE SYSTEM A SUBSTITUTE FOR GOOD JUDGEMENT, EXPERIENCE AND ACCEPTED SAFE CRANE OPERATING PRACTICES.

With untrained or inexperienced operators, two blocking the winch cable is a very likely possibility. When the winch cable end attachments contact the underside of the sheave case, whether by winching up or by extending the boom without paying out winch cable, the winch cable can be damaged by crimping or over tensioning, and the sheave may also be damaged.

An anti two blocking system can help prevent cable damage by sensing the position of the winch cable end attachments with respect to the sheave case and shutting down the functions that cause two blocking.

Normal functioning of the crane is restored by winching down, retracting the boom or boom down until the anti two block weight is once again suspended freely.

NOTE

IN THE BOOM DOWN FUNCTION YOU MAY APPROACH AN OVERLOAD CONDITION IN WHICH CASE THE BOOM DOWN FUNCTION WILL STOP DUE TO THE CAPACITY ALERT SYSTEM.

The anti two block system should be checked daily as follows:

1. Examine flexible rod and weight to insure free unrestricted mechanical operation
2. Examine cord for damage, cuts or breaks. Grasp cord and pull to check operation of cord reel. The cord should retract on reel when released.
3. Start vehicle, engage PTO and slowly winch loadline up until anti two block weight comes in contact with the hook end of the loadline cable. At the moment the weight is fully supported, a marked difference in winch operation should be noted. At this point, the winch up function should become very sluggish or non-functioning and have very little pull capability. Slowly increase truck engine speed while simultaneously actuating the winch up function. The winch characteristics should remain sluggish with little or no tensioning of the cable. If operation other than as described occurs, stop immediately and investigate. Failure to do so will risk damage to the cable or the crane.

If all is well at this point, actuate the boom extend function slowly, and gradually increase to full actuation. Once again the function should be sluggish or non-existent with no tightening of the winch cable. If operation other than described occurs, stop immediately and reverse the function.

The final check involves actuating both the winch up and extend functions together and checking for proper operation of the anti two blocking circuit. Once again, start slowly and stop if it appears the cable is being tensioned.

If the anti two block function appears to be functioning normally, winch the cable down until the sensing weight swings free.

1-9. TASK PERFORMANCE**REFER TO SAFETY MANUAL**

See Section 6. CRANE OPERATION.

To operate the crane:

1. Position the crane as close to the job as possible on a firm, dry and level surface. Avoid overhead obstructions on the work side of the unit.

2. Set the auxiliary (parking) brake.
3. Depress the clutch pedal. Shift the transmission into neutral and engage the PTO.
4. Operate the throttle control to achieve the proper engine speed.
5. Before conducting any boom operations, extend both outriggers and level the crane side to side. Provide blocks if necessary to level the unit on sloping ground or bearing pads if the outriggers tend to sink into soft terrain or hot asphalt. Some concrete or asphalt surfaces are relatively thin and cannot withstand the outrigger loading. Concrete can break through and cause instability.

WARNING

DO NOT ATTEMPT TO HANDLE A LOAD IF THE OUTRIGGERS ARE UNABLE TO MAKE SOLID CONTACT WITH THE GROUND.

REFER TO SAFETY MANUAL

See Section 10. OPERATIONAL REFERENCE, OUTRIGGER OPERATION.

It is recommended to remove all of the vehicle weight from the wheels. Stability over the front (without front stabilizers) can be hampered by raising the vehicle excessively. Extreme caution must be taken when operating in areas around the truck not supported by outriggers because of cushion of tires and springs. When swinging loads from areas supported by outriggers, extreme caution must be used because of potential sudden shifting of the support point. Always keep the load as close to the ground as possible.

CAUTION

DO NOT ATTEMPT TO ROTATE THE CRANE BEFORE PLACING IT IN THE DEPLOYED POSITION. DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL MAY RESULT.

6. Raise the inner boom.

REFER TO SAFETY MANUAL

See Section 10. OPERATIONAL REFERENCE, FIGURE-FOUR FOLDING CRANES.

7. Rotate the boom to the selected location. If the crane is equipped with a winch, be sure to lower the hook block to an adequate length to allow for extended boom length before extending any telescoping boom sections.

REFER TO SAFETY MANUAL

See Section 10. OPERATIONAL REFERENCE, EXTENSION BOOM SEQUENCE.

CAUTION

ON CRANES EQUIPPED WITH MULTIPLE EXTENSION BOOMS, ALWAYS EXTEND THE INNERMOST EXTENSION FIRST, AND THEN SEQUENTIALLY TO THE OUTERMOST BOOM. ATTEMPTING TO LIFT THE RATED LOAD WITH ONLY THE OUTER EXTENSION BOOM EXTENDED WILL EXCEED THE STRUCTURAL CAPABILITIES OF THE BOOM AND MAY DAMAGE THE BOOM.

CAUTION

NEVER USE THE WINCH TO DRAG A LOAD INTO POSITION BEFORE LIFTING. THIS MAY SIDE LOAD THE CRANE OR STRESS THE WIRE ROPE BEYOND SAFE LIMITS. DAMAGE TO THE EQUIPMENT MAY RESULT.

CAUTION

BEFORE EXTENDING THE BOOM, ALWAYS PAY OUT THE WIRE ROPE. FAILURE TO DO SO MAY RESULT IN OVERSTRESSING THE WIRE ROPE AND CAUSING A "TWO BLOCK" CONDITION.

CAUTION

IMT CRANES ARE EQUIPPED WITH AN OVERLOAD PROTECTION SYSTEM. IN AN OVERLOAD CONDITION, NO FUNCTION WILL OPERATE WHICH RESULTS IN AN INCREASE IN OPERATING RADIUS. HOWEVER, THE SAME FUNCTION MAY BE OPERATED IN THE OPPOSITE DIRECTION IF IT RESULTS IN DECREASED OPERATING RADIUS.

BEAR IN MIND THAT THE OVERLOAD PROTECTION SYSTEM IS NOT SENSITIVE TO CARRIER VEHICLE STABILITY - IT IS STILL POSSIBLE TO CAUSE VEHICLE INSTABILITY. THE OPERATOR MUST BE AWARE THAT THE OVERLOAD PROTECTION SYSTEM IS NOT A SUBSTITUTE FOR GOOD JUDGEMENT. ALWAYS REFER TO THE CAPACITY CHART BEFORE ATTEMPTING TO LIFT A LOAD.

WARNING

WHEN USING A WINCH, ALWAYS KEEP THE TIP OF THE EXTENSION BOOM AS CLOSE TO THE LOAD AS PRACTICAL. THIS WILL HELP KEEP THE LOAD FROM SWINGING OUT OF CONTROL WHEN USING THE ROTATION (SWING) FUNCTION. TO DAMPEN EXCESSIVE SWING OF THE LOAD, ROTATE THE CRANE IN THE DIRECTION OF THE SWING. FAILURE TO COMPLY MAY RESULT IN AN INJURY OR DAMAGE TO THE EQUIPMENT.

NOTE

IMT TELESCOPING CRANES USING A WINCH ARE EQUIPPED WITH AN ANTI-TWO BLOCKING DEVICE. IT IS THE OPERATOR'S RESPONSIBILITY TO AVOID TWO-BLOCKING AND NOT TO RELY ON THIS DEVICE ALONE.

REFER TO SAFETY MANUAL

See Section 10. OPERATIONAL REFERENCE, ANTI-TWO-BLOCKING DEVICE.

1-10. CRANE SHUTDOWN

1. Retract the extension boom (and cable if applicable).

2. Stow the crane in its travel configuration.

REFER TO SAFETY MANUAL

See Section 10. OPERATIONAL REFERENCE, STOWING TELESCOPING CRANES or STOWING ARTICULATING CRANES.

3. Secure the hook.

4. Stow the outriggers.

REFER TO SAFETY MANUAL

See Section 10. OPERATIONAL REFERENCE, OUTRIGGER STORAGE SEQUENCE.

5. Disengage the throttle control.

6. Depress clutch pedal and disengage PTO.

7. Secure loose items on truck bed.

8. Release the auxiliary brake.

1-11. OPERATORS

Personnel permitted to operate a crane must have certain minimum qualifications, conform to conduct and physical requirements and possess certain abilities as defined in the Safety Manual. Other restrictions may be imposed by other local, state or federal regulations. Be aware of and follow all such regulations.

REFER TO SAFETY MANUAL

See Section 5. THE OPERATOR for information on operator qualifications, physical condition, conduct and knowledge.

1-12. OPERATION IN ADVERSE CONDITIONS

1-12-1. DUSTY AND SANDY AREAS

Operating in dusty or sandy areas presents special problems due to the abrasive action of dust which shortens the life of parts. Make every effort to keep dust and sand out of the moving parts of the crane machinery and engine.

1. All lubricants and lubricating equipment must be kept clean. Service breathers and air cleaners frequently to remove accumulated sand and dust. Lubricate more frequently to keep a supply of clean lubricant in the moving parts. Clean all lubrication fittings thoroughly before attaching the grease gun.
2. Keep the fuel tank filler cap tight to prevent sand and dust from entering the fuel tank. Service fuel filters frequently to keep them free of sand and dust.
3. Keep the hydraulic oil reservoir caps tight to prevent sand and dust from entering the hydraulic systems. Service the hydraulic oil filters frequently to keep the system free of sand and dust.
4. Use wood blocking or mats under the outrigger pads when operating in sand. See that the carrier vehicle does not shift during operation.
5. Before performing service on the crane, such as replacing hoses, thoroughly clean hose connections and surrounding area. Failure to do so will allow sand particles into the hydraulic system which will damage the pump, holding valves, valvebank and cylinders, leading to costly repairs.

1-12-2. HIGH HUMIDITY OR SALT AIR CONDITIONS

Moisture and salt will cause deterioration of paint, cables, wiring and all exposed metallic parts. Keep parts dry and well lubricated in high humidity or salt air conditions.

1. Completely remove rust and corrosion as soon as it appears on any part of the machine. Wash off salt water and dry all parts thoroughly. Paint the exposed surfaces immediately. Place a film of lubricant or grease on all polished or machined surfaces and other surfaces which cannot be painted.
2. Keep parts thoroughly lubricated to repel water from polished metal surfaces and to prevent the entry of water into bearings. Keep lifting cables well lubricated.

1-12-3. HIGH ALTITUDE

Operation at high altitudes presents special problems due to lower atmospheric pressure and wide temperature ranges. At altitudes above 5000 feet it may be necessary to change the engine fuel injectors. Make certain the air cleaner is clean and free from obstructions. Check the engine frequently for overheating. For additional information, consult your vehicle owner's manual.

1-12-4. COLD WEATHER

For cold weather operation with temperatures of -25°F or lower, the following procedures must be followed:

1. Start the truck and run at manufacturer's recommended idle speed for proper warm up.
2. After a time period of approximately 45 minutes of truck warm up time, depress the clutch pedal. Shift the transmission into neutral and engage the PTO.
3. At engine idle, release clutch pedal slowly until full engagement of PTO is realized.
4. With the PTO fully engaged and the truck engine running at idle speed, let the hydraulic system oil circulate.

CAUTION

DURING THE 45 MINUTES ALLOWED FOR WARM UP, DO NOT RACE TRUCK ENGINE AND THEREFORE OVER SPEED HYDRAULIC PUMPS. PUMP CAVITATION, WITH PERMANENT DAMAGE, MAY RESULT.

If at any time during oil circulation, and especially during the initial warm up time, any hydraulic pump noise such as metal grinding, or a popping noise is heard, shut down the unit immediately. Check that the hydraulic oil line leading to the suction port on the pump is not clogged, or that the hydraulic oil itself does not have a jelling condition.

CAUTION

FOR CRANE OPERATION IN TEMPERATURES BELOW -25°F, HYDRAULIC OIL CONFORMING TO MIL-L-46167 MUST BE USED IN THE CRANE HYDRAULIC SYSTEM.

CAUTION

FOR WINCH OPERATION IN TEMPERATURES BELOW -25°F, THE LUBRICATION OIL IN A WINCH GEARBOX MUST BE CHANGED TO LUBRICATING OIL CONFORMING TO MIL-L-2105C, GRADE 75W (GO-75).

5. After the 45 minute warm up period, begin crane operation as follows:

- a. Slowly extend horizontal outrigger cylinders out approximately 6 inches and retract, extend out again approximately half way and retract, and then extend full stroke.
- b. Follow the procedure above on crane deployment, and extend cylinders.
- c. When completed, begin crane swing operation by rotating slowly approximately one eighth revolution one way, return to previous position and rotate in opposite direction. Do this several times, then rotate 90° and return.
- d. If equipped with a winch, begin winch operation by slowly opening the control valve allowing several revolutions in one direction. Then reverse the control valve and operate several revolutions in the opposite direction. Repeat several times allowing longer operation intervals.

CAUTION

VALVES SHOULD BE ENGAGED SLOWLY DURING WARM UP CYCLE TO PREVENT SUDDEN HYDRAULIC SPIKES WHICH WILL DAMAGE HYDRAULIC COMPONENTS.

NOTE

IT IS NORMAL FOR SOME OIL SEEPAGE TO OCCUR AROUND PISTON ROD SEALS DURING THE WARM UP OPERATION. SEEPAGE SHOULD CEASE WHEN HYDRAULIC SYSTEM HAS REACHED OPERATING TEMPERATURE.

1-13. HAND SIGNALS

Under certain circumstances, in order to provide a safe working environment, it will be necessary for communication between the crane operator and a signal person. Hand signals provide such a means of communication as well as voice communication equipment such as telephone and radio.

Signals to the operator shall be in accordance with those signals illustrated in this section, unless voice communication is utilized. Signals shall be discernible or audible at all times. No response by the operator is to be made unless the signal is clearly understood.

For operations not covered by the illustrated hand signals, additions to or modifications may be made. These special signals must be agreed upon by the operator and signal person before the crane is operated.

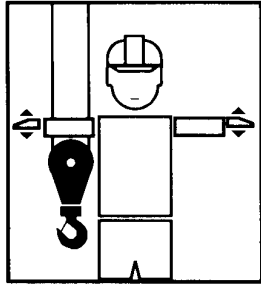
If it is desired to give instructions verbally to the operator, instead of by hand signals, all crane motions must be stopped before doing so.

The following illustrations of hand signals includes an illustration of the hand signal, the operation associated with the signal, and a description of the signal. The operator and signal person must review these signals and agree to their use before implementing them.

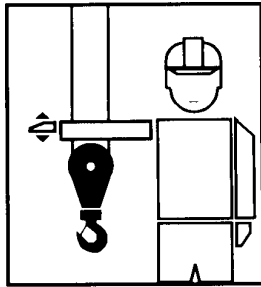
For complete hand signal information, refer to the following publication of The American Society of Mechanical Engineers:

Mobile and Locomotive Cranes
(ASME/ANSI B30.5)

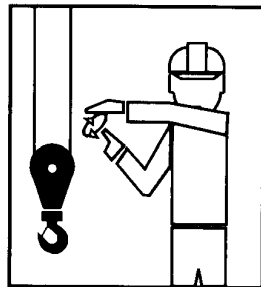
The hand signals presented by The American Society of Mechanical Engineers have been accepted by the Occupational Safety and Health Administration (OSHA).



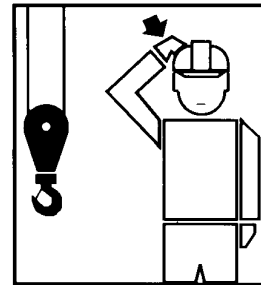
EMERGENCY STOP - Both arms extended, palms down, move arms back and forth horizontally.



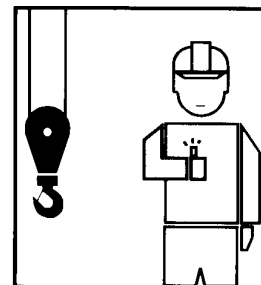
STOP - Arm extended, palm down, move arm back and forth horizontally.



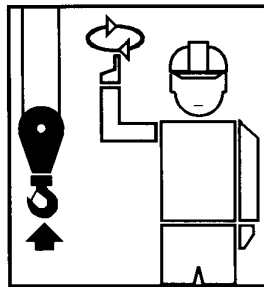
MOVE SLOWLY - One hand gives any motion signal; place other hand motionless in front of that hand. (Hoist slowly shown).



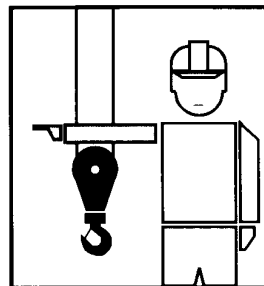
USE MAIN HOIST - Tap fist on head; then use regular signals.



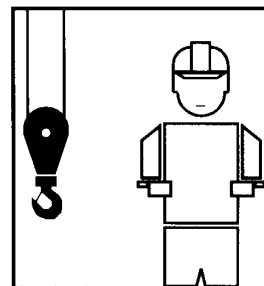
EXTEND BOOM - (Telescoping Booms). One Hand Signal. One fist in front of chest with thumb tapping chest.



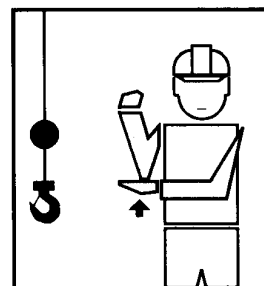
HOIST - With forearm vertical, forefinger pointing up, move hand in small horizontal circles.



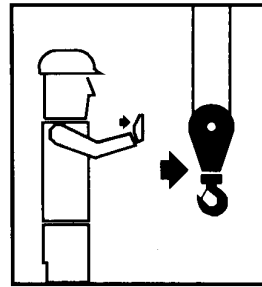
SWING - Arm extended, point with finger in direction of boom swing.



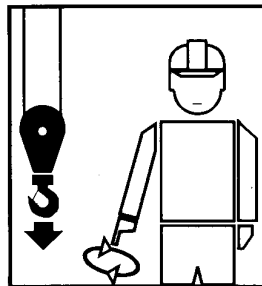
EXTEND BOOM - (Telescoping Booms). Both fists in front of body with thumbs pointing outward.



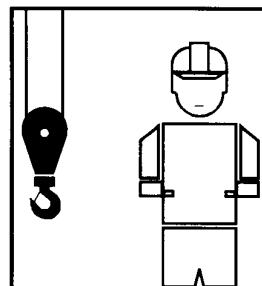
USE WHIPLINE (Auxiliary Hoist)- Tap elbow with one hand; then use regular signals.



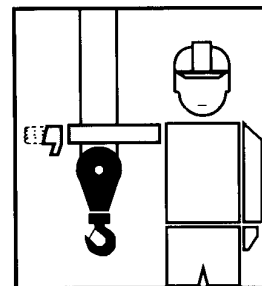
TRAVEL - Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



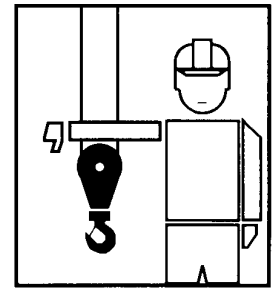
LOWER - With arm extended downward, forefinger pointing down, move hand in small horizontal circle.



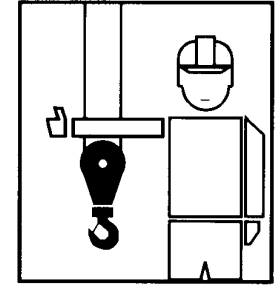
RETRACT BOOM - (telescoping Booms). Both fists in front of body with thumbs pointing inward.



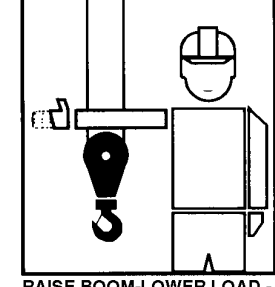
LOWER BOOM-RAISE LOAD - Arm extended, thumb pointing down, flex fingers in and out until desired movement is completed.



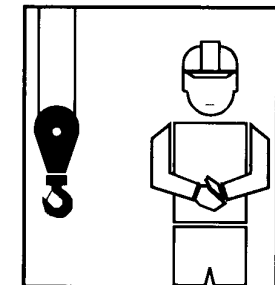
LOWER BOOM - With arm extended, fingers closed, thumb pointing downward.



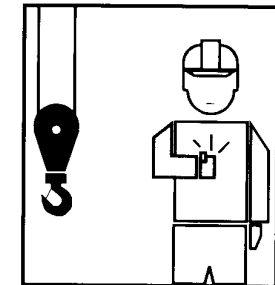
RAISE BOOM - With arm extended, fingers closed, thumb pointing upward.



RAISE BOOM-LOWER LOAD - Arm extended, thumb pointing up flex fingers in and out until desired movement is completed.



DOG EVERYTHING - Clasp hands in front of body.



RETRACT BOOM - (Telescoping Booms). One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.

Figure A-8. HAND SIGNALS

1-14. CRANE CAPACITY ALERT SYSTEM (ELECTRICALLY OPERATED)

IMT provides an electrically operated capacity alert system on its field service, telescoping, stick-boom cranes. This system is designed to prevent loads from being lifted which exceed the rated capacity of the crane.

The capacity alert system consists of a pressure switch mounted on the lift side of the lower boom cylinder which senses hydraulic pressure. It is connected electrically to the lift side of the winch, the extend side of the extension boom, and the down side of the lower boom.

If an operator attempts to lift a load which exceeds the rated capacity of the crane, the system will be activated. When activated, it will prevent the winch from lifting, the extension boom from extending, and the lower boom from being lowered.

To resume operation of the crane when the capacity alert system is activated, the winch may be lowered or the extension boom retracted. Being able to lower the winch will give the operator the opportunity to reevaluate the load and adjust it. Retracting the extension boom will move the load closer to the centerline of rotation and within acceptable limits of load capacity.

It is important that this system be maintained in good operating condition at all times. Wiring should be checked on a regular basis for loose connections, corrosion and broken wires. The manifold should be checked for leakage from its o-ring seal. The pressure switch is available through IMT and its distributors and easily replaced.

See Figure A-9 for general electrical wiring reference and refer to your particular crane manual for specific information on parts and wiring.

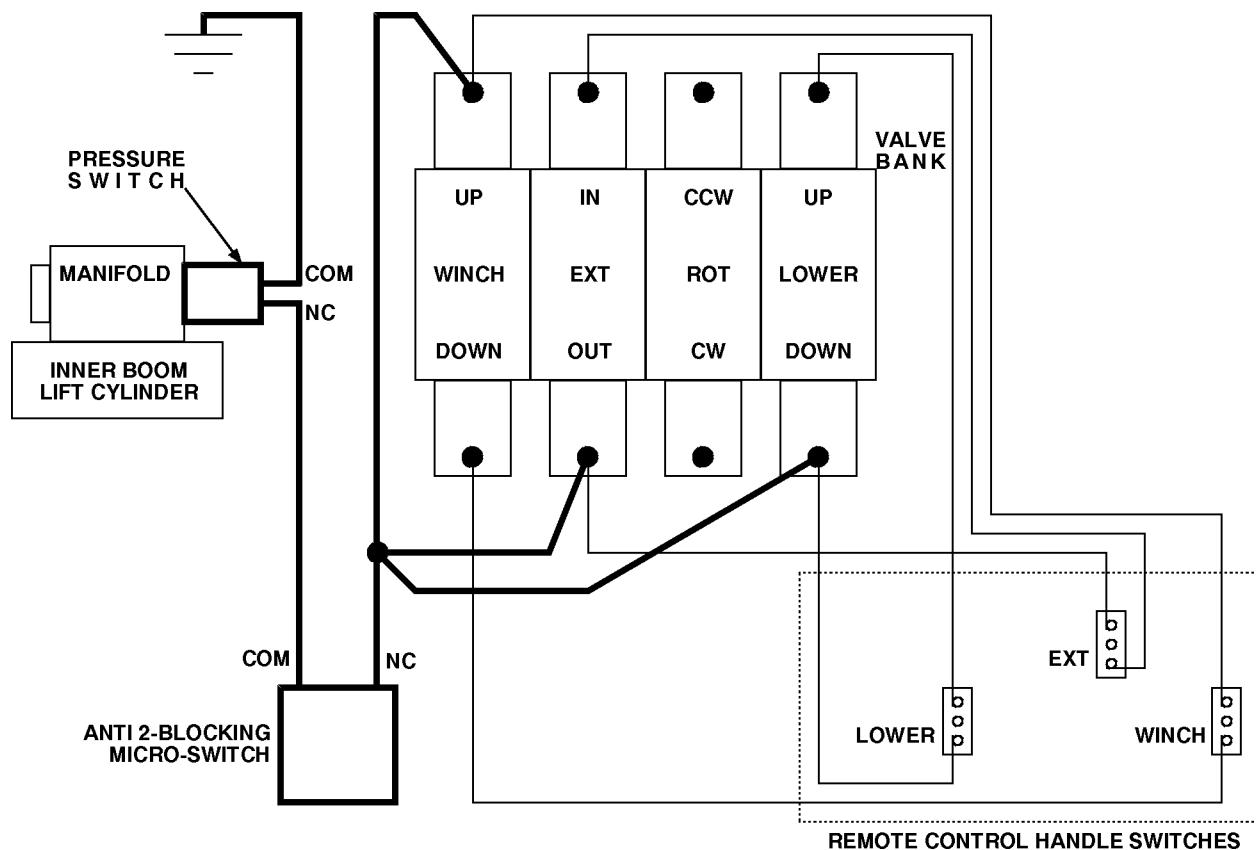


FIGURE A-9. GENERAL CAPACITY ALERT SYSTEM WIRING DIAGRAM (ELECTRICAL)

1-15. CAPACITY ALERT SYSTEM (HYDRAULICALLY OPERATED)

IMT provides a hydraulically operated capacity alert system on cranes designed for wallboard handling. The system is designed to prevent loads from being lifted which exceed the rated capacity of the crane.

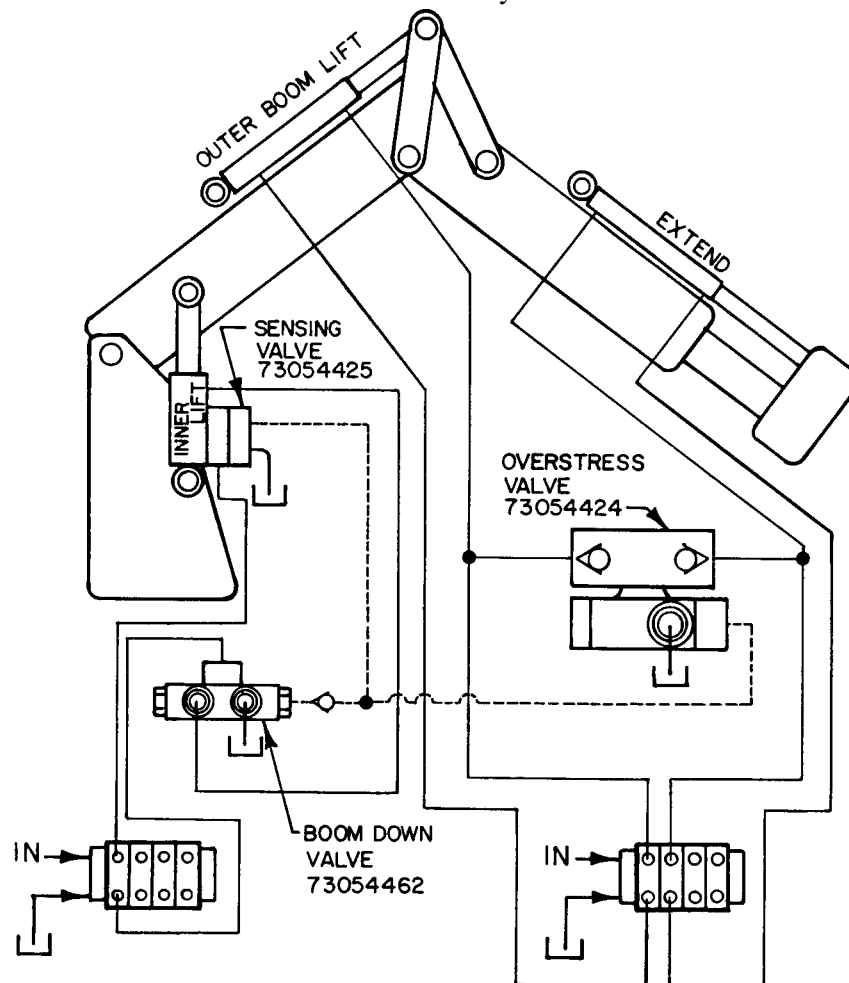
The capacity alert system, consisting of a sensing valve, overstress valve, and a boom-down valve, senses the inner boom lift cylinder pressure and disables the offending function when the cylinder pressure reaches a preset level.

If an operator attempts to lift a load which exceeds the rated capacity of the crane, the system prevents the operator from raising the outer boom, lowering

the inner boom or extending the extension boom. The operator will be able to lower the outer boom or retract the extension boom, but will not be able to work these functions both ways until the inner boom cylinder pressure has been lowered below the preset level. The sensing valve is typically set at 10% over system pressure.

It is important that this system be maintained in good operating condition at all times. All hydraulic lines and fittings should be checked regularly for leakage. Refer to the Capacity Shut-Down System Troubleshooting Guide and your particular crane manual for specific information.

See Figure A-10 for a general diagram of the system.



NOTES:

One sensing valve controls two dump valves.

The boom down valve is plumbed in a 3-way configuration.

FIGURE A-10.GENERAL CAPACITY ALERT SYSTEM DIAGRAM (HYDRAULIC)

1-16. CRANE CAPACITY AUDIBLE ALERT SYSTEM (ELECTRICALLY OPERATED)

IMT provides an electrically operated capacity audible alert system on its articulating cranes. This system is designed to inform the operator, by audible means, when a load is being lifted which exceeds the rated capacity of the crane.

This capacity alert system consists of a pressure switch mounted on the lift side of the inner boom lift cylinder which senses hydraulic pressure. It is to be connected electrically to an audible warning device such as the truck chassis horn.

If an operator attempts to lift a load which exceeds the rated capacity of the crane, the audible warning device will be activated.

To eliminate the overload condition, the winch may be lowered or the extension boom retracted. Being able to lower the winch will give the operator the opportunity to reevaluate the load and adjust it. Retracting the extension boom will move the load closer to the centerline of rotation and within acceptable limits of load capacity.

The overload condition can also be eliminated by lowering the outer boom in those instances when, by doing so, it will bring the load closer to the centerline of rotation and within acceptable limits of load capacity.

It is important that this system be maintained in good operating condition at all times. Wiring should be checked on a regular basis for loose connections, corrosion and broken wires. The manifold should be checked for leakage from its o-ring seal. The pressure switch is available through IMT and its distributors and easily replaced.

See Figure A-11 for general electrical wiring reference and refer to your particular crane manual for specific information on parts and wiring.

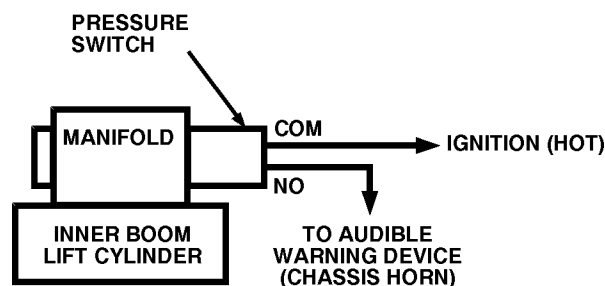
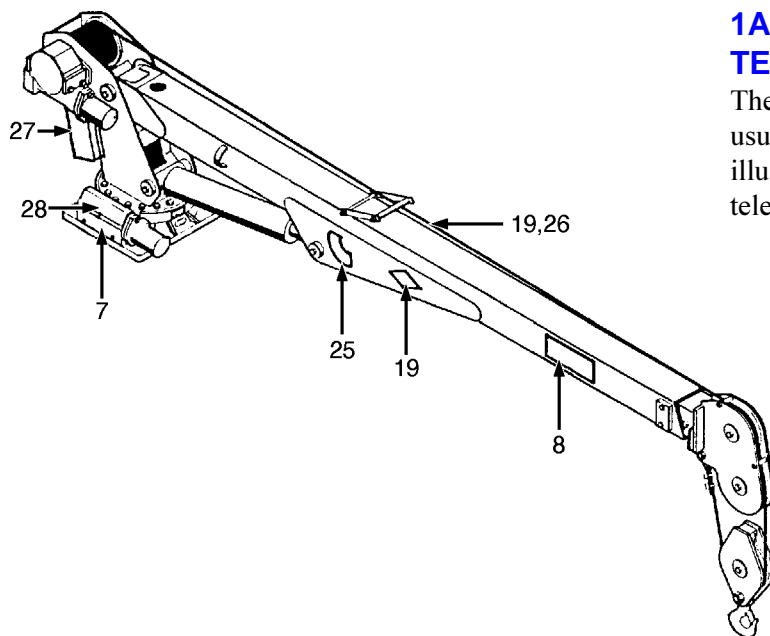


FIGURE A-11. GENERAL CAPACITY AUDIBLE ALERT SYSTEM WIRING DIAGRAM

SECTION 1A. DECALS

1A-1. DECAL PLACEMENT-TELESCOPING CRANES

The positioning of decals on a telescoping crane is usually similar between varying models. Figure A1-1 illustrates common positioning of decals used on telescoping cranes.



NOTE

PLACEMENT OF A HAZARD WARNING DECAL MUST BE IN A POSITION WHICH IS EASILY VISIBLE TO THE PERSON RESPONSIBLE FOR TAKING THE APPROPRIATE ACTION WHICH THAT DECAL ADDRESSES.

ITEM	DECAL DESCRIPTION	QTY	SEE FIG.
1.	WARNING-MANUAL OUTRG	2	A1-23
2.	GREASE WEEKLY-LEFT ARROW	AR	A1-26
3.	GREASE WEEKLY-RIGHT ARROW	AR	A1-26
4.	SUCTION LINE	1	A1-30
5.	RETURN LINE	1	A1-29
6.	CAUTION-DO NOT WASH/WAX	1	A1-32
7.	ROTATE CRANE/GREASE	1	A1-27
8.	CRANE MODEL NUMBER	2	
9.	DANGER-ELECTROCUTION	1	A1-4
10.	DANGER-UNTRAINED OPER	2	A1-18
11.	DANGER-OPERATION	2	A1-19
12.	DANGER-TWO BLOCKING	2	A1-15
13.	DANGER-HOISTING PERSONNEL	2	A1-17
14.	DANGER-OUTGR STAND CLR	2	A1-11
15.	DANGER-ELECTROCUTION	4	A1-6
16.	DANGER-OPER CONDITIONS	2	A1-20
17.	DANGER-OUTRIGGER MOVING	2	A1-12
18.	DGR-CRANE LOADLINE (TRUCK)	4	A1-16
19.	IMT DIAMOND	2	
20.	DANGER-OPERN RESTRICT	2	A1-21
21.	DANGER-RC ELECTRO-LG	1	A1-8
22.	DANGER-ROTATING DRIVELINE	1	A1-14
23.	CONTACT IMT	1	A1-28
24.	CAUTION-OIL LEVEL	1	A1-34
25.	ANGLE CHART- RIGHT SIDE	1	A1-33
26.	ANGLE CHART-LEFT SIDE	1	A1-33
27.	CAPACITY CHART	2	
28.	LUBRICATE WORM GEAR	1	A1-31
29.	DANGER-RC ELECTRO-HANDLE	1	A1-10
30.	DANGER-FREEFALL MNL BOOM	1	A1-22
31.	HYD OIL RECOMMENDATION	1	A1-35

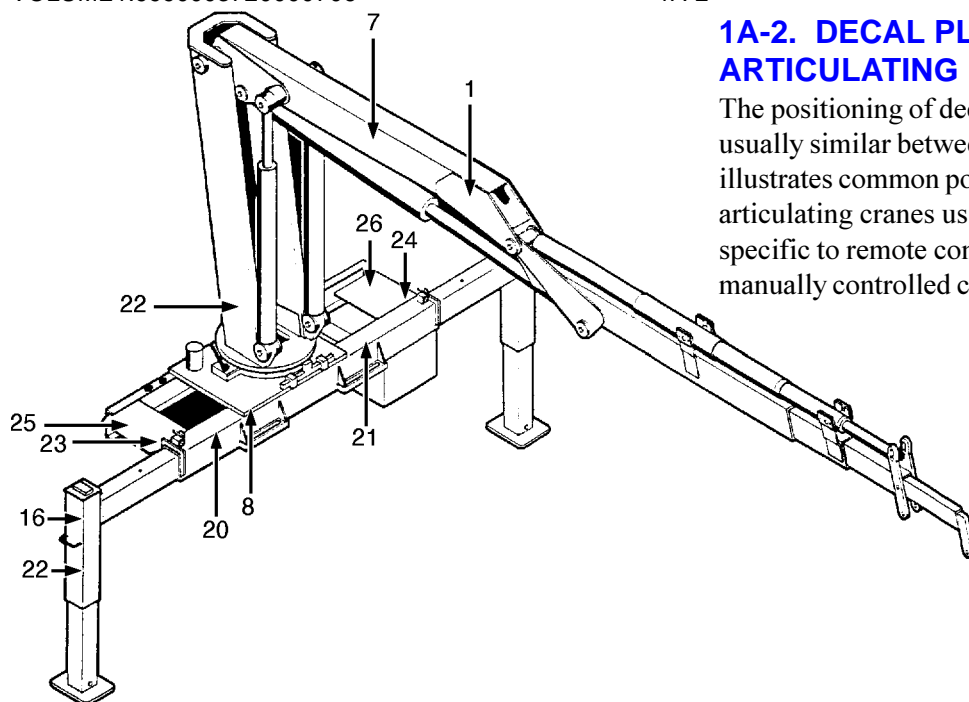
DECAL PLACEMENT

ITEM NUMBER	LOCATION
6, 9, 10, 11, 12, 13, 16, 17, 20, 21, 23, 24, 27	AT OR NEAR REMOTE CONTROL HANDLE STORAGE POINT
1, 14	ONE ON EACH OUTRIGGER
15, 18	ONE ON EACH SIDE OF THE CARRIER VEHICLE
7	AT TURNABLE GREASE ZERK
2, 3	AT ALL GREASE ZERKS
5	ON RESERVOIR AT RETURN LINE
4	ON RESERVOIR AT SUCTION LINE
29	ON REMOTE CONTROL HANDLE
30	AT OR NEAR MANUAL EXTENSION BOOM RETENTION MECHANISM
31	ON OR NEAR HYD OIL RESERVOIR
22	AT OR NEAR DRIVELINE
28	ON WORM GEAR COVER

FIGURE A1-1. DECAL LOCATIONS ON TELESCOPING CRANES

1A-2. DECAL PLACEMENT - ARTICULATING CRANES

The positioning of decals on an articulating crane is usually similar between varying models. Figure A1-2 illustrates common positioning of decals used on articulating cranes using remote controls. Decals specific to remote controls will not be used on manually controlled cranes.



ITEM	DECAL DESCRIPTION	QTY	SEE FIG.
1.	IMT DIAMOND	2	
2.	SET UP/STOW INSTRUCTIONS	1	A1-24
3.	GREASE WEEKLY-LEFT ARROW	AR	A1-26
4.	GREASE WEEKLY-RIGHT ARROW	AR	A1-26
5.	SUCTION LINE	1	A1-30
6.	RETURN LINE	1	A1-29
7.	CRANE MODEL NUMBER	2	
8.	CAUTION-DO NOT WASH/WAX	1	A1-32
9.	ROTATE CRANE/GREASE	1	A1-27
10.	DANGER-ELECTROCUTION	2	A1-3
11.	DANGER-UNTRAINED OPER	2	A1-18
12.	DANGER OPERATION	2	A1-19
13.	DANGER-OUTRG STAND CLEAR	2	A1-11
14.	DANGER-ELECTROCUTION	4	A1-5
15.	DANGER-OPER CONDITIONS	2	A1-20
16.	DANGER-OUTRIGGER MOVING	2	A1-12
17.	DANGER OPER RESTRICTIONS	2	A1-21
18.	DANGER-STOWING/UNFOLDING	2	A1-13
19.	DANGER-ROTATING DRIVELINE	1	A1-14
20.	CONTACT IMT	1	A1-28
21.	CAUTION-OIL LEVEL	2	A1-34
22.	CAPACITY CHART	2	
23.	STREET SIDE CONTROLS	1	
24.	CURB SIDE CONTROLS	1	
25.	OUTRIGGER CONTROLS SS	1	
26.	OUTRIGGER CONTROLS CS	1	
27.	CRANE ROTATION ALIGNMENT	1	A1-25
28.	DANGER-RC ELECTRO-LG	2	A1-7
29.	DANGER-RC ELECTRO-HNDL	1	A1-9
30.	DANGER-TWO BLOCKING	2	A1-15
31.	DGR-CRANE LOADLINE (TRUCK)	4	1-
16			
32.	DANGER-HOISTING PERSON	2	A1-17
33.	DANGER-FREEFALL MNL BOOM	1	A1-22
34.	HYD OIL RECOMMENDATION	1	A1-35

NOTE

PLACEMENT OF A HAZARD WARNING DECAL MUST BE IN A POSITION WHICH IS EASILY VISIBLE TO THE PERSON RESPONSIBLE FOR TAKING THE APPROPRIATE ACTION WHICH THAT DECAL ADDRESSES.

DECAL PLACEMENT

ITEM NUMBER	LOCATION
2, 8, 10, 11, 12, 15, 16, 17, 18, 20, 21, 28, 30, 31, 32	AT OR NEAR THE NORMAL OPERATING STATIONS
13	ONE ON EACH OUTRIGGER
14, 31	ONE ON EACH SIDE OF THE CARRIER VEHICLE
9	AT TURNTABLE GREASE ZERK
3, 4	AT ALL GREASE ZERKS
6	ON RESERVOIR AT RETURN LINE
5	ON RESERVOIR AT SUCTION LINE
29	ON REMOTE CONTROL HANDLE
33	AT OR NEAR MANUAL EXTENSION BOOM RETENTION MECHANISM
34	ON OR NEAR HYD OIL RESERVOIR
19	AT OR NEAR DRIVE LINE
27	ALIGNED ON MAST AND BASE

FIGURE A1-2. DECAL LOCATIONS ON ARTICULATING CRANES

1A-3. "DANGER" DECAL DESCRIPTIONS

All operators must familiarize themselves with the "DANGER" decals shown in this section. Your equipment may have additional safety decals that are not described here. Any safety decals affixed to your equipment must be identified, read and understood.

The materials and adhesives used in the production of these decals were designed for maximum durability, adhesion and legibility. Nevertheless, if a decal (including capacity chart) becomes damaged or illegible, replace it at your earliest opportunity. If a crane is repaired or repainted, replace all decals before the crane is put back into service. Individual decals as well as complete decal kits are available from IMT.

Shown in the following figures are the safety decals used on IMT cranes. They are shown here as an aid in their identification with an explanation of their purpose, where they are placed on the crane and the normal quantity used on each crane. All decals are shown half-size.

Figure A1-3

DECAL: Electrocution Hazard

PART NUMBER: 70392813

FUNCTION: To inform the operator of the hazard associated with contact or proximity to electrical lines, the possible consequences should the hazard occur, and how to avoid the hazard.

WHERE USED: Articulating cranes

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2

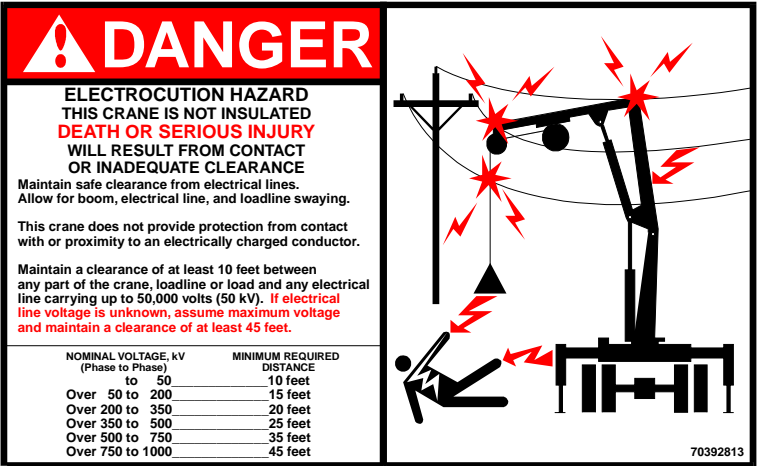


Figure A1-4

DECAL: Electrocution Hazard

PART NUMBER: 70394444

FUNCTION: To inform the operator of the hazard associated with contact or proximity to electrical lines, the possible consequences should the hazard occur, and how to avoid the hazard.

WHERE USED: Service body mounted Telescoping Cranes - remote controls.

PLACEMENT: At or near the remote control handle storage point.

QUANTITY: 1

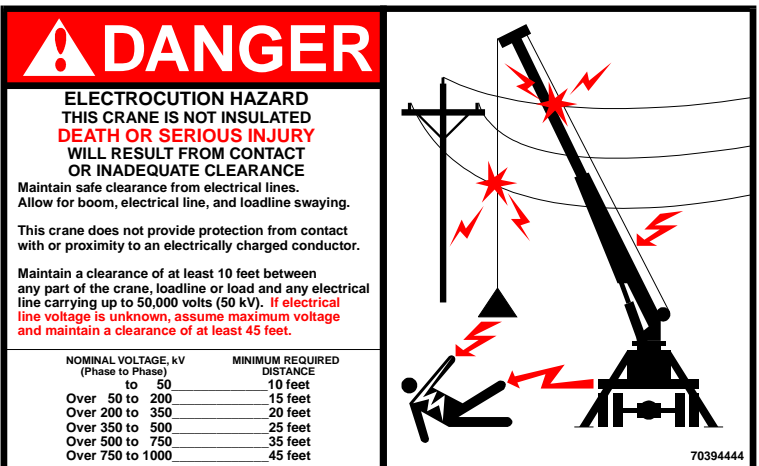




Figure A1-5

DECAL: Electrocutation Hazard

PART NUMBER: 70392865

FUNCTION: To inform the operator and other personnel in the work area of the hazard associated with contact or proximity to electrical lines, the possible consequences should the hazard occur, and how to avoid the hazard.

WHERE USED: Articulating cranes

PLACEMENT: On all four sides of the carrier vehicle.

QUANTITY: 4

Figure A1-6

DECAL: Electrocutation Hazard

PART NUMBER: 70394445

FUNCTION: To inform the operator and other personnel in the work area of the hazard associated with contact or proximity to electrical lines, the possible consequences should the hazard occur, and how to avoid the hazard.

WHERE USED: Service body mounted Telescoping Cranes - remote controls

PLACEMENT: On all four sides of the carrier vehicle.

QUANTITY: 4

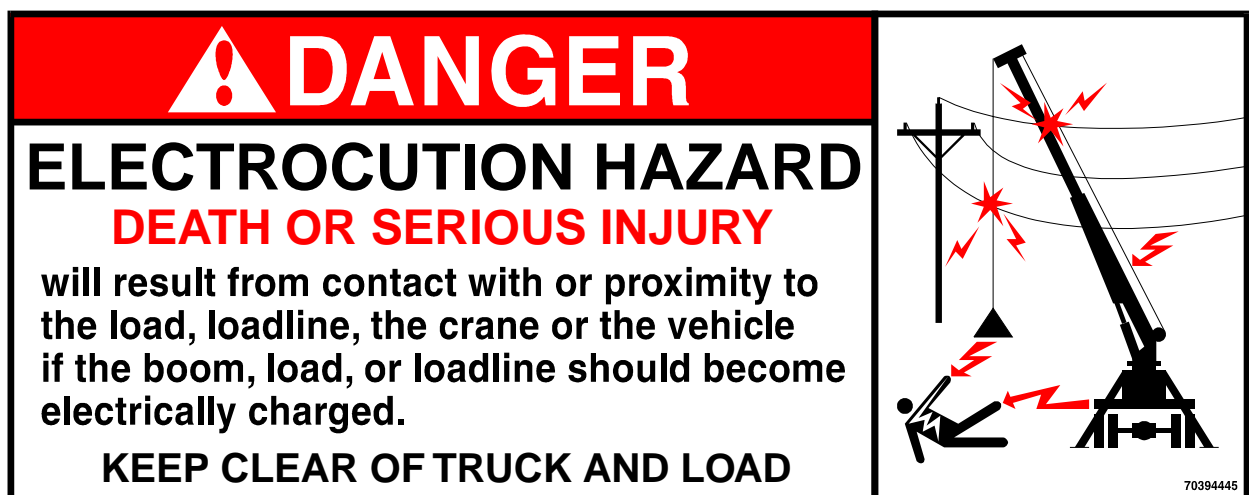


Figure A1-7

DECAL: Electrocution Hazard-Remote Control Operation

PART NUMBER: 70392889

FUNCTION: To inform the operator and other personnel in the work area of the lack of protection from electrocution afforded by the remote control handle, the possible consequences of the crane becoming electrically charged, and how to avoid the hazard.

WHERE USED: Articulating cranes - remote controls

PLACEMENT: If crane is equipped with manual control(s) in addition to remote controls, placed at or near the operator's manual control station(s). If crane is equipped with remote controls only, placed at remote control handle storage point.

QUANTITY: 2 or 1 if only with remote controls.

**Figure A1-8**

DECAL: Electrocution Hazard-Remote Control Operation

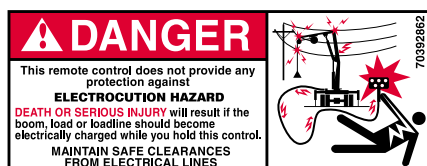
PART NUMBER: 70394446

FUNCTION: To inform the operator and other personnel in the work area of the lack of protection from electrocution afforded by the remote control handle, the possible consequences of the crane becoming electrically charged, and how to avoid the hazard.

WHERE USED: Service body mounted Telescoping Cranes - remote controls

PLACEMENT: At or near the remote control handle storage point.

QUANTITY: 1

**Figure A1-9**

DECAL: Electrocution Hazard-Remote Control Operation

PART NUMBER: 70392862

FUNCTION: To inform the operator of the lack of protection from electrocution afforded by the remote control handle, the possible consequences of the crane becoming electrically charged, and how to avoid the hazard.

WHERE USED: Articulating cranes - Remote Controls

PLACEMENT: On the hand held controller.

QUANTITY: 1

**Figure A1-10**

DECAL: Electrocution Hazard-Remote Control Operation

PART NUMBER: 70394447

FUNCTION: To inform the operator of the lack of protection from electrocution afforded by the remote control handle, the possible consequences of the crane becoming electrically charged, and how to avoid the hazard.

WHERE USED: Service body mounted Telescoping Cranes - Remote Controls

PLACEMENT: On the hand held controller.

QUANTITY: 1

Figure A1-11**DECAL:** Outrigger Foot Crushing Hazard**PART NUMBER:** 70392864

FUNCTION: To inform the operator and other personnel in the work area of the hazard associated with the operation of the outriggers, the possible consequences should the hazard occur, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes

PLACEMENT: On each outrigger.

QUANTITY: 2

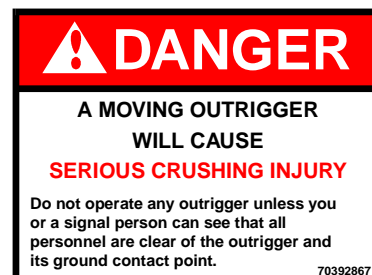
**Figure A1-12****DECAL:** Moving Outrigger Hazard**PART NUMBER:** 70392867

FUNCTION: To inform the operator of the hazard associated with outrigger operation, the possible consequences should the hazard occur, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's outrigger control station(s).

QUANTITY: 2

**Figure A1-13****DECAL:** Moving Boom Hazard**PART NUMBER:** 70392890

FUNCTION: To inform the operator and other personnel in the work area of the hazard associated with a moving boom especially while stowing and unfolding the crane, the possible consequences should the hazard occur, and how to avoid the hazard.

USED ON: Articulating Cranes

PLACEMENT: At or near the operator's control station(s) and/or the boom stow area(s).

QUANTITY: 2

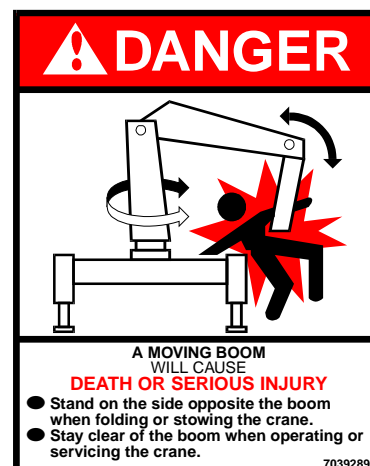


Figure A1-14**DECAL:** Rotating Driveline Hazard**PART NUMBER:** 70392891

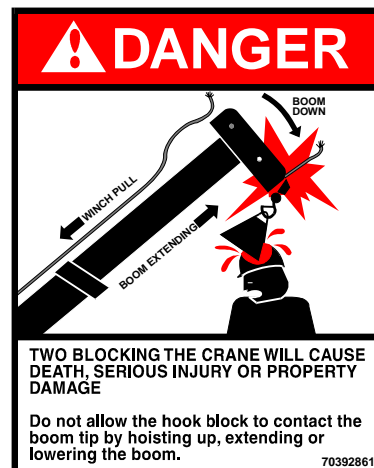
FUNCTION: To inform personnel of the hazard associated with servicing an operating driveline or PTO, the possible consequences should the hazard occur, and how to avoid the hazard. **USED ON:** Articulating and Service body mounted Telescoping Cranes that are driven by a PTO/pump system.

PLACEMENT: At or near the drive line.**QUANTITY:** 1**Figure A1-15****DECAL:** Two Block Hazard**PART NUMBER:** 70392861

FUNCTION: To inform the operator of the hazard associated with bringing the sheave(s) into contact with the hook, snatch block or load, the possible consequences should the hazard occur, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2**Figure A1-16****DECAL:** Riding on Boom, Hook, or Loadline Hazard**PART NUMBER:** 70392868

FUNCTION: To inform personnel in the work area of the possible consequences of riding on the boom, boom hook, the load or winch loadline, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes.

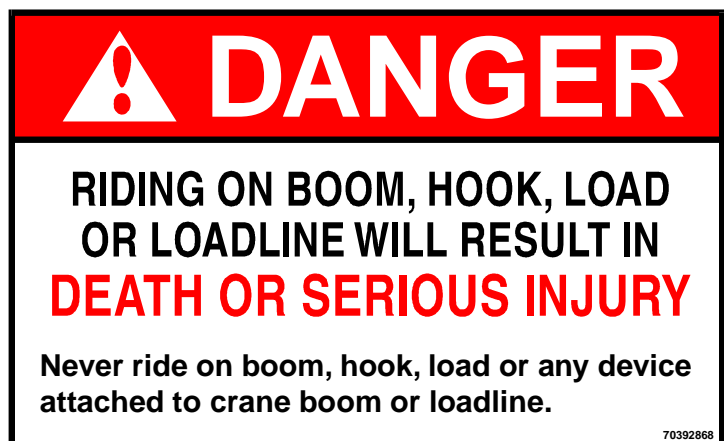
PLACEMENT: On all four sides of the vehicle.**QUANTITY:** 4

Figure A1-17

DECAL: Hoisting Personnel on Boom, Hook, or Loadline Hazard

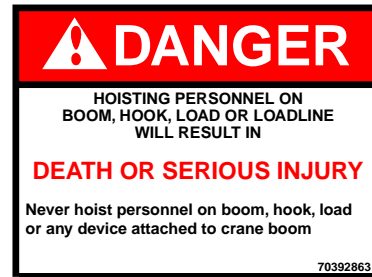
PART NUMBER: 70392863

FUNCTION: To inform the operator of the hazard associated with lifting personnel with the boom, boom hook, the load or winch loadline, the possible consequences of lifting personnel, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2

**Figure A1-18**

DECAL: Untrained Operator Hazard

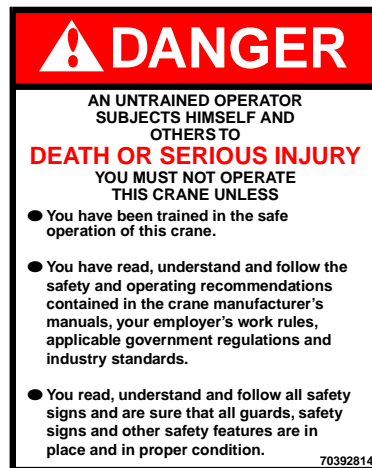
PART NUMBER: 70392814

FUNCTION: To inform the operator of the need for proper training, familiarity with safe operating procedures, and the possible consequences of operation without training.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2

**Figure A1-19**

DECAL: Operation Hazards

PART NUMBER: 70392815

FUNCTION: To inform the operator of precautions necessary in the safe operation of the crane, and the possible consequences of operation without taking those precautions.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2



Figure A1-20

DECAL: Failure to Obey Hazards-Inspections, Modifications, and Chassis Selection.

PART NUMBER: 70392866

FUNCTION: To inform personnel of the hazard associated with improper maintenance and unauthorized modifications, the possible consequences should the hazard occur, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2

**Figure A1-21**

DECAL: Failure to Obey Hazards-Load Charts, Crane Ratings, Winch Ratings, Accessories, and Manual Boom Extensions.

PART NUMBER: 70392888

FUNCTION: To inform the operator of the hazard associated with overloading the crane, the possible consequences should the hazard occur, and how to avoid the hazard.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the operator's control station(s).

QUANTITY: 2

**Figure A1-22**

DECAL: Free Falling Manual Boom Extension(s) Hazard

PART NUMBER: 70394443

FUNCTION: To inform the operator of precautions necessary in the safe deployment of manually operated extension booms, and the possible consequences of not taking those precautions.

USED ON: Articulating and Service body mounted Telescoping Cranes.

PLACEMENT: At or near the manual boom extension(s) retention mechanism(s).

QUANTITY: 1



1A-4. INSTRUCTIONAL DECALS

Shown in this section are instructional decals which may be affixed to your crane. Some are relevant to maintenance while others focus on operation. They are provided here as reference in the understanding of their purpose and placement.

Figure A1-23

DECAL: Warning - Manual Outriggers

PART NUMBER: 70391598

FUNCTION: To warn the operator of precautions necessary in the deployment of manual outriggers and to instruct in their use.

USED ON: All cranes equipped with manual outriggers.

PLACEMENT: On each outrigger.

QUANTITY: 1 per outrigger leg.



Figure A1-24

DECAL: Set Up/Stow Instructions

PART NUMBER: 70391583

FUNCTION: To provide the operator with sequential steps to be taken in the set up and storing of a Figure-4 folding crane.

USED ON: All Figure-4 folding cranes.

PLACEMENT: At or near the operator's station.

QUANTITY: 1

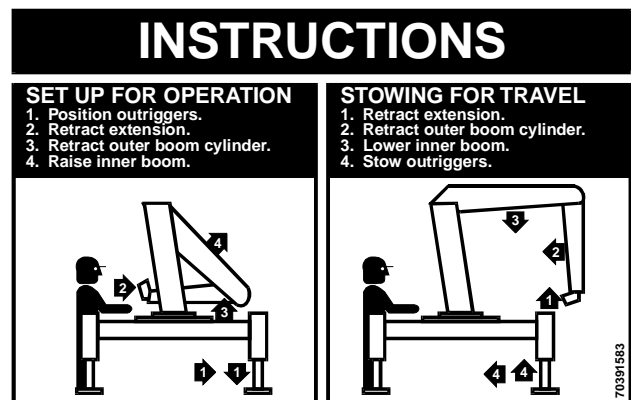


Figure A1-25

DECAL: Rotational Alignment

PART NUMBER: 71392365

FUNCTION: To provide the operator with a method of knowing when the crane mast and base are in alignment for placing the crane into the stored position.

USED ON: All cranes requiring alignment of mast and base before storing.

PLACEMENT: Upper half on the mast base plate edge. Lower half on the base gear-bearing guard. To be applied when the crane is in its approved stored position.

QUANTITY: 1

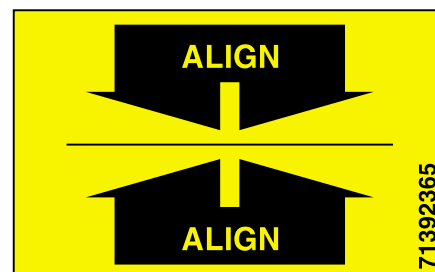


Figure A1-26

DECAL: Grease Weekly - Left Arrow

PART NUMBER: 70391612

DECAL: Grease Weekly - Right Arrow

PART NUMBER: 70391613

FUNCTION: To inform maintenance personnel of the location and necessity to apply grease to zerks on a weekly basis.

USED ON: All cranes.

PLACEMENT: At grease zerks with arrow pointing toward the zerk.

QUANTITY: 1 per grease zerk



Figure A1-27

DECAL: Rotate Crane/Grease

PART NUMBER: 70392524

FUNCTION: To inform maintenance personnel that it is necessary to rotate the crane while greasing the turntable gear-bearing. Rotation is required for proper and even distribution of grease to the gear-bearing.

USED ON: All cranes with turntable gear-bearings.

PLACEMENT: At or near the gear-bearing's grease zerk location.

QUANTITY: 1



Figure A1-28

DECAL: Contact IMT

PART NUMBER: 70392982

FUNCTION: To provide the owners/operators and maintenance personnel with the address and telephone number of IMT for service and repair purposes, safety questions, etc.

USED ON: All cranes.

PLACEMENT: Visible from the operator's station.

QUANTITY: 1



Figure A1-29**DECAL:** Return Line**PART NUMBER:** 70392109

FUNCTION: To aid in the identification of the hydraulic system return line to minimize errors during hydraulic maintenance.

USED ON: All cranes with hydraulic fluid reservoirs.

PLACEMENT: On the hydraulic fluid reservoir at the return line.

QUANTITY: 1

**Figure A1-30****DECAL:** Suction Line**PART NUMBER:** 70392108

FUNCTION: To aid in the identification of the hydraulic system suction line to minimize errors during hydraulic maintenance.

USED ON: All cranes with hydraulic fluid reservoirs.

PLACEMENT: On the hydraulic fluid reservoir at the suction line.

QUANTITY: 1

**Figure A1-31****DECAL:** Lubricate Worm Gear**PART NUMBER:** 70392399

FUNCTION: To inform maintenance personnel of the need to lubricate the worm gear on a weekly basis.

USED ON: All cranes which use a worm gear drive for crane swing.

PLACEMENT: On the worm gear cover.

QUANTITY: 1

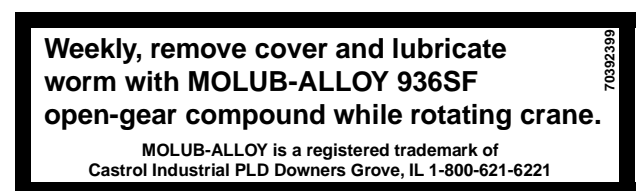


Figure A1-32**DECAL:** Caution - Do Not Wash/Wax**PART NUMBER:** 70392213

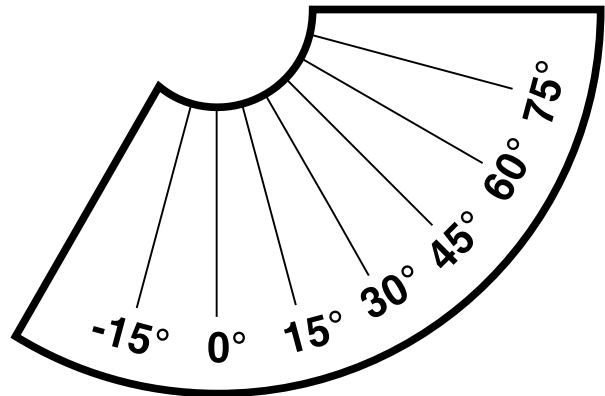
FUNCTION: To inform maintenance personnel not to use high pressure washers and not to wax the crane for a period of 60 days after delivery. The use of high pressure washers and wax is detrimental to the crane's paint until cured.

USED ON: All cranes.**PLACEMENT:** Near the crane operating station.**QUANTITY:** 1**Figure A1-33****DECAL:** Boom Angle Indicator - Left Hand**PART NUMBER:** 71391523**DECAL:** Boom Angle Indicator - Right Hand**PART NUMBER:** 71391522

FUNCTION: To display to the operator the actual angle of the boom of a telescoping crane.

USED ON: All telescoping cranes.

PLACEMENT: On the left or right side of the lower boom in alignment with the angle indicator arrow.

QUANTITY: 1**Figure A1-34****DECAL:** Caution - Oil Level**PART NUMBER:** 71039134

FUNCTION: To caution the operator to check the hydraulic reservoir oil level regularly.

USED ON: All cranes with hydraulic fluid reservoirs.

PLACEMENT: At or near the normal operating station.

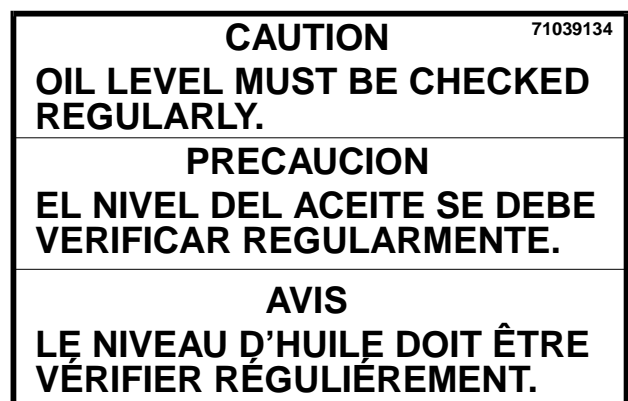
QUANTITY: 1

Figure A1-35

DECAL: Hydraulic Oil Reservoir Fill Recommendations

PART NUMBER: 70394189


FUNCTION: To inform operator and maintenance personnel of the recommended hydraulic oil to be used under differing climatic conditions.

USED ON: All cranes.

PLACEMENT: On or near the hydraulic oil reservoir.

QUANTITY: 1

Iowa Mold Tooling Co., Inc.
Garner, Iowa, USA
1-641-923-3711



70394189

**HYDRAULIC OIL RESERVOIR
FILL RECOMMENDATION**

HYDRAULIC OIL	AMBIENT TEMPERATURE RANGE	
	°F	°C
Mobil DTE® 13M	0° to 90°	-18° to 32°
Mobil DTE® 11M	Below 0°	Below -18°
Mobil DTE® 25	Above 90°	Above 32°

For Arctic conditions, consult your oil supplier.

For Mobil Product information:
1-800-662-4525

SECTION 2. MAINTENANCE

2-1. GENERAL

Proper, regularly scheduled maintenance is essential in keeping your crane at peak operating efficiency. This section outlines maintenance information and service intervals. Personnel responsible for crane maintenance should familiarize themselves with the service intervals and maintenance operations described.

REFER TO SAFETY MANUAL

It is necessary that all maintenance personnel familiarize themselves with the Operator's Crane Safety Manual before performing any maintenance on the crane.

Following the designated lubrication procedures is important in providing maximum crane life. The procedures and lubrication charts in this section include information on the types of lubricants used, location of lubrication points and frequency of lubrication. Information concerning the lubrication requirements of the truck chassis are not included. Refer to the appropriate truck manufacturer's manuals for chassis lubrication requirements.

The service intervals specified are for normal operation where moderate temperatures, humidity and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet those conditions. For information concerning extreme condition lubrication, contact your local service representative.

2-2. LUBRICANTS

Any mention of specific brand names and grades of lubricants should be used as reference only. Regional availability, operating conditions and the introduction of new products renders such specifics inaccurate. When questions arise, refer to component manufacturer's specifications and a reliable lubricant supplier.

CHASSIS GREASE

Lubricating grease of proper consistency is to be applied periodically at relatively frequent intervals with grease guns through grease fittings. Recommended grease consistency is NLGI #2.

EXTREME PRESSURE MULTIPURPOSE GEAR LUBRICANT (EPGL)

This gear lubricant is compounded to achieve high load carrying capacity and meet the requirements of either API-GL-5 or MIL-L-2105. Unless specified otherwise, SAE 80W-90 viscosity may be used for year round service. Low temperature usage is restricted as follows:

SAE VISCOSITY NUMBER	MINIMUM AMBIENT TEMPERATURE °F (°C)
75W	-40 (-40)
80W	-15 (-26)
85W	0 (-18)
90	+20 (- 7)
140	+40 (+ 5)
250	+50 (+10)

OPEN GEAR LUBRICANT

This is a special adhering lubricant of heavy consistency for protection of wire rope and exposed gears where provision is not made for continuous lubricant replenishment. Select the viscosity that gives best protection and lubrication without peeling, scaling or excessive throw off.

CHASSIS GREASE - LOW TEMP

This special grease for low temperature application remains plastic at -60°F with a melting point of 280°F. It is a heavy duty extreme pressure type lubricant (Lubriplate Low Temp or equivalent).

HYDRAULIC OIL

Oil in a hydraulic system serves as the power transmission medium, system lubricant, and coolant. Selection of the proper oil is essential to ensure satisfactory system performance and life. The following types of oil are suitable under most operating conditions:

1. Good quality antiwear hydraulic oils meeting ISO VG 32.
2. Engine oils meeting the requirements of MIL-L-2104 or API Service Classification CD or CE, and having a minimum of 0.06% zinc by weight as zinc dithiophosphate.

The most important factors in selecting an oil for hydraulic service are:

1. Viscosity
2. Antiwear Additives.
3. Viscosity - The oil must have proper viscosity to provide a lubricating film at system operating temperature.

Oil viscosity is important because it has a direct bearing on efficient transmission of power. An oil must flow readily through the system with a minimum of pressure and flow loss. Positive lubrication depends on viscosity. The oil must be sufficiently light to get between the components machined surfaces and maintain a lubricating film at system operating temperatures. Oil too light may cause the following conditions within the system.

1. Excessive leakage.
2. Lower volumetric efficiency of the pump.
3. Increased component wear.
4. Loss of system pressure.
5. Lack of positive hydraulic control.
6. Lower overall efficiency.

Oil too heavy may cause the following conditions in the system:

1. System pressure increase.
2. Increased system temperature.
3. Sluggish system operation.
4. Low mechanical efficiency.
5. Higher power consumption.

The following oil viscosity characteristics are recommended:

1. 80 to 180 SSU optimum at system operating temperature.
2. 60 SSU minimum at system operating temperature.
3. 7500 SSU maximum at starting temperature.
4. 90 Viscosity Index (VI) minimum.

When an engine crankcase oil is selected, the following grades will usually meet the above viscosity requirements.

SAE VISCOSITY DESIGNATION	TEMPERATURE °F (°C)
5W-20	-10 to 180 (-23 to 82)
10W	+10 to 180 (-12 to 82)
10W-30	+10 to 210 (-12 to 99)

ARTIC CONDITIONS BELOW -25°F (-32°C)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. Certain fluids, such as hydrogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands.

1. Engine oil meeting the requirements of MIL-L-46167 will perform satisfactorily for arctic conditions and should be used if operating in temperatures below -25°.
2. Gear oil in a winch must be changed to oil conforming to MIL-L-2105C, Grade 75W (GO- 75) for operation in temperatures below -25°F.

Regardless of temperature and oil viscosity, always use suitable start-up procedures to ensure adequate lubrication during system warmup.

ANTIWEAR ADDITIVES

Excessive wear in the system may cause a loss in volumetric efficiency and may cause shutdowns for maintenance. An efficient antiwear oil protects the components against rusting, resists oxidation, and helps prevent wear.

2-3. LUBRICATION

Maintaining the proper lubrication schedule will vary with climatic conditions and the amount of use the unit receives. The lubrication schedule (Figure B-2) is intended to serve for a normal work load and moderate weather variance. Periods of heavy use would shorten service intervals. See Figures B-4 through B-8 for typical grease fitting locations. For locations of grease zerks on your crane, see the manual specific to your model of crane.

NOTE

Each grease zerk on the crane is identified by a decal as shown in Figure B-1.

2-4. HYDRAULIC FLUID SPECIFICATION

Minimum viscosity specifications for hydraulic oil to be used in the crane are shown in Figure B-3. Any major oil company can supply products which meet these requirements.

Oils selected by the user for this class of equipment, in addition to meeting viscosity requirements, should have the following additives:

1. ANTI-FOAM INHIBITORS
2. ANTI-OXIDANT INHIBITORS
3. RUST RESISTANT ADDITIVES
4. ANTI-WEAR ADDITIVES

At the time the crane leaves the factory, it is filled with an ISO VG 32, low pour, anti-wear hydraulic oil.

To check the hydraulic reservoir oil level:

1. Operate the crane until the system is warmed up. Make certain that air is purged from the system (paragraph 2-7).
2. Disengage the PTO to stop the pump.
3. Remove the cap on the reservoir and visually check the oil level which should be near the top of the fill screen or use the sight gauge if so equipped.



FIGURE B-1. GREASE WEEKLY DECAL

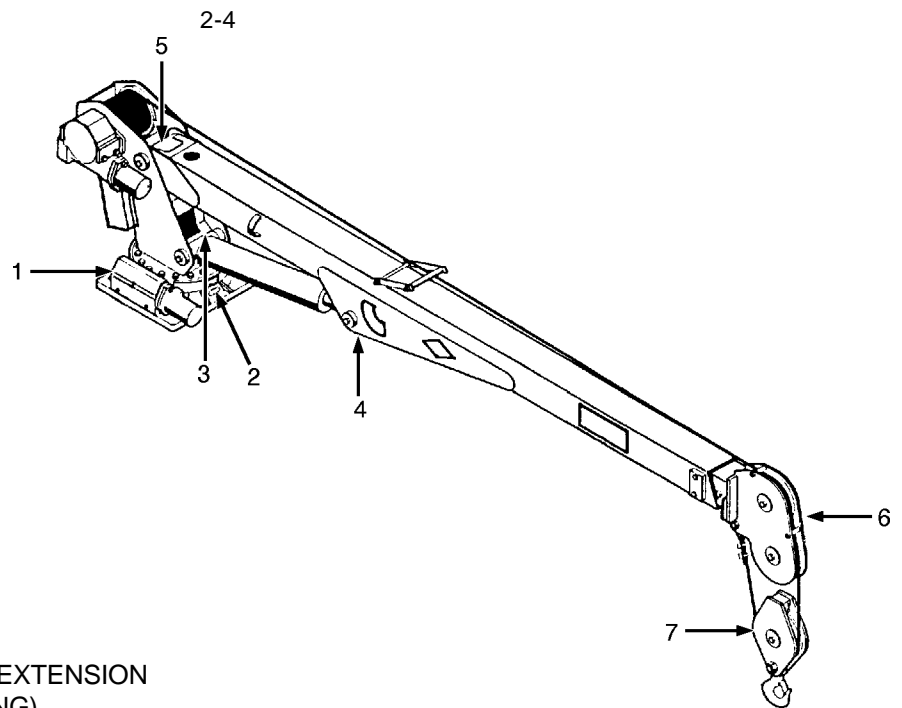
APPLICATION POINT	LUBRICATION PRODUCT	APPLICATION MEANS	INTERVAL
PINION AND DRIVE GEAR ROTATION BRAKE WINCH BRAKE WINCH SHEAVE TURNABLE-BEARING CYLINDER PINS BOOM HINGE PINS BOOM ROLLERS	SHELL ALVANIA 2EP OR SHELL RETINAX "A" OR MOBILITH AW2 OR EQUIVALENT	HAND GREASE GUN OR PNEUMATIC PRESSURE GUN	WEEKLY
ROTATION WORM GEAR	MOLUB-ALLOY 936 OR EQUIVALENT	BRUSH ON	WEEKLY
POWER TAKE-OFF TRANSMISSION	MOBILUBE HD 80W90 OR EQUIVALENT	FILL TO CHECK PLUG	MONTHLY
WINCH SUMP			

Figure B-2. LUBRICATION PRODUCT AND SCHEDULE

AMBIENT TEMPERATURE RANGE	0-90°	BELOW 0°	ABOVE 90°
MINIMUM POUR POINT, °F	-40°	-40	-10°
MAXIMUM VISCOSITY, SSU @ 0°F	5000	1500	---
MINIMUM VISCOSITY, SSU @ 100°F	140-195	80-90	200-335
MINIMUM VISCOSITY, SSU @ 210°F	48	39	49
MINIMUM VISCOSITY INDEX	139	139	95
ISO VG GRADE	32	15	46
MOBIL OILS (REFERENCE)	DTE 13M	DTE 11M	DTE 25

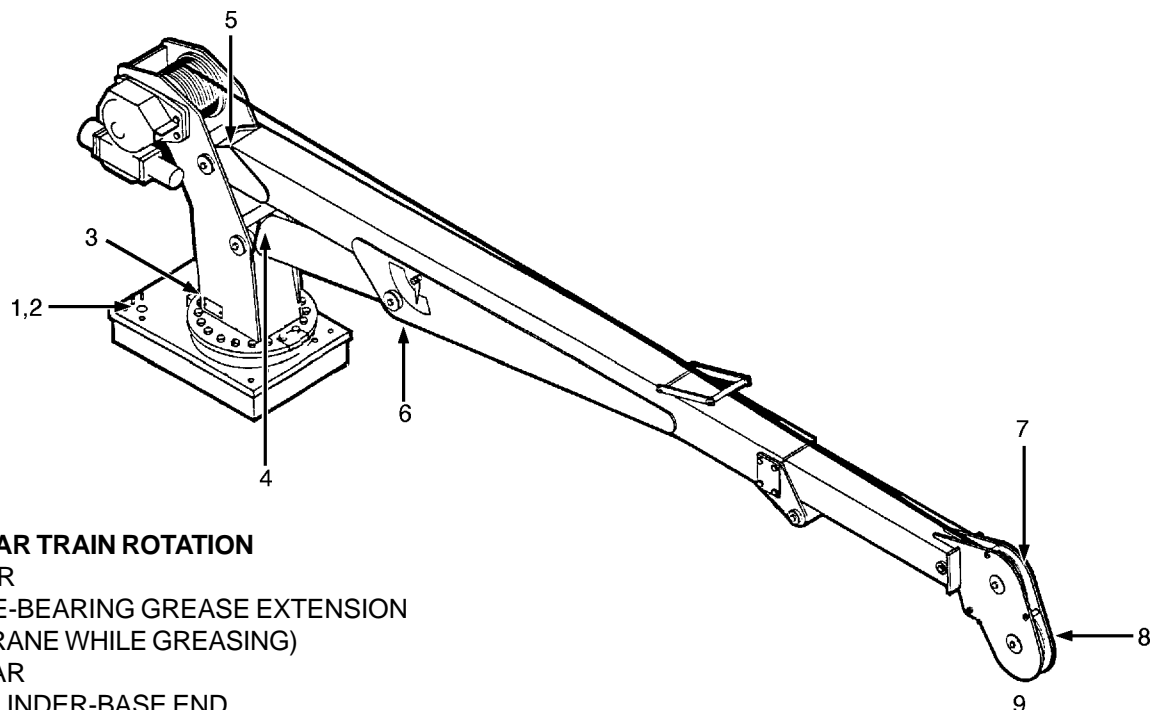
Arctic conditions present special requirements which are not within the scope of this table and must be given special consideration and individual analysis. Consult your oil supplier for the proper fluid for working under these severe conditions. In addition, electric hydraulic oil reservoir heaters are available to improve operation at extremely low temperatures.

Figure B-3. HYDRAULIC FLUID SPECIFICATIONS



WITH WORM GEAR ROTATION

1. WORM GEAR
2. TURNTABLE-BEARING GREASE EXTENSION
(ROTATE CRANE WHILE GREASING)
3. LOWER CYLINDER-BASE END
4. LOWER CYLINDER-ROD END
5. MAST/LOWER BOOM HINGE PIN
6. SHEAVE PIN
7. SNATCH BLOCK PIN



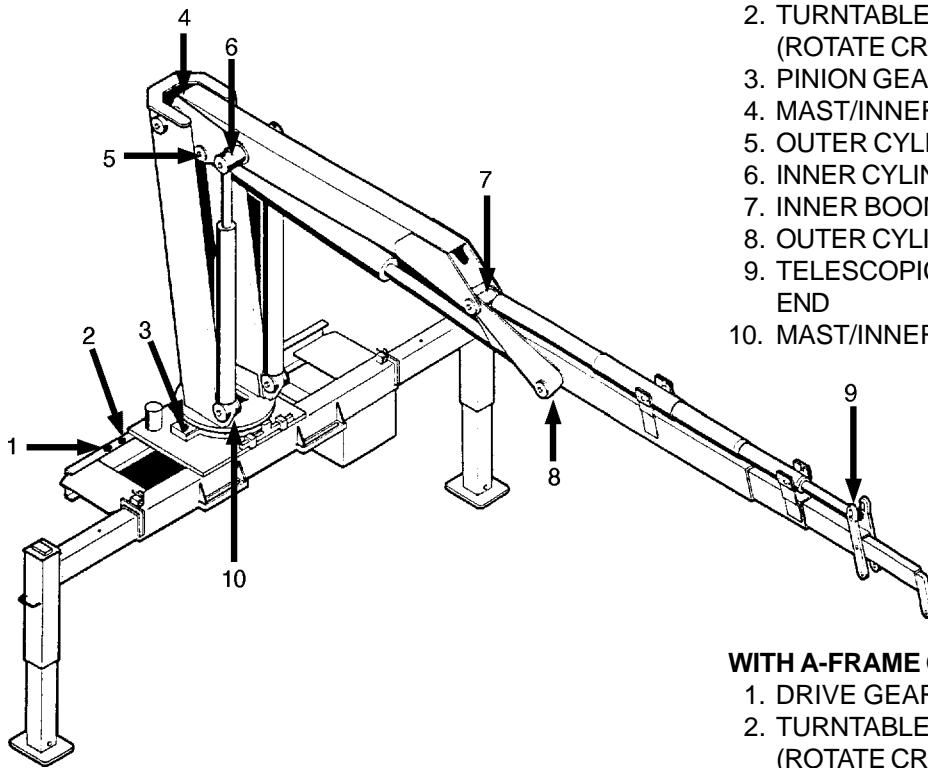
WITH SPUR GEAR TRAIN ROTATION

1. DRIVE GEAR
2. TURNTABLE-BEARING GREASE EXTENSION
(ROTATE CRANE WHILE GREASING)
3. PINION GEAR
4. LOWER CYLINDER-BASE END
5. MAST/LOWER BOOM HINGE PIN
6. LOWER CYLINDER-ROD END
7. UPPER SHEAVE PIN
8. LOWER SHEAVE PIN
9. SNATCH BLOCK PIN

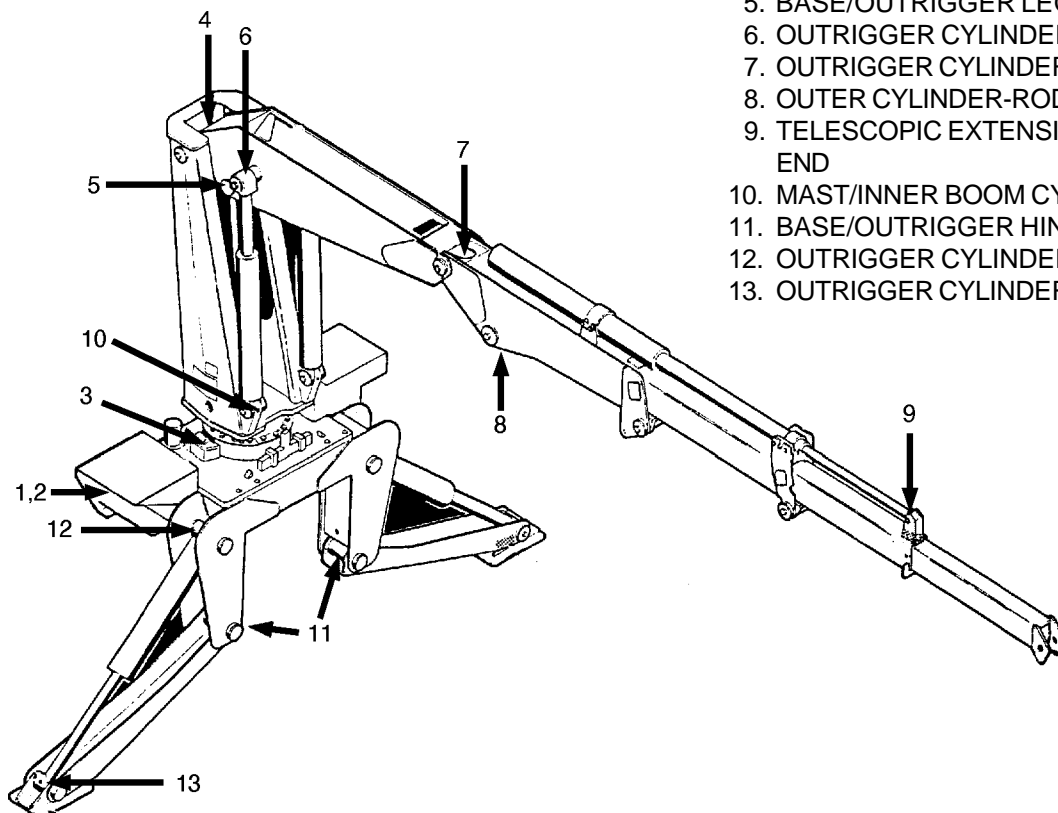
FIGURE B-4. TYPICAL GREASE ZERK LOCATIONS-TELESCOPING CRANES

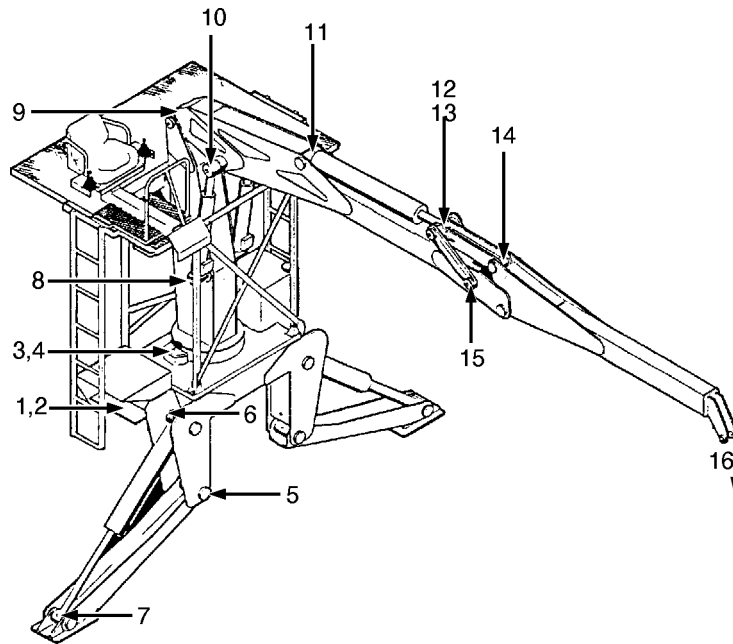
WITH POWER OUT AND DOWN OUTRIGGERS

1. DRIVE GEAR GREASE EXTENSION
2. TURNTABLE-BEARING GREASE EXTENSION (ROTATE CRANE WHILE GREASING)
3. PINION GEAR
4. MAST/INNER BOOM HINGE PIN
5. OUTER CYLINDER-BASE END
6. INNER CYLINDER-ROD END
7. INNER BOOM/OUTER BOOM HINGE PIN
8. OUTER CYLINDER-ROD END
9. TELESCOPIC EXTENSION CYLINDER-ROD END
10. MAST/INNER BOOM CYLINDER-BASE END

**WITH A-FRAME OUTRIGGERS**

1. DRIVE GEAR GREASE EXTENSION
2. TURNTABLE-BEARING GREASE EXTENSION (ROTATE CRANE WHILE GREASING)
3. PINION GEAR
4. MAST/INNER BOOM HINGE PIN
5. BASE/OUTRIGGER LEG HINGE PIN
6. OUTRIGGER CYLINDER BASE
7. OUTRIGGER CYLINDER ROD
8. OUTER CYLINDER-ROD END
9. TELESCOPIC EXTENSION CYLINDER-ROD END
10. MAST/INNER BOOM CYLINDER-BASE END
11. BASE/OUTRIGGER HINGE PIN
12. OUTRIGGER CYLINDER BASE
13. OUTRIGGER CYLINDER ROD

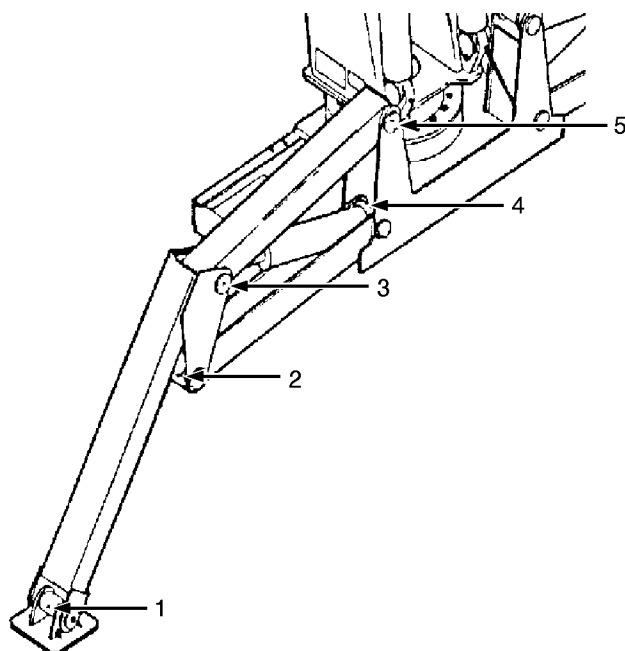
**FIGURE B-5. TYPICAL GREASE ZERK LOCATIONS-ARTICULATING CRANES**



WALLBOARD CRANE

1. DRIVE GEAR GREASE EXTENSION
2. TURNABLE-BEARING GREASE EXTENSION (ROTATE CRANE WHILE GREASING)
3. PINION GEAR
4. PINION COVER
5. OUTRIGGER LEG/BASE HINGE PIN
6. OUTRIGGER CYLINDER-BASE END
7. OUTRIGGER CYLINDER-ROD END
8. INNER CYLINDER-BASE END
9. MANS/INNER BOOM HINGE PIN
10. INNER BOOM/INNER CYLINDER HINGE PIN
11. INNER BOOM/OUTER CYLINDER BASE HINGE PIN
12. OUTER CYLINDER-ROD END
13. INNER LINK/OUTER CYLINDER HINGE PIN
14. INNER LINK/OUTER BOOM HINGE PIN
15. OUTER LINK/OUTER BOOM HINGE PIN
16. WALLBOARD FORKS (NOT SHOWN)

FIGURE B-6. TYPICAL GREASE ZERK LOCATIONS-WALLBOARD CRANES



SPIDER LEG OUTRIGGERS

1. OUTRIGGER PAD/LEG HINGE PIN
2. LOWER OUTRIGGER ARM/LEG HINGE PIN
3. OUTRIGGER CYLINDER-ROD END
4. OUTRIGGER CYLINDER-BASE END
5. UPPER OUTRIGGER ARM/BASE HINGE PIN

FIGURE B-7. TYPICAL GREASE ZERK LOCATIONS-SPIDER LEG OUTRIGGERS

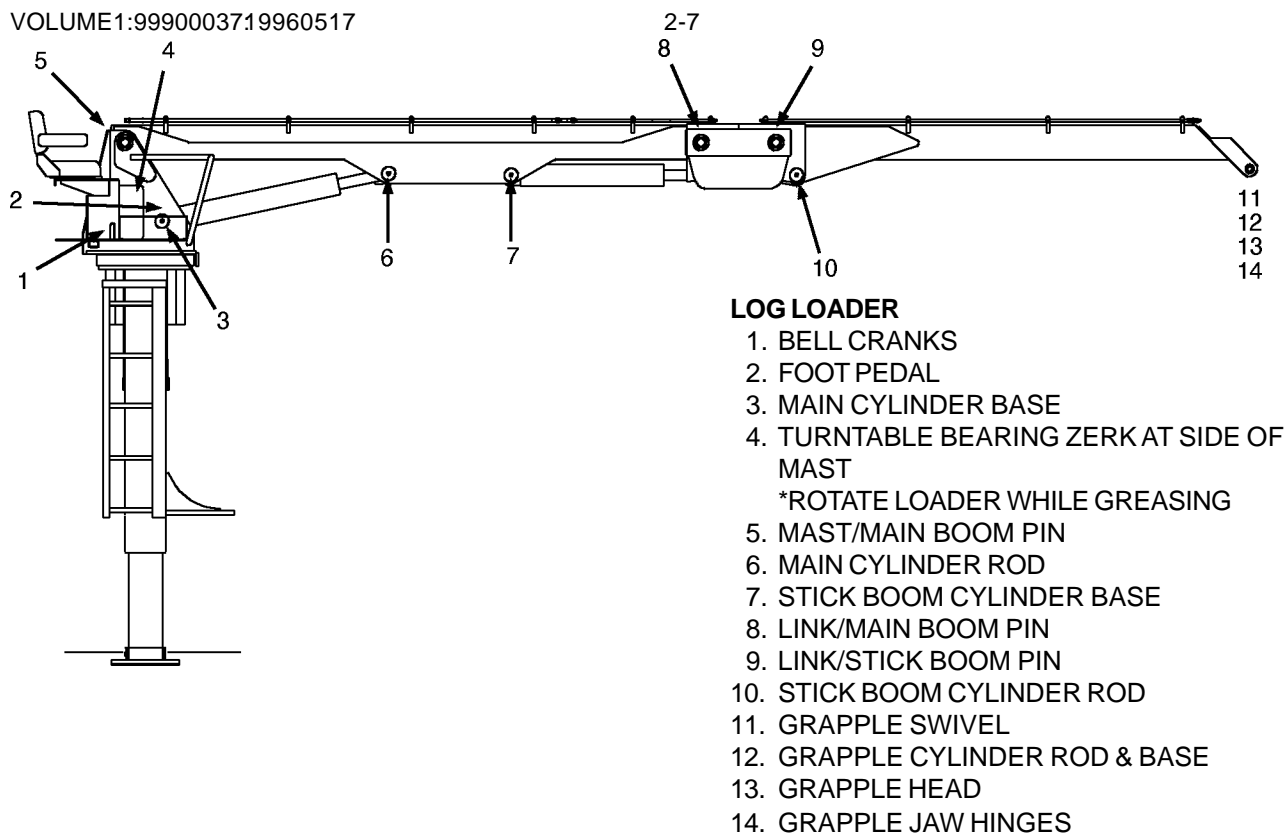


FIGURE B-8. TYPICAL GREASE ZERK LOCATIONS-LOG LOADERS

- System operating temperatures should be kept below 130°F.
- Use only oils suited for your conditions of operation.
- Use 10-micron filters or better.
- Keep the hydraulic system full. Doing so reduces sloshing and overheating.
- Change hydraulic fluid as specified.
- Keep the system cool.
- Inspect oil quality regularly - Lab testing is recommended.
- Replace hydraulic components before they can contaminate the system.
- Operate unit at specified temperatures and pressures.
- Use low temperature heaters to bring oil up to operating temperatures.
- Use oil coolers or heat exchangers to keep oil temperatures below 130°F.
- Hydraulic oil will never cost more than expensive equipment downtime.

FIGURE B-9. HYDRAULIC FLUID PRECAUTIONS

2-5. HYDRAULIC OIL DETERIORATION

CAUTION

Engine oil (multi-viscosity) is not recommended as an alternative to hydraulic fluids. Engine oils contain detergent additives which hold dirt in suspension and will not provide the longevity of hydraulic formulation oils.

NOTE

Automatic transmission fluids are capable of low-temperature operations and perform satisfactorily under pressures found in low-pressure hydraulic operations.

Contamination of the hydraulic oil by solvents, water, dust or other abrasives will result in premature breakdown of the oil's anti-foam, lubrication, anti-rust and viscosity properties. Prolonged exposure to water or high operating temperatures (above 180°F - 82°C) will cause an increase in the oxidation rate, producing varnish-forming materials and sludge in the oil.

Varnish and deposits are the result of oil oxidation and cause loss of the oils lubricating properties as the oil becomes thicker. Thick oil produces more friction, creating heat. When the filter becomes clogged with varnish, the oil gets dirtier faster, reducing performance.

Periodically, a sample of the hydraulic oil in the system should be drawn off and its condition checked for breakdown. Have oil sampled by a local laboratory or your supplier. Increased viscosity of over 10% and a high TAN (Total Acid Number) of over 3.0 are indications the oil has oxidized and should be replaced. When any of these conditions is observed, the system should be purged and filled with new oil.

2-6. HYDRAULIC SYSTEM PURGING

The oil should be changed in the reservoir and complete system after 800 hours of operation or every 6 months (whichever occurs first) and after pump or other major hydraulic component failure.

Purging the system requires a new oil supply sufficient to completely fill the reservoir, lines, cylinders, etc., and an extra quantity for loss during this procedure. To minimize oil loss during this process, operate the truck engine at low RPM.

During purging, new oil is supplied to the pump suction line through the reservoir fill cap and old oil is drained from the valve bank return hose.

Two operators are required during the purging operation: one to operate the crane controls and the other to regulate pump output (engine speed).

CAUTION

DO NOT ALLOW THE RESERVOIR OIL LEVEL TO DROP BELOW 1/3 CAPACITY DURING THIS OPERATION.

1. Locate the unit in an area which provides solid footing and space to accommodate the full operating range of the crane.
2. Stabilize the unit with the outriggers. Move the crane to 90° either side of the truck and extend the inner, outer and extension cylinders.
3. Disengage the PTO, drain the hydraulic oil reservoir, remove the suction line filter and drain all hoses. Disconnect the pressure hose from the pump, drain and reassemble. Replace the suction line filter element (paragraph 2-10) and reassemble the system.

NOTE

DISPOSE OF WASTE OIL IN A RESPONSIBLE MANNER, FOLLOWING ANY FEDERAL, STATE OR LOCAL REGULATIONS.

4. Remove the reservoir return line and direct the flow into a sump or waste container. Plug the drain port on the reservoir and fill with new oil.

NOTE

BE THOROUGHLY FAMILIAR WITH THE FOLLOWING STEPS AND BE PREPARED TO PERFORM THEM IN AN UNINTERRUPTED SEQUENCE OR STOP THE ENGINE AT THE END OF EACH STEP. IF THIS IS NOT DONE, EXCESSIVE OIL WILL BE DISCHARGED THROUGH THE DISCONNECTED VALVE BANK RETURN HOSE.

5. Start the truck engine, depress the clutch, shift the transmission into neutral and engage the PTO. Rotate the crane 90°, retract the extension boom, lower the outer boom to the lowest position and lower the inner boom.
6. Return the crane to its stowed position as marked on the rotation system. Raise the outriggers and kill the engine.
7. All components of the system are now purged. Replace the return line filter cartridge and reinstall the return line on the reservoir.
8. Check the reservoir oil level and top off if necessary.

2-7. PURGING AIR FROM THE SYSTEM

Air that is trapped in the cylinder will cause an erratic “bumpy” motion. To expel the air, hold the affected control open for a few seconds after the function has “bottomed out”. Move the function in the opposite direction and again hold the control open a few seconds after the function has “bottomed out”. Attempt to operate the crane in the normal manner to determine if the air has been purged.

2-8. SYSTEM RELIEF PRESSURE

The relief valve is provided to prevent the user from placing too much strain on the hydraulic components. The system relief pressure is preset and sealed at the factory and is not to be tampered with, for any reason. If the system relief pressure is suspected of malfunctioning, see your qualified IMT representative for testing, and replacement if necessary.

WARNING

SETTING THE RELIEF PRESSURE HIGHER THAN THAT SPECIFIED FOR YOUR MODEL CRANE IS UNSAFE AND MUST NOT BE ATTEMPTED. EXCESSIVE RELIEF PRESSURE WILL DAMAGE THE EQUIPMENT AND CAN RESULT IN SERIOUS INJURY OR DEATH. ONLY AN AUTHORIZED IMT REPRESENTATIVE SHALL ADJUST THE RELIEF PRESSURE AND THEN RESEAL THE RELIEF VALVE. A BROKEN SEAL ON THE RELIEF VALVE WILL VOID THE WARRANTY OF THE UNIT.

2-9. CYLINDER HOLDING CAPABILITIES

The cylinders are equipped with holding valves that prevent sudden movement of the cylinder rods in the event of a hydraulic hose or other hydraulic component failure. The valve is non-adjustable and failure is unlikely. However, if a malfunction is suspected, it may be checked in the following manner:

1. With a full rated load, extend the cylinder in question and kill the engine.
2. Operate the control valve to retract the cylinder. If the cylinder “creeps”, replace the holding valve. If the cylinder does not “creep”, the valve is serviceable.

2-10. FILTER ELEMENT REPLACEMENT

The unit contains hydraulic oil filters for removal of contaminating particles. To avoid residue accumulation in the reservoir and to protect hydraulic system components - valves, pumps, cylinders, etc. - the filter elements must be changed after 50 hours of new-unit operation and every 200 hours thereafter. Periodically, check the vacuum gauge reading on the suction line filter for a reading greater than 8" of mercury. If the gauge reads higher than 8", it could damage the pump due to cavitation. In addition, the filter elements should be replaced 50 hours after the repair of a major hydraulic component.

To change filter cartridges:

1. Kill the engine.

NOTE

WHEN CHANGING THE SUCTION LINE FILTER, ALWAYS CLOSE THE GATE VALVE AT THE RESERVOIR FIRST.

2. Replace the cartridge with a new one ensuring proper rubber seal seating and tightening as much as possible with both hands. Hand tighten only.
3. Open the gate valve, engage the PTO and test the system for leaks.

2-11. WIRE ROPE MAINTENANCE

REFER TO SAFETY MANUAL

See Section 8A. HOOK PRECAUTIONS

Rope should be maintained in a well lubricated condition. It is important that lubricant applied as part of a maintenance program shall be compatible with the original lubricant and to this end, the rope manufacturer should be consulted. Those sections of rope which are located over sheaves or otherwise hidden during inspection and maintenance procedures require special attention when lubricating rope. The object of rope lubrication is to reduce internal friction and to prevent corrosion.

When an operating rope shows greater wear at well defined areas than on the remainder of the rope, rope life can be extended in cases where a reduced rope length is adequate, by cutting off a section at one end, and thus shifting the wear to different areas on the rope.

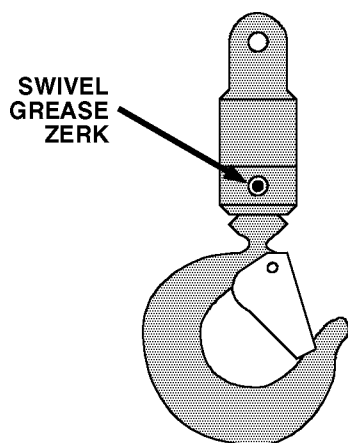


FIGURE B-10. SWIVEL HOOK GREASE ZERK

2-12. HOOK MAINTENANCE

REFER TO SAFETY MANUAL

See Section 8A. HOOK PRECAUTIONS

Crane hooks which are of the swivel type must be kept lubricated. Most swivel hooks provide a grease fitting for application of lubricant to the swivel bearing.

If a crane latch becomes inoperative because of wear or deformation, it must be repaired before the hook is put back into service. It may be necessary to “mouse” the latch until the latch can be repaired.

Make certain that wedge socket or cable thimble attachments are secure and that wire rope clips, as shown in Figures B-11, are torqued to manufacturers specifications, lubricated and functioning properly.

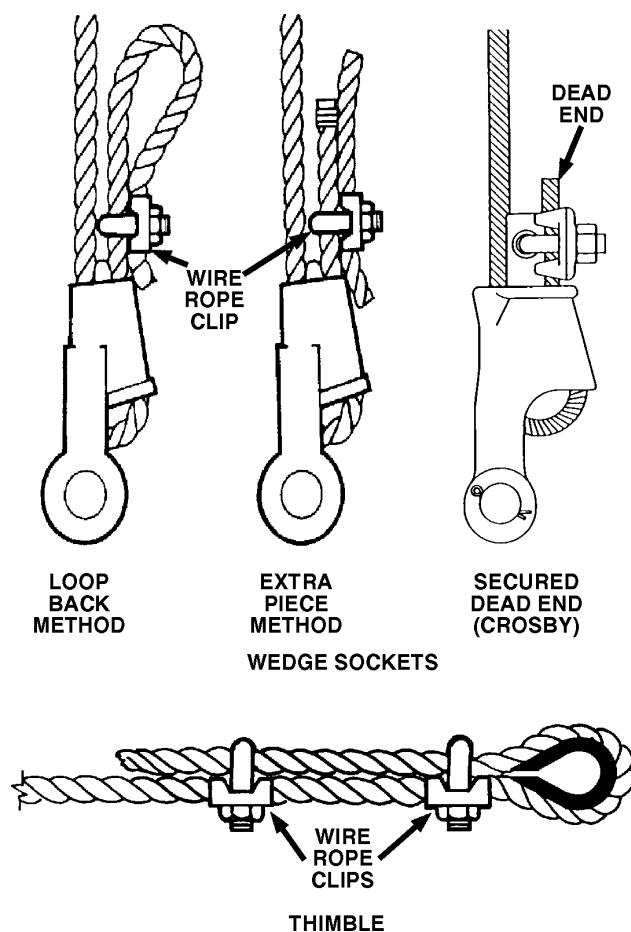


FIGURE B-11. ROPE ATTACHMENTS

2-13. PERIODIC VEHICLE INSPECTION

Maintaining the carrier vehicle in safe operating condition is an essential safety procedure. The vehicle should be inspected in accordance with the vehicle manufacturer's recommendations. Consult the documentation which accompanied your vehicle.

2-14. PERIODIC CRANE INSPECTION

The Crane Inspection Checklist, shown in the Reference Section, is designed to assist you in maintaining the crane in safe operating condition. Familiarize yourself with the Checklist before operation of your crane. Inspect to the instructions shown on the Checklist.

NOTE

A CRANE LOG BOOK IS AVAILABLE FROM IMT, WHICH PROVIDES A CONVENIENT AND PRECISE INSPECTION RECORDING METHOD. CONTACT IMT TECHNICAL SUPPORT AND SPECIFY PART NO. 99900686.

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2-15. ADDITIONAL INSPECTIONS

Every three months or more often when equipment is subjected to heavy use, the following inspections should be performed in addition to any specified in the Crane Inspection Checklist, shown in the Reference Section.

INNER, OUTER AND EXTENSION BOOMS

1. Check structural defects evidenced in weld cracks, dents or bends.
2. Check slide pads for wear.
3. Check inner, outer and extension cylinder pins for proper installation. Check hinge pin bushings for excessive wear.

MAINFRAME

1. Check control valvebank and all other fittings for oil leaks and tightness.
2. Check all bolts and retainer plates on pin assemblies for proper installation.
3. Check torque on all unit mounting bolts - should be power-wrenched tight (not more than 200 ft-lbs).
4. Check for loose bolts, fatigue cracks or corroded structural members.

MAST AND ROTATION SYSTEM

1. Check mast housing for cracks.
2. Check for proper rotation function by making several start-stop operations. Maximum allowable free-play at mast front should be 1/8" to 3/16".
3. Check for proper gear mesh in turntable gear-bearing. Check motor and gear mounting bolts for tightness.

HYDRAULIC SYSTEM

1. CYLINDERS
 - A. Check rods for damage such as scarring, nicks, dents and rust on out-of-service units.
 - B. Check for leaks at weld joints and rod seals. Check for drift indicating leakage around piston rings or defective holding valves.
 - C. Check cylinder case for dents.

2. HYDRAULIC PUMP
 - A. Check for leaks at shaft seal and section joints.
 - B. Check for drop in operating speed.
 - C. Check hydraulic oil for excessive heating.
 - D. Check bolts and fasteners for tightness.

Note any unusual vibration or noise.

3. UNDERDRIVE AND PUMP

- A. Inspect for proper transmission gear to PTO engagement.
- B. When supplied, inspect driveline U-joints for securing cap tightness and adequate lubrication.
- C. Check mounting bolts on pump and PTO for tightness.

WIRE ROPE INSPECTION

REFER TO SAFETY MANUAL

See Section 8. WIRE ROPE PRECAUTIONS

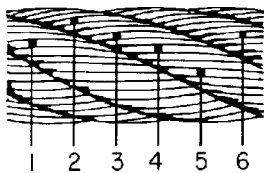
1. INSPECTOR - A representative of the user of the unit shall be appointed and this representative shall keep written reports of the rope condition on file at the work site. The representative shall have the authority to order wire rope replacements and keep unsafe wire rope from being used.
2. PERIODS OF INSPECTION - Inspection periods shall be set up for each material hoist wire rope. The frequency of inspection shall be determined by consideration of environment, degree of hazard to materials, frequency of operation and the frequency with which the wire rope is subjected to its capacity limits. Inspection shall be made not less than once each 30 days.
3. METHODS OF INSPECTION - The working length of the wire rope shall be unwound from the hoist drum. Thorough inspection shall be made of the rope sections that pass over sheaves, drums or contact saddles or which make opposing turns. The rope close to end attachments shall be carefully inspected.
4. USED WIRE ROPE - A used wire rope shall be thoroughly inspected prior to installation.
5. IDLE EQUIPMENT - The wire rope on equipment that has been idle or shut down for a period of one month or more shall be completely inspected prior to operation.

6. **SURFACES CONTACTED BY WIRE ROPE** - Sheaves, guards, guides, drum flanges and other surfaces contacted by wire rope during operation should be examined at the time of inspection. Any condition harmful to the rope in use at the time should be corrected.

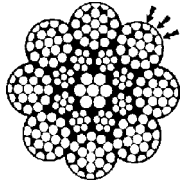
7. **WIRE ROPE REPLACEMENT** - Wire rope with any of the defects shown below shall be removed and replaced immediately.

A. Corrosion can be cause for replacement. Any development of corrosion must be noted and monitored closely.

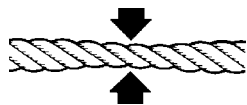
B. When there are either 3 broken wires in one strand or a total of six broken wires in all strands in any one rope lay.



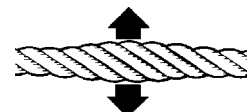
C. When flat spots on the outer wires appear and those outside wires are less than $\frac{2}{3}$ the thickness of the unworn outer wire.



D. When there is a decrease of diameter indicating a core failure.



E. When kinking, crushing, birdcaging or other distortion occurs.



F. When there is noticeable heat damage (discoloration) of the rope by any means.



G. When the diameter is reduced from nominal size by $\frac{1}{32}$ " or more.



H. If a broken wire protrudes or loops out from the core of the rope.



2-16. REMOTE CONTROL INSPECTION

The remote controls are subject to corrosion and must be checked at least twice yearly and more often if operated in severe, wet conditions. To check for corrosion:

1. Remove the cover of the control handle and inspect for a lack of luster. Metal should appear bright and untarnished.
2. Spray the inside of the control handle with ignition sealer.
3. Remove the cover of the junction box and inspect for signs of corrosion. Spray with ignition sealer.
4. Check the wiring for the ENGINE SPEED and ENGINE STOP functions under the hood. Spray with ignition sealer.
5. Check for broken or corroded ground wires, normally attached to the chassis frame with a self tapping screw. If faulty or extremely corroded, clean thoroughly and replace using new hardware.

WARNING

FAILURE TO COMPLY WITH THESE INSTRUCTIONS MAY RESULT IN A CONTROL FAILING TO RETURN TO NEUTRAL AND MAY CAUSE SERIOUS INJURY, DEATH OR DAMAGE TO THE EQUIPMENT.

NOTE

SEE THE PROPORTIONAL REMOTE CONTROL MANUAL, IMT PART NUMBER 99900339 FOR SPECIFIC INFORMATION ON THOSE SYSTEMS, AMP DRIVERS AND REPLACEMENT.

2-17. CORROSION CONTROL

To ensure the life and appearance of the crane, which includes booms, hydraulic hoses, rotation bearings and rotation gearing, the crane must be thoroughly washed and lubricated after performing job functions in harsh environments, such as dirt, sand, salt water spray, etc. If this maintenance step is neglected, you run the risk of shortening the life of the crane through corrosion and abrasion. After a thorough washing, refer to the Lubrication Chart for proper maintenance as scheduled.

2-18. LONG TERM STORAGE

When a crane is put into long term storage, it is suggested that it be stored within a controlled environment. To prolong the life of hydraulic system seals, o-rings, hoses, filters and pumps, the crane must be operated and maintained on a regular basis. If this maintenance is neglected, hydraulic system components will dry out which will require extensive repair and expense. IMT recommends the crane be operated, with all functions cycled fully as in normal operation, at least every three months. The climate in which the crane is stored may dictate more frequent operation to prevent component deterioration.

All wire rope which has been idled for a period of a month or more, due to shutdown or storage of a machine, shall be given a thorough inspection before it is placed into service. This inspection should cover all types of deterioration.

2-19. PROPORTIONAL REMOTE CONTROL TROUBLESHOOTING

This paragraph describes the operating characteristics of the Fauver valvebank (73733057). It also provides troubleshooting information which applies to this valvebank. See Figure B-14 for reference.

ELECTRICAL-AMP DRIVER POWER LED

The Power LED illuminates red while power is being applied to the valve amplifier. If the LED is not illuminated, no power is being applied to the valve amplifier.

If the Power LED does not function as described, inspect input wiring and repair or replace as necessary. When input power is applied, the LED should illuminate.

PMW% LED

The PMW% LED indicates the condition of the output current flowing to the proportional valve. The LED will change colors from, red to yellow to green. The change of colors indicates the variance of current flowing to the proportional valve. Red indicates minimum current and green indicates maximum current. This represents the flow condition going from low flow (red) to maximum flow (green), thus varying the speed of crane functions.

If the LED stays red, as the speed control trigger is activated, a dead short is present in the circuit. This could be the result of a wiring problem, shorted out proportional coil, etc. Inspect the wiring and replace the proportional coil, if required.

MIN POTENTIOMETER

The Min adjustment pot will be used to set the minimum amount of movement of an individual function at the valvebank when the corresponding function switch at the handset is depressed. To adjust, set engine at high speed control setting. Depress the "Rotation" function switch at the handset. Adjust the Min pot at the AMP driver card clockwise until crane begins to rotate or counterclockwise until motion begins to stop. No other electrical adjustments are required to properly operate the crane.

HYDRAULICS-VALVEBANK RELIEF VALVE

The relief valve limits the maximum system pressure. Pressure limits the amount of torque or force an actuator will see. This pressure is preset (see specific crane manual for pressure setting). If the relief valve should fail, it would likely stick open. This would prevent system pressure from developing and cause a lack of torque/force at the actuator. The relief valve can be changed easily by screwing it out and replacing with a new one.

PROPORTIONAL VALVE

The proportional valve varies the oil flow to the individual crane functions. Doing so dictates the speed of the crane functions. As the electrical current increases to the valve, by using the trigger on the control handle, more oil is ported downstream to the crane function. If the valve coil burns out, the operator would be unable to vary the flow to the crane functions. If the valve spool becomes stuck, the operator would be unable to vary the downstream flow. If speed control is the problem, it is likely an indication of a proportional valve problem. It is necessary to verify that current is flowing to the coil correctly, and that it is not an electrical problem.

The proportional valve can also be operated manually for test purposes. The valve stem can be screwed in manually to port oil downstream. Doing so will manually position the valve spool and hold it in the manually commanded position.

DIRECTIONAL VALVES

The directional valves (4) control the direction of the crane functions. When one of the solenoids is energized, it shifts the valve spool. This allows oil to flow out one of the valve ports. If a function does not work, a directional valve may be to blame.

These valves have a standard manual override. You may manually shift the valve by pushing the pin, located in the middle of the solenoid.

CAUTION

MANUALLY OVERRIDING A DIRECTIONAL VALVE WILL PORT OIL IMMEDIATELY TO THE VALVE FUNCTION. THIS WILL CAUSE A SUDDEN MOVEMENT OF THE ACTUATOR. OPERATORS AND MAINTENANCE PERSONNEL MUST KEEP THE WORK AREA CLEAR OF OTHER PERSONNEL WHEN OVERRIDING A DIRECTIONAL VALVE.

If the valve shifts using manual overrides, the problem is of an electrical nature. Valve coils are interchangeable and may be changed by removing the coil nut. This allows maintenance personnel to isolate individual coil failures. If the valve cannot be actuated manually or electrically, it is necessary to replace the section.

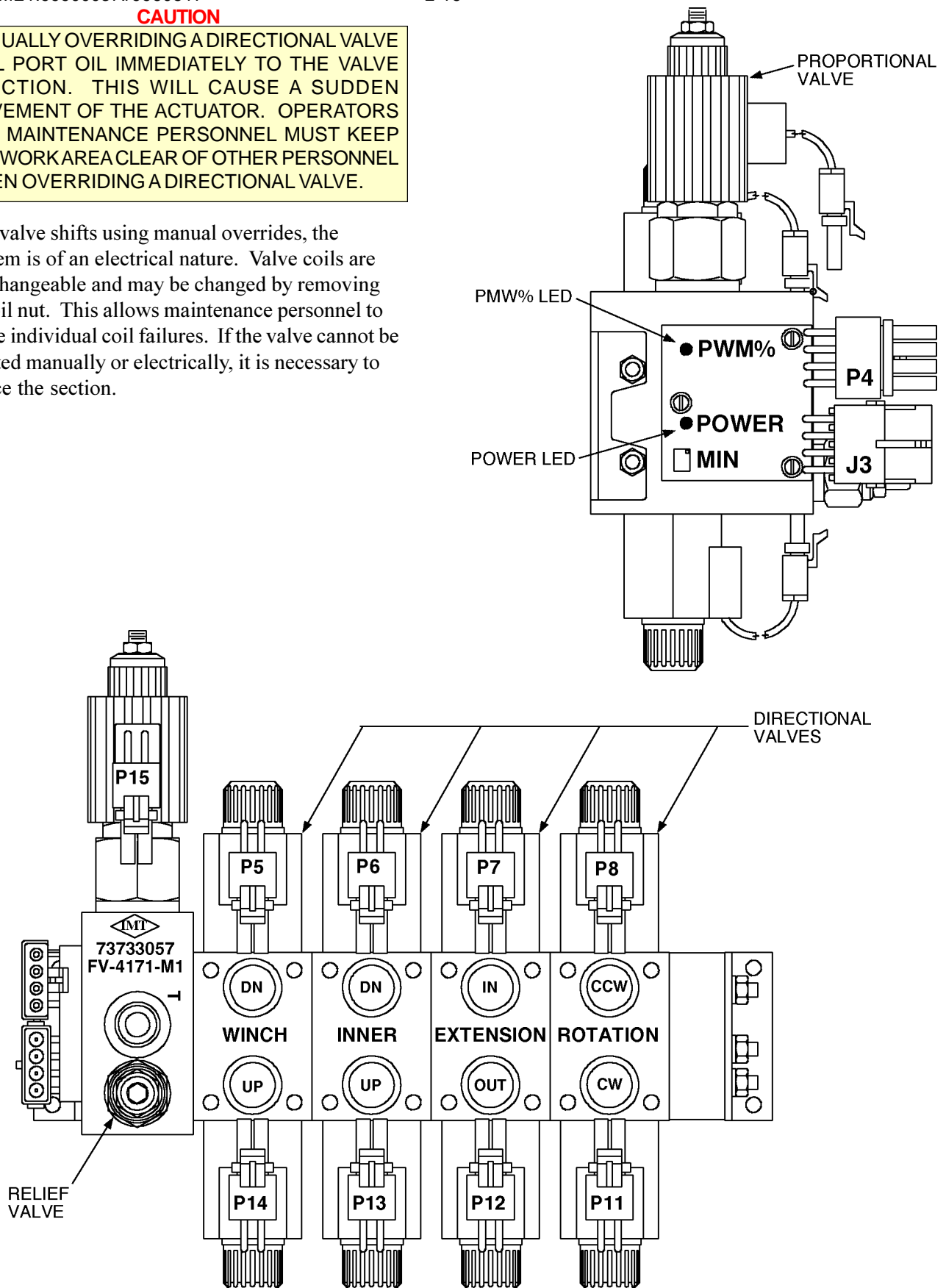


FIGURE B-14. VALVEBANK-PROPORTIONAL REMOTE CONTROL

SECTION 3. REPAIR

3-1. GENERAL

The information supplied in this section of the manual is designed to assist you in service and repair of your IMT crane. Inspection, lubrication and general maintenance information are found in the previous sections of this manual. Before attempting to perform any service work, the machine must be shut down as outlined in the Operation Section.

REFER TO SAFETY MANUAL

Read and familiarize yourself with the IMT OPERATOR'S CRANE SAFETY MANUAL before performing any maintenance on your crane

3-2. MAINTENANCE PRECAUTIONS

Proper and regular maintenance of the crane is a very important safety factor. As in the operation of the crane, there are also precautions to take during crane maintenance. Before beginning any maintenance, familiarize yourself with the maintenance sections of any manuals for the equipment being repaired.

Listed below are precautions to consider before maintenance is performed:

1. Place the crane in an area where other equipment is not operating and where there is no through traffic.
2. Make certain the carrier vehicle's parking brake is set. Use wheel chocks to prevent vehicle movement.
3. Position the crane in its stowed position if possible or with the boom lowered to the ground so that any booms will be prevented from collapsing during maintenance.
4. Place all controls in the "OFF" position and disable any means of starting the carrier vehicle or powering the crane.
5. Disconnect the PTO.
6. Secure sheaves and/or load blocks so they will not swing or fall during maintenance.
7. Relieve the hydraulic oil pressure from all circuits before disconnecting any hydraulic fittings or components.
8. Replace any parts with only factory approved replacements.

Before the crane is placed back into service:

1. Replace all shrouds, guards and safety devices which may have been removed during maintenance.
2. Remove all trapped air in the hydraulic system to prevent erratic operation.
3. Make certain all controls are free of grease and oil.
4. Make certain all decals are present and legible.
5. DO NOT return to the worksite until all repairs are proven to be in proper working condition.

3-3. GENERAL PRECAUTIONS

1. DO NOT wear loose clothing while working near machinery.
2. ALWAYS wear safety hat and safety glasses or goggles.
3. DO NOT place your hands near operating gear trains.
4. ALWAYS know where you are and what is happening around you.
5. DO NOT place yourself close to hot hydraulic fluid leaks, which will cause serious burns and injuries.
6. REVIEW all maintenance procedures before attempting.
7. NEVER perform maintenance procedures when unnecessary personnel are in the vicinity.

3-4. REPAIR PROCEDURE

Generally, a study of the hydraulic schematics in conjunction with a systematic procedure to locate and correct the problem will enable a skilled mechanic to determine the problem and correct it. If at any time you cannot find or correct the problem, contact your local distributor or the Iowa Mold Tooling Co., Inc. Service Department. Be sure you have your parts manual, model number and serial number at hand when you call. This information is on the serial number placard located on the crane mast.

The following general suggestions should be helpful in analyzing and servicing your crane. Use of the following systematic approach should be helpful in finding and fixing problems:

1. Determine the problem.
2. List possible causes.
3. Devise checks.
4. Conduct checks in a logical order to determine cause.
5. Consider the remaining service life of components against the cost of parts and labor necessary to replace them.
6. Make the necessary repair.
7. Recheck to ensure that nothing has been overlooked.
8. Functionally test the new part in its system.

NOTE

YOUR SAFETY AND THAT OF OTHERS IS ALWAYS THE NUMBER ONE CONSIDERATION WHEN WORKING AROUND CRANES. SAFETY IS A MATTER OF THOROUGHLY UNDERSTANDING THE JOB TO BE DONE AND THE APPLICATION OF GOOD COMMON SENSE. IT IS NOT JUST A MATTER OF "DO'S" AND DON'TS". STAY CLEAR OF ALL MOVING PARTS.

3-5. CLEANLINESS

An important item in preserving the long life of the crane is keeping dirt out of working parts. Enclosed compartments, seals, and filters have been provided to keep the supply of air, fuel, and lubricants clean. It is important that these enclosures be maintained.

Whenever hydraulic oil, fuel or lubricating oil lines are disconnected, clean any adjacent areas as well as the point of disconnect. As soon as the disconnection is made; cap, plug or tape each line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when they are installed. Leave new parts in their containers until ready for assembly.

3-6. HYDRAULIC SYSTEMS

Certain procedures involving the hydraulic system require special consideration for proper functioning and service life of the unit. Contaminants in a hydraulic system affect operation and will result in serious damage to the system components. Dirty hydraulic systems are a major cause of component failures. These steps are to be taken whenever a hydraulic component is disconnected.

1. ALWAYS relieve internal hydraulic pressure before proceeding with the repair.
2. NEVER allow foreign matter, such as dirt, water, or metal particles, to enter the hydraulic system through an open connection. Seal the connection as completely as possible. If evidence of foreign particles is found in the hydraulic system, flush the system and change filters.
3. ALWAYS inspect all sealing elements (o-rings, gaskets, etc.) when disassembling and assembling the hydraulic components. Installation of new elements is always recommended.
4. ALWAYS position hoses so they do not rub the machine or another hose and with a minimum of bending and twisting. Due to manufacturing methods, there is a natural curvature to a hydraulic hose. The hose should be installed so any bend is with this curvature.
5. ALWAYS cycle all controls after completing a repair. Doing so will eliminate air trapped in the cylinders, hoses and valves, and will alleviate erratic movement during actual operation.
6. ALWAYS check for hydraulic leaks after a repair. A high-pressure leak is hazardous and must be repaired before putting the unit in operation.
7. NEVER assemble a hydraulic component without thoroughly cleaning all of the components. Use a suitable cleaning solvent and follow all precautions presented by its manufacturer. Disassemble and assemble hydraulic components on a clean surface.

WARNING

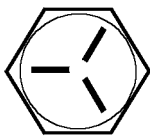
USE CLEANING SOLVENTS IN A WELL VENTILATED AREA WITH FIRE EXTINGUISHERS READILY AVAILABLE.

3-7. FASTENERS AND TORQUE VALUES

Use bolts of the correct length. A bolt which is too long may bottom before the head is tight against the part it is to hold. If a bolt is too short, there may not be enough threads engaged to hold the part securely. Threads can be damaged. Inspect them and replace fasteners as necessary. See Torque Data Chart on page 5-2 (domestic) or page 5-3 (metric).

Torque values should correspond to the type bolts, studs, and nuts being used. Always use hardened washers when torquing nuts or the bolts themselves. The torque tables are provided for reference when performing maintenance. Use of proper torque values is extremely important. Improper torquing can seriously affect performance, reliability and especially safety.

Identification of fastener grade is always necessary. When marked as a high grade bolt (grade 5, 8, etc.) the mechanic must be aware that he is working with a highly stressed component and the fastener should be torqued accordingly.

**GRADE 5****GRADE 8****HEX HEAD CAP SCREW IDENTIFICATION**

If a fastener must be replaced and a similar grade is not available, always use a higher grade torqued to the same value as the original grade. As soon as available, the correct grade fastener should be installed to avoid a future state of confusion.

Special attention should be given to the existence of lubrication, plating, or other factors that might require variation from standard torque values.

When maximum recommended torque values have been exceeded, the fastener must be replaced.

NOTE

TEMPERATURE VARIATION, VIBRATION, AND ELASTICITY OF METALS CAN RESULT IN THE GRADUAL REDUCTION OF BOLT TORQUE. BOLTS SHOULD BE RETORQUED AS OUTLINED IN THE INSPECTION PROCEDURES.

Torque wrenches are precision instruments and are to be handled with care to ensure calibrated accuracy. Calibration checks should be made on a scheduled basis. Whenever the wrench might be either overstressed or damaged, it should immediately be removed from service until recalibrated. An erratic or jerking motion of the wrench can easily result in excessive torque. ALWAYS use a slow wrench movement and STOP when the predetermined value has been reached.

3-8. LABEL PARTS WHEN DISASSEMBLING

When removing or disconnecting a group of wires, cables, hoses, or other multiple parts, tag each one to ensure proper identification during assembly.

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

3-9. BOOM WEAR PADS**NOTE**

THE FOLLOWING PROCEDURES ARE WRITTEN FOR A FIGURE-FOUR FOLDING CRANE WITH MULTIPLE EXTENSION BOOMS. THIS SAME PROCEDURE CAN BE MODIFIED FOR USE WITH TELESCOPING CRANE MODELS. SEE YOUR CRANE PARTS MANUAL FOR WEAR PAD LOCATIONS.

The outer boom of most cranes can house a number of extension boom sections, depending on crane options. The boom sections extend and retract on nylatron wear pads. With crane use, these pads wear and must be replaced. Replace wear pads when any of the following conditions exist:

1. When the pads wear such that the boom sections rub on boom sections, with the result of metal scraping and the removal of paint on the boom sections.
2. With the boom sections extended in the horizontal position, any noticeable droop of the boom sections would indicate the need for wear pad replacement.

To replace front wear pads, proceed as follows:

1. Retract all extension boom sections.
2. Operate OUTER BOOM and INNER BOOM control levers such that the outer boom is horizontal and at a comfortable working height.
3. Extend the required extension boom section sufficiently to allow access to front wear pads.

Manual boom sections may be extended as follows:

- a. Extend a hydraulic section.
 - b. Secure outermost extension boom to a fixed object.
 - c. Remove the pin that secures the manual section.
 - d. Retract the hydraulic extension boom as required.
4. Remove upper pads by removing retaining cap screws and sliding pads out.
 5. Slide in new pads and replace cap screws.
 6. Remove lower pads by removing retaining cap screws. To relieve pressure on wear pad, either use a hoist to lift the end of the boom, or operate boom hoist control lever DOWN so that boom touches ground and allows ground pressure to lift up on front of boom slightly. Slide pad out.
 7. Slide in new pad and replace retaining cap screws. Relieve hoist pressure on boom.

To replace rear boom wear pads proceed as follows:

1. Retract all EXTENSION BOOMS.
2. Operate OUTER BOOM and INNER BOOM control levers such that the outer boom is horizontal and at a comfortable working height.
3. For hydraulic extension boom sections, remove cylinder rod pin by loosening set screw in end of rod eye and prying out the pin. Identify and remove hydraulic lines that supply the next telescoping section.
4. Cap or plug all open hydraulic fittings.
5. Position hoist for pulling boom section out of boom.
6. Using hoist, begin pulling disconnected sections from crane. When partially pulled out, remove top front stop block or wear pad by removing cap screws and sliding item out.
7. Lift boom end with hoist just sufficient to relieve pressure on bottom stop block or wear pad. Remove cap screws and slide block or pad out.
8. Re-position hoist for lifting boom sections. Use 2 fabric slings of adequate capacity. Use hoist to lift and remove extended boom section from crane. Position boom section on a firm work support while replacing rear wear pads.

9. Reverse procedure for re-assembly. Torque threaded fasteners per Torque Data Charts on page 5-2 or 5-3.

10. Start the crane and slowly cycle the boom in and out with no load to purge air from the system.

11. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-10. PIN AND BEARING INSPECTION AND INSTALLATION

3-10-1. PIN INSPECTION

1. Remove the protective covering from pins and inspect each pin for nicks, gouges or deep, wide scratches. A small nick or gouge up to 1/8" diameter can be repaired by dressing the edges of the imperfection with a file so that no metal protrudes above the circular surface of the pin.
2. A circular scratch of up to 1/16" wide or deep can be repaired in the same manner as described above.
3. A lengthwise scratch on the pin of up to 1/32" wide or deep can be repaired as above.
4. Pins with defects larger than those listed in 1, 2 and 3 above, should be replaced.

3-10-2. PIN BEARING INSPECTION

The pin bearings (used at boom joints) are made of a tough epoxy impregnated wound glass backing shell with a thin inner layer of filament wound bearing material. The outer bearing material should be visually checked for imperfections. Bearings with cracks or gouges larger than 1/4" diameter on the outside diameter should be replaced.

3-10-3. INSTALLATION

1. The bearings should be started in their respective bores by rotating the bearing while applying inward pressure with the hand. Once the bearing has been started squarely into its bore, it can be driven to its full counterbored depth by tapping with a rubber mallet. The head diameter of the mallet should exceed the outside diameter of the bearing to ensure that the bearing is not damaged during assembly.
2. If the bearing appears to be loose in the bore (if it can be pushed in with hand pressure alone), it is permissible to tighten the bearing by centerpunching the bore diameter in approximately 50 places around and throughout the 2" deep bored area. Centerpunching will raise the metal around the edge of the punch mark and this raised metal will hold the bearing firmly in place during machine operation.

3. After all bearings have been installed and before attempting to assemble the machine, insert the pins through both bearings in each end of the lift cylinders and through the boom pivot bearings to ensure alignment and fit are correct. Pins should slide freely through the leading hole and start in the opposite hole. If a pin starts to bind through the leading hole, do not force the pin any further to avoid damaging the pin surface finish. Remove the pin and clean any corrosion or burrs out of the holes with a round file or emery cloth. A heavy hammer is allowed for pin replacement as long as pin bearing material is not removed while driving pin.

3-11. TURNTABLE GEAR - REMOVAL AND REPLACEMENT

The following procedure is for when a hoist of adequate capacity is available to lift off the entire boom assembly. If such a hoist is not available, some boom disassembly will be necessary.

1. Retract all extension booms.
2. Operate OUTER BOOM and INNER BOOM control levers to position outer boom in a vertical position with boom point as low as possible.
3. Position 2 fabric slings around boom and cinch on opposite sides of boom center of gravity. Hook slings on hoist and raise hoist to tension the slings.
4. Identify, mark and remove hose connections between crane base and boom. Cap or plug all open hydraulic fittings.
5. With boom fully supported in position by hoist, remove bolts securing mast to turntable gear.
6. Disconnect lubrication line at turntable gear. Lift crane away slowly, checking for hydraulic lines or other obstructions.

CAUTION

DO NOT LIFT CRANE TOO QUICKLY AS DAMAGE TO HOSES MAY OCCUR.

7. Turntable gear bearing is now exposed. Remove cap screws that secure turntable gear to crane base.
8. Remove turntable gear from crane base.
9. Thoroughly clean the top of the crane base and bottom of the new turntable gear bearing. The mating surfaces must be clean and dry - no oil or grease.
10. Install the new gear bearing, with ball loading plug located next to pinion gear (See Figure C-1), using new bolts, hardened flat washers and Loctite 262 on bolt threads. Torque all cap screws per Torque Data Charts on page 5-2 or 5-3.

NOTE

FOR PROPER OPERATION OF THE CRANE, THE HIGH SPOT ON THE TURNTABLE GEAR MUST BE MATCHED TO THE PINION GEAR. THE HIGH SPOT ON THE TURNTABLE GEAR IS NORMALLY MARKED WITH YELLOW OR LIGHT BLUE PAINT. REMOVE PAINT AND CHECK GEAR BACKLASH WITH A FEELER GAUGE. CLEARANCE BETWEEN PINION GEAR AND TURNTABLE GEAR BEARING TEETH WILL USUALLY BE LISTED ON THE BASE ASSEMBLY DRAWING IN THE PARTS SECTION OF YOUR SPECIFIC CRANE MANUAL. SHIFT THE TURNTABLE GEAR AROUND TO ADJUST THE BACKLASH. SEE FIGURE C-1A FOR BACKLASH INFORMATION.

WARNING

ANYTIME A GEAR BEARING MOUNTING BOLT HAS BEEN REMOVED, IT MUST BE REPLACED WITH A NEW BOLT OF THE IDENTICAL GRADE AND SIZE. ONCE A BOLT HAS BEEN TORQUED TO 75% OF ITS PROOF LOAD AND THEN REMOVED, THE TORQUE COEFFICIENT MAY NO LONGER BE THE SAME AS WHEN THE BOLT WAS NEW, THUS GIVING INDETERMINATE CLAMP LOADS AFTER TORQUEING. FAILURE TO REPLACE GEAR BEARING BOLTS MAY RESULT IN BOLT FAILURE DUE TO METAL FATIGUE AND COULD CAUSE A SERIOUS INJURY OR DEATH.

CAUTION

BEFORE TORQUEING, SEE TURNTABLE BEARING FASTENER TIGHTENING SEQUENCE IN THE REFERENCE SECTION.

11. Reverse procedure for reassembly. Use new cap screws and hardened washers when attaching mast to turntable gear. Torque cap screws per Torque Data Charts on page 5-2 or 5-3.

12. Start the unit and slowly cycle all of the controls to evacuate air trapped in the hydraulic system. Simultaneously check for leaks.

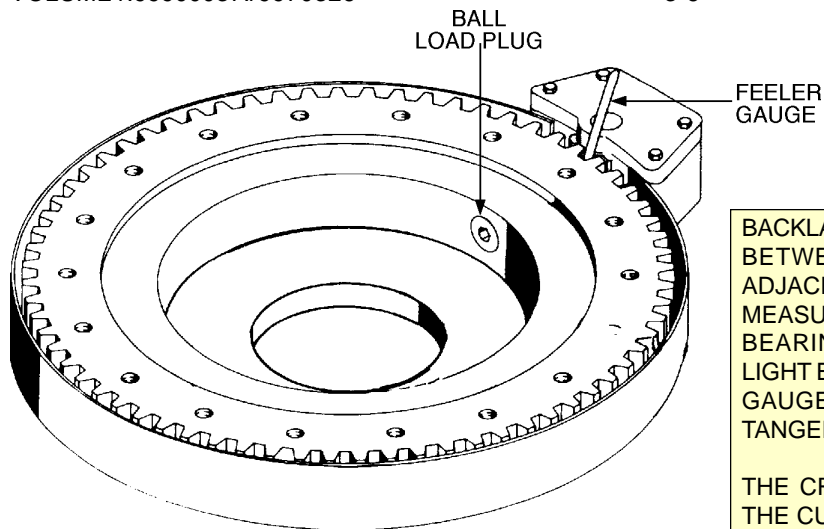
13. After air has been purged from the system, check the reservoir oil level and top off if necessary.

14. Lift the full rated load and swing it completely around in both directions. Actuate the controls very slowly and keep the load as close to the ground as possible. Set the load down and move the crane to the stored position.

15. Recheck the gear bearing bolt torque of all gear bearing mounting bolts.

WARNING

IT IS VERY CRITICAL THAT YOU CHECK ALL OF THE BOLTS AFTER SWINGING THE FULL RATED LOAD. APPLYING THE FULL LOAD AGAINST ALL OF THE BOLTS WILL BE A VERY GOOD INDICATION WHETHER THE BOLTS WERE COMPLETELY TORQUED.

**NOTE**

BACKLASH IS DEFINED AS THE SHORTEST DISTANCE BETWEEN NON-DRIVING TOOTH SURFACES OF ADJACENT TEETH IN MATING GEARS. BACKLASH IS MEASURED AT THE HIGH SPOT ON THE TURNTABLE BEARING (USUALLY INDICATED BY YELLOW OR LIGHT BLUE PAINT), USING A THICKNESS OR FEELER GAUGE AT OR NEAR THE PITCH DIAMETER AND TANGENT TO THE GEAR TEETH.

THE CRANE BASE ASSEMBLY PARTS DRAWING IN THE CURRENT PARTS MANUAL LISTS THE PROPER BACKLASH RANGE FOR EACH TURNTABLE BEARING.

FIGURE C-1. TURNTABLE GEAR BEARING INSTALLATION

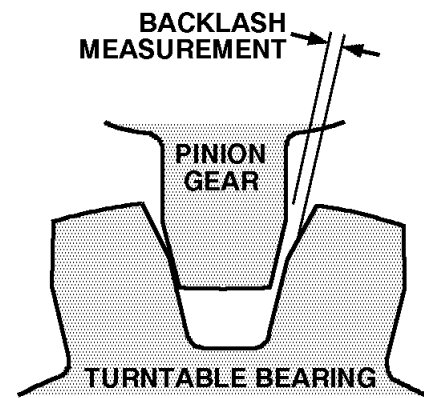


FIGURE C-1A. TURNTABLE GEAR BEARING BACKLASH MEASUREMENT

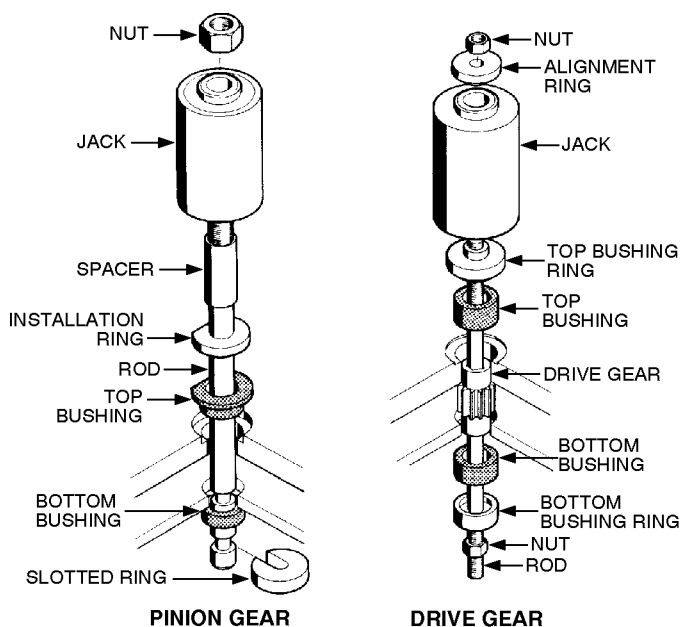


FIGURE C-2. BUSHING REMOVAL

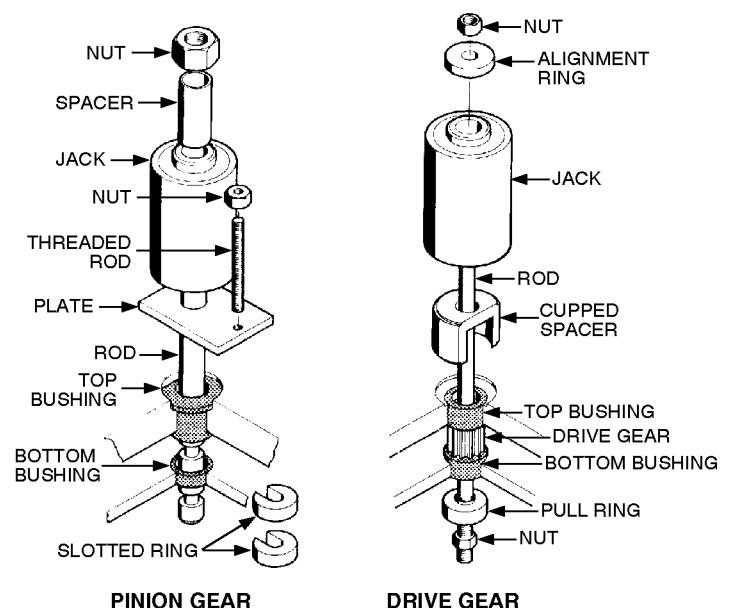


FIGURE C-3. BUSHING INSTALLATION

3-12. PINION AND DRIVE GEAR BUSHINGS - REMOVAL AND REPLACEMENT

To remove the pinion gear and bushings:

1. Rotate the crane mast until the notch on the mast base plate is positioned over the pinion gear.
2. Remove the pinion gear cover.
3. Locate and remove the retaining ring on the bottom of the pinion gear under the base.
4. Lift the pinion gear up and out of the intermediate gear. Slide the intermediate gear out of the way.
5. Install the bushing removal tool (IMT part number 92091200) as shown in Figure C-2.
6. Apply power to pull the bushings up and out of the base.

NOTE

POWER MAY BE SUPPLIED BY A SIMPLE HAND PUMP OR BY AN AIR-OVER-HYDRAULIC INTENSIFIER PUMP.

7. To install the bushings, assemble the tool as shown in Figure C-3. The flat side of the ring bushing set and top bushing fits against the gear bearing. A spacer is installed and then the hydraulic jack.
8. Apply power to press the bushing into place.
9. Install the pinion gear and intermediate gear. Install the retaining ring on the bottom of the pinion gear. Pack the cavity around the pinion gear with grease and then install the pinion gear cover.
10. Lubricate the pinion through the grease zerk.

To remove the drive gear bushing:

1. Disconnect the hydraulic hoses and remove the rotation motor.
2. Remove the grease plate on the bottom of the drive gear.
3. Install the bushing removal tool as shown in Figure C-3. Apply power to pull the bushing and gear upward.

NOTE

POWER MAY BE SUPPLIED BY A SIMPLE HAND PUMP OR BY AN AIR-OVER-HYDRAULIC INTENSIFIER PUMP.

4. Reassemble the tool as shown in Figure C-3 and press the gear and bushings into place.
5. Install the grease plate and rotation motor. Lubricate the drive gear.
6. Connect the hydraulic hoses to the motor.
7. Start the engine, engage the PTO and test actuate the rotation motor. Check for leaks.
8. Rotate the crane at least five times in both directions to purge the air trapped in the rotation motor.

3-13. REMOVAL AND REPLACEMENT OF OUTRIGGER ARMS

Remove outrigger arms as follows:

1. Extend horizontal outrigger cylinder to maximum.
2. Disconnect rod end of horizontal cylinder from outrigger.
3. Retract horizontal cylinder.
4. Disconnect hydraulic hoses from vertical outrigger cylinder and beam. Cap or plug all open hydraulic fittings.
5. Position 2 fabric slings around outrigger beam and use hoist to lift and pull out the outrigger beam assembly. Position the beam assembly on a firm work support.
6. Reverse procedure for re-assembly. Torque threaded fasteners per Torque Data Chart.
7. Start the crane and slowly cycle the vertical outrigger cylinder down and up with no load to purge air from the system.
8. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-14. VERTICAL OUTRIGGER CYLINDERS - REMOVAL AND REPLACEMENT

1. Remove horizontal outrigger beam assembly as described above.
2. Position outrigger beam assembly on side.
3. Remove the 2 cap screws that secure the vertical cylinder to the beam.
4. Position a fabric sling around leg weldment. Use a hoist to begin pulling leg and lower cylinder from beam weldment. Use a second sling around upper end of leg to finish pulling leg from beam. Position leg on a firm work support.
5. Remove retaining ring and pin that secures lower end of outrigger leg to rod end of vertical cylinder.
6. Position a fabric sling around upper end of vertical cylinder. Use hoist to begin pulling cylinder from leg weldment. Use a second sling around lower end of cylinder to finish pulling cylinder from leg. Position cylinder on firm work support.
7. Reverse procedure for re-assembly. Torque threaded fasteners per Torque Data Charts on page 5-2 or 5-6.
8. Start the crane and slowly cycle the vertical outrigger cylinder down and up with no load to purge air from the system.
9. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

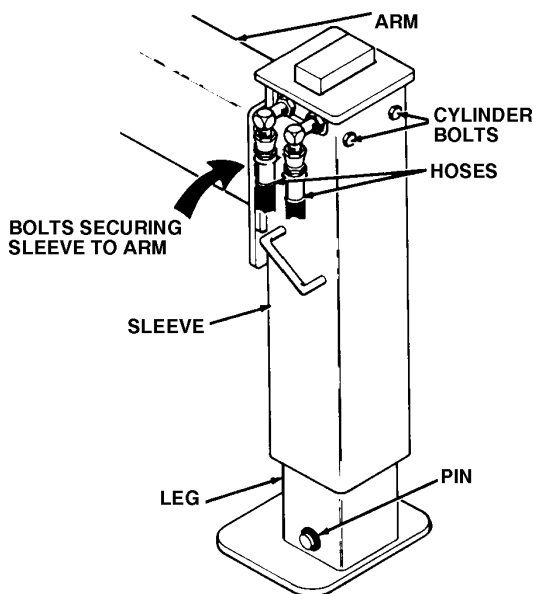


FIGURE C-4. POWER DOWN OUTRIGGER

3-15. EXTERNAL HORIZONTAL OUTRIGGER CYLINDERS - REMOVAL AND REPLACEMENT

1. Remove hydraulic hoses from horizontal outrigger cylinder.
2. Remove retaining hardware on both ends of cylinder.
3. Slide cylinder out of support bracket and remove from base. Position cylinder on a firm work support.
4. Reverse procedure for re-assembly.
5. Start the crane and slowly cycle the horizontal outrigger cylinder out and in with no load to purge air from the system.
6. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-16. FOLD-DOWN OUTRIGGER CYLINDER-REMOVAL AND REPLACEMENT

To remove the cylinder:

1. Extend the outrigger until the pad is approximately 12" above the ground. Place a block which is about 8" thick under the pad. Continue to lower the outrigger until the pad rests on the block.
2. Remove the rod end pin.

CAUTION

IT MAY BE NECESSARY TO RETRACT THE CYLINDER SLIGHTLY TO RELIEVE THE PRESSURE EXERTED ON THE PIN. ANY ATTEMPT TO FORCE THE PIN AT THIS TIME MAY DAMAGE THE PIN AND BUSHING.

3. Position a fabric sling, supported by a hoist, around the rod between the cylinder case and pin boss. Be careful to not damage the machined surface of the rod. Slowly retract the rod.
4. Raise the rod end of the cylinder to a vertical position. Disconnect the hydraulic hoses from the port block. Plug the ports at this time.
5. Take up any slack in the hoist and remove the base-end pin. Lift the cylinder away and place on a clean work surface.

To install the cylinder:

1. Using fabric slings and a hoist, lower the cylinder into position until the base-end pin boss lines up with the hole on the base. Make certain the port block is facing toward the outrigger arm and not upward. Install the pin.

2. Raise the rod end to a vertical position and connect the hydraulic hoses to the port block.
3. Lower the cylinder to a horizontal position. Extend and retract the rod one complete cycle to evacuate air in the system. Check for leaks.
4. Lower the cylinder and extend the rod until the pin boss lines up with the hole in the outrigger leg. Install the pin.
5. Start the crane and slowly cycle the outrigger cylinder down and up with no load to purge air from the system.
6. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-17. EXTENSION CYLINDER-REMOVAL AND REPLACEMENT

There are basically three types of extension cylinders; internal, external and bolt-on.

3-17-1. EXTERNAL CYLINDER

(See Figure C-6)

An external extension cylinder is mounted on top of the outer boom and is removed as follows:

1. Position the crane with the inner, outer and extension booms horizontal.
2. Disconnect and cap the extension cylinder hydraulic hoses. Plug the hose ports.
3. Secure the cylinder in place using fabric slings and hoist.
4. Remove the side plates securing the extension cylinder to the outer boom.
5. Remove the pin at the rod-end of the cylinder which connects it to the extension boom ear.
6. Lift the cylinder away, being careful to not scratch the machined rod surface.
7. Place the cylinder on a clean work surface.

To install an external extension cylinder:

1. Using fabric slings and hoist, position the cylinder atop the outer and extension booms. The extension boom may have to be moved manually to align the rod of the cylinder with the ears of the extension boom. Once aligned, insert and secure pin.
2. Install the side plates securing the cylinder to the outer boom. Torque fasteners per Torque Data Chart.

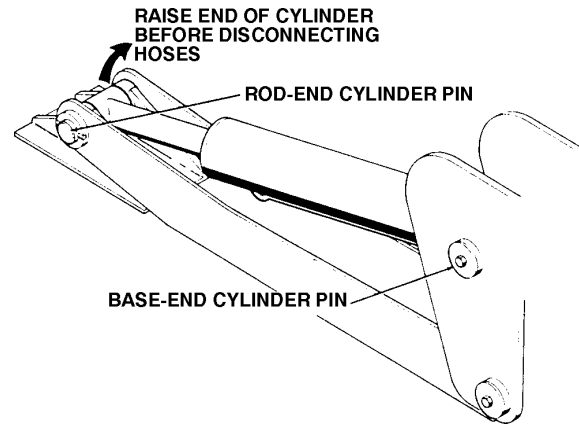


FIGURE C-5. FOLD-DOWN OUTRIGGER

3. Connect the hydraulic hoses and fasten any hose clamps which may have been loosened during disassembly, making certain hose have enough free play during crane articulation.

4. Purge the air from the hydraulic system and check for leaks. Top off the reservoir if necessary.

3-17-2. INTERNAL CYLINDER

(See Figure C-7)

An internal extension cylinder is housed inside the outer boom and is removed as follows:

1. Extend the cylinder to its full stroke.
2. Disconnect and cap any hydraulic lines connected to tools attached to the tip of the extension boom.
3. Remove any tools attached to the extension boom.
4. Remove the trunnion or roller and all wear pads from the outer boom.
5. Remove the pin securing the rod-end of the extension cylinder to the extension boom.
6. Retract the extension cylinder, being careful not to scratch the machined rod surface.
7. Using fabric slings and overhead lifting device, support the extension boom. Slowly work the extension boom out of the outer boom and set it to one side.
8. Disconnect and cap the extension cylinder hydraulic hoses. Plug the cylinder ports.
9. Remove the pin securing the base-end of the cylinder to the outer boom and carefully remove the cylinder. The use of fabric slings and a hoist is recommended.
10. Place the cylinder on a clean work surface.

To install the cylinder:

1. Slide the base end of the cylinder into the outer boom until the base end is positioned between the cylinder mounting plates and aligned with the pin hole. Install the pin and insert the hair pin to secure the pin.
2. Slide the extension boom into the outer boom until the end of the extension cylinder is inside the extension boom.
3. Connect the hydraulic hoses to the extension cylinder. Slowly extend the cylinder until the pin boss on the cylinder rod is aligned with the pin boss on the extension boom. Install the pin, securing the cylinder to the boom.

WARNING

IF THE EXTENSION BOOM CREEPS WHILE EXTENDING THE CYLINDER, THE ROD END OF THE CYLINDER IS SNAGGED ON SOMETHING INSIDE THE EXTENSION BOOM. MAKE CERTAIN THE EXTENSION BOOM IS NOT PUSHED OUT OF THE OUTER BOOM. FAILURE TO COMPLY WITH THIS INSTRUCTION CAN RESULT IN SERIOUS INJURY, DEATH OR EQUIPMENT DAMAGE.

4. Install the trunnion or roller and all wear pads on the outer boom.
5. Re-install any tools which were removed during removal of the extension cylinder. Connect hydraulic lines to the tools.
6. Purge the air from the hydraulic system and inspect for leaks. Check the level of the hydraulic reservoir and top-off if necessary.

3-17-3. BOLT-ON EXTENSION CYLINDER

(See Figure C-8)

A bolt-on extension cylinder is housed inside the extension boom and is removed as follows:

1. Position the crane with the booms horizontal and in a location to provide for an overhead lifting device.
2. Disconnect and remove any tools attached to the tip of the extension boom.
3. If equipped with a winch, remove the sheave and snatch block from the tip of the extension boom.
4. Remove and cap the hydraulic hoses from the cylinder. Mark and identify the hoses for proper port connection.
5. Remove the retaining ring, bushing and pin securing the trunnion or roller to the end of the outer boom.

NOTE

THE WEIGHT OF THE EXTENSION BOOM WILL MAKE PIN REMOVAL DIFFICULT. RAISE THE END OF THE EXTENSION BOOM TO RELIEVE PRESSURE ON THE PIN.

6. Remove the bolts securing the wear pad retainer plates. Remove the plates and wear pads.
7. Remove the retaining ring, bushing, hair pin and pin securing the rod end of the cylinder to the boom.
8. With an overhead lifting device and fabric slings, slide the extension boom out of the outer boom. Stop before it clears the end of the boom.
9. Wrap a sling around the extension boom at both ends to stabilize load. Continue removing the extension boom until it clears the outer boom.

WARNING

FAILURE TO SUPPORT THE EXTENSION BOOM AT BOTH ENDS WILL RESULT IN THE BOOM SWINGING OUT OF CONTROL WHEN IT CLEARS. THE SWINGING BOOM MAY RESULT IN A SERIOUS INJURY, DEATH OR EQUIPMENT DAMAGE.

10. With the boom resting on a solid surface, remove the bolts securing the cylinder case to the boom. Pull the cylinder out of the boom.

To install the cylinder:

1. Slide the cylinder inside the extension boom until it bottoms out.
2. With a pry bar through either end of the extension boom, move the cylinder until the bolt holes are properly aligned. Start all four bolts before tightening. Torque in a criss-cross pattern per the Torque Data Chart.
3. Support the assembled extension boom at two points and lift. Slide the boom at least 12" inside the outer boom. Remove one of the supports and continue to slide the boom into place.
4. Use a pry bar to align the rod-end of the cylinder with the pin hole. Install the pin, bushing, retaining ring and hair pin.
5. Connect the hydraulic hoses to the cylinder.
6. Install the trunnion with the pin, bushing and retaining ring. Lift the end of the extension boom to provide clearance for the trunnion.
7. Install the wear pads, retaining plates and bolts. Torque the bolts in a criss-cross manner per the Torque Data Chart.

8. Install any sheaves, wire rope and snatch blocks which may have been removed during disassembly.

9. Install any tools which may have been removed during disassembly and connect their hydraulic lines.

10. Start the engine, engage the PTO and test operate the crane.

11. Purge the air from the system.

12. Check for leaks and repair if necessary.

13. Check the reservoir fluid level and fill if necessary.

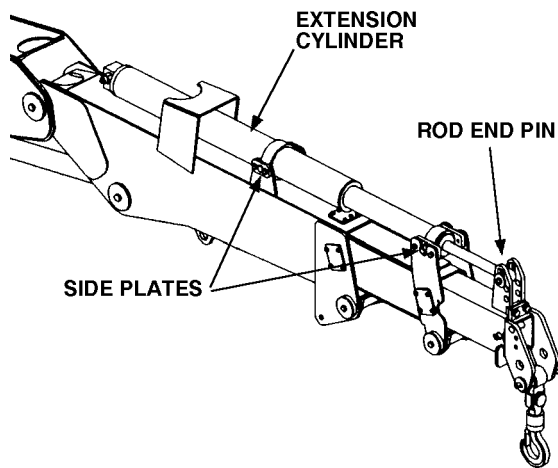


FIGURE C-6. EXTERNAL EXTENSION CYLINDER

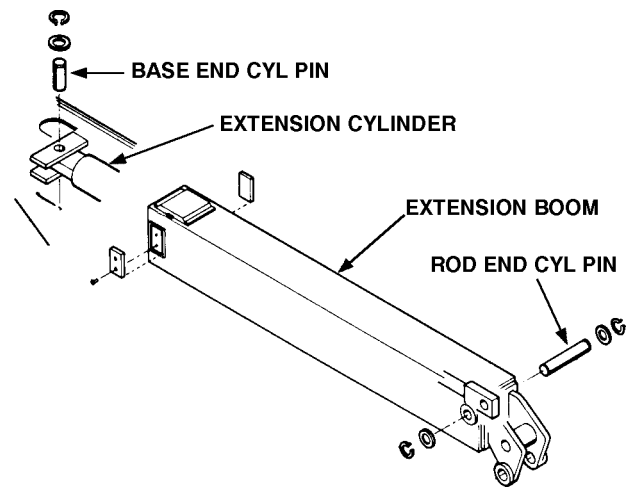


FIGURE C-7. INTERNAL EXTENSION CYLINDER

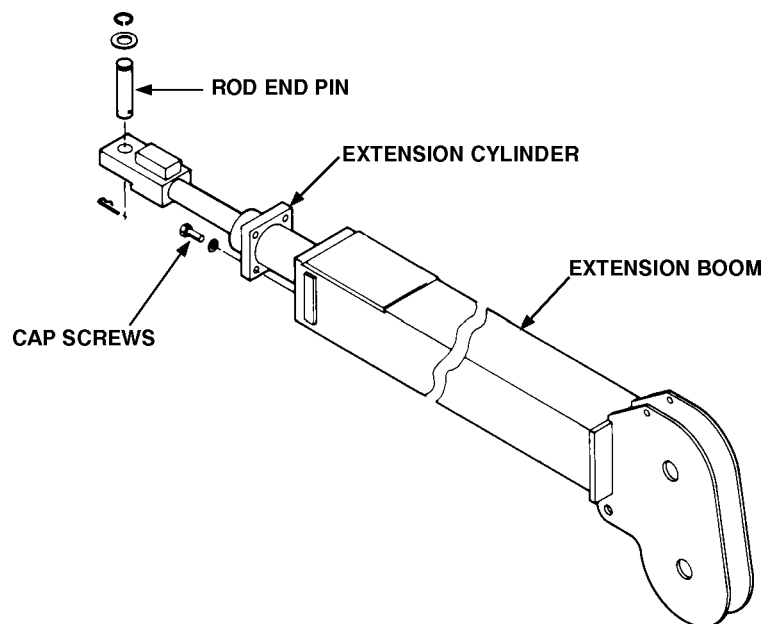


FIGURE C-8. BOLT-ON EXTENSION CYLINDER

3-18. REMOVAL AND REPLACEMENT OF OPERATOR CONTROL VALVE

1. Remove cotter pins and clevis pins which secure any control rods to valve sections.
2. Identify and mark all hoses and position at the control valve first and then remove the hoses from the valve. Cap or plug all open hydraulic fittings.
3. If valve is large, position a fabric sling around the valve to prepare for lifting. Hook the sling onto a hoist. Raise hoist to tension the sling. Remove hardware securing valve to crane base. Position valve on a firm work support.
4. Reverse procedure for re-assembly. DO NOT induce any distortion in valve body when mounting it. Use shims under mounting pads if necessary to prevent distortion. Torque threaded fasteners per Torque Data Charts on page 5-2 or 5-3. Observe hose identification when re-connecting hoses to valve.
5. Start the crane and slowly cycle all cylinders out and in with no load to purge air from the system.
6. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-19. OUTER BOOM -REMOVAL AND REPLACEMENT

1. Retract all sections of the outer boom.
2. Operate OUTER BOOM and INNER BOOM control levers such that the outer boom is horizontal and at a comfortable working height.
3. Position 2 fabric slings of adequate size around opposite ends of the outer boom assembly. Slings must not pinch hydraulic hoses. Position hoist to lift on slings and lift up to tension the slings.
4. Identify and disconnect hydraulic hoses from rear of outer boom assembly. Cap or plug all open hydraulic fittings.
5. Remove pin retaining bolt through hoist pin of outer boom base section.
6. With the aid of a heavy sledge hammer and a pin driving tool, drive the boom hoist pin from the base section of outer boom. Allow link to hang down.
7. Remove pin retaining bolt through pivot pin of outer boom base section. With aid of a heavy sledge hammer and a pin driving tool, drive the boom hoist pin from the base section of the outer boom. Hoist outer boom onto a firm work support.
8. Reverse procedure for reassembly. Torque threaded fasteners per Torque Data Charts on page 5-

3-12

2 or 5-3.

9. Start the crane and slowly cycle the boom in and out with no load to purge air from the system.

10. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-20. OUTER CYLINDER -REMOVAL AND REPLACEMENT

1. Retract all sections of the outer boom.
2. Operate OUTER BOOM and INNER BOOM control levers to position outer boom as low as possible and supported at both ends. Outer boom hoist cylinder must be positioned to allow it to swing to vertical position when end rod is removed.
3. Identify and remove hose connections at outer boom hoist cylinder. Cap or plug all open hydraulic fittings.
4. Position 1 long sling of adequate capacity around outer boom hoist cylinder and cinch it near rod end. Hook sling on hoist and raise hoist to tension the sling.
5. Remove pin retaining bolt and keeper on rod end.
6. With the aid of a heavy sledge hammer and a pin driving tool, drive the rod end pin from the cylinder and linkage. Allow cylinder to hang down.
7. Re-position the sling toward piston end of cylinder. Cinch sling such that sling will support cylinder in vertical position.
8. Remove pin retaining bolt and keeper on piston end.
9. With aid of a heavy sledge hammer and a pin driving tool, drive the piston end pin from the cylinder and inner boom. An assistant will be required to hold the cylinder straight vertically while driving out the pin.
10. Position cylinder on a firm work support.
11. Reverse procedure for re-assembly. Torque threaded fasteners per Torque Data Charts on page 5-2 or 5-3.
12. Start the crane and slowly cycle boom hoist cylinder out and in with no load to purge air from the system.
13. After the air has been purged from the system, check reservoir oil level and top off if necessary.

3-21. INNER CYLINDER -REMOVAL AND REPLACEMENT

1. Retract all sections of the outer boom.
 2. Operate OUTER BOOM and INNER BOOM control levers to position inner boom as low as possible and support the outer boom at both ends.
 3. Identify and remove hose connections at inner boom hoist cylinders. Cap or plug all open hydraulic fittings.
 4. Position a fabric sling of adequate capacity around one inner boom cylinder and cinch sling near rod end such that sling will lift cylinder in vertical position. Hook sling on hoist and raise hoist to tension the sling.
 5. Remove retaining bolt from rod end of cylinder. Use pry bar to remove pin from inner cylinder.
 6. Remove retaining bolt and keeper plate from piston end of cylinder. With aid of a heavy sledge hammer and pin driving tool, drive piston end pin from the mast. Position cylinder on a firm work support.
- Repeat steps 4, 5 and 6 for opposite side.
7. Reverse procedure for reassembly. Torque threaded fasteners per Torque Data Charts on page 5-2 or 5-3.
 8. Start the crane and slowly cycle inner boom hoist cylinder out and in with no load to purge air from the system.
 9. After the air has been purged from the system, check the reservoir oil level and top off if necessary.

3-22. INNER BOOM -REMOVAL AND REPLACEMENT

1. Remove outer boom as per above.
2. Operate OUTER BOOM hoist control lever to retract the cylinder. If desired, remove outer boom hoist cylinder from inner boom.
3. Operate INNER BOOM control lever to lower the inner boom point to firm contact on ground. A block between the boom and ground is desirable.
4. Identify and disconnect hydraulic hoses running between outer boom and inner boom. Cap or plug all open hydraulic fittings.
5. Disconnect rod ends of inner boom hoist cylinders. Position a block for cylinders to rest against. Be careful not to pinch or pull hydraulic hoses.
6. Position 2 fabric slings of adequate capacity around inner boom and cinch slings on opposite sides of center of gravity. Hook slings on hoist and raise hoist to tension the sling.
7. Remove cap screw and retainer from inner boom pivot pin. With aid of a heavy sledge hammer and pin driving tool, remove the inner boom and lay down on a firm work support.

3-23. ROTATION MOTOR, COUNTERBALANCE VALVE AND BRAKE - REMOVAL AND REPLACEMENT

1. Shut down hydraulic system to ensure there is no pressure in the system.
2. Remove the two input/output hoses and three drain hoses connected to the counterbalance valve.
3. Remove the four counterbalance valve mounting bolts, being careful to cover parts with clean rags to prevent contamination.
4. Remove the two hydraulic motor mounting cap screws and carefully remove the motor.
5. For removal of the hydraulic brake, remove the two cap screws (longest ones in the mounting flange) and remove the brake assembly.
6. Installation is the reverse of the steps above. Be sure the mounting bolts for all three items are torqued to the correct specification.

CAUTION

ALWAYS IDENTIFY EACH HYDRAULIC HOSE BEFORE REMOVAL TO ENSURE PROPER HOOKUP TO NEW COMPONENTS.

3-24. 'KICKOUT' A-FRAME OUTRIGGER CYLINDER- REMOVAL AND REPLACEMENT

1. Retract outrigger completely.
2. Attach a fabric sling under pin boss of outrigger leg and another around and through rubber bumper bracket.
3. Remove hydraulic hoses from cylinder and mark each for reconnection. Cap all ports and fittings to prevent dirt from entering system.
4. Tension the slings to remove all slack and to support weight of outrigger assembly. Remove outrigger link/outrigger leg pin.
5. Before removal of outrigger arm/base (top) pin, raise the outrigger arm to a horizontal position using the two previously attached slings. Remove the top pin and carefully move the outrigger assembly to a workbench in a workshop environment and place in a horizontal position.

6. Remove the pin securing the outrigger pad to the outrigger leg which also passes through the cylinder case pin boss. Place the pad aside. The cylinder may now be pulled from the outrigger tubes, while being careful not to drop the cylinder.
7. Reverse the previous process to reassemble. Torque threaded fasteners per the Torque Data Chart.
8. With all hydraulic fittings secured, start crane and cycle the cylinder with no load to purge air from system.
9. Check reservoir oil level and top off if necessary.

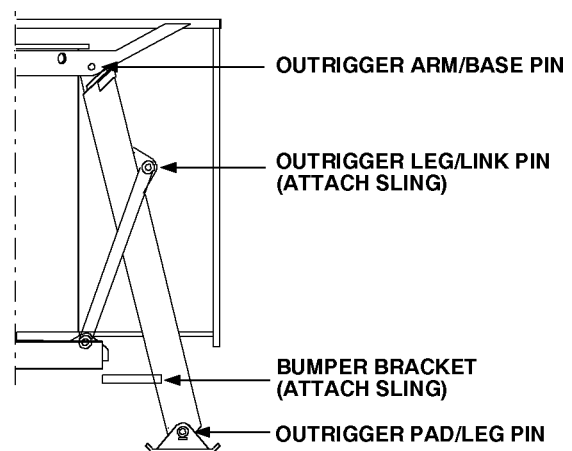


FIGURE C-9. 'KICKOUT' A-FRAME OUTRIGGER REFERENCE

SECTION 3A. CYLINDER REPAIR

TOOLS REQUIRED

Use the following tools in the disassembly and repair of IMT cylinders:

PLASTIC AWL

FOR SEAL REMOVAL AND REPLACEMENT.

PLASTIC/RUBBER HAMMER

USED TO REMOVE WAFER LOCK FROM ROD.

SPANNER WRENCH ATTACHMENT

ATTACH TO A STANDARD TORQUE WRENCH TO TORQUE OR REMOVE CYLINDER HEADS AND PISTONS. SEE CHART AT END OF SECTION TO SELECT ATTACHMENT FOR YOUR PARTICULAR CRANE.

O-RING / ROD SEAL INSTALLATION TOOL

USED TO INSTALL / REMOVE O-RINGS & SEALS. MEASURE ROD DIA. TO SELECT CORRECT TOOL.

IMT PART #	ROD DIA.
79075110	0.75 - 1.5 "
79075111	1.5 - 2.0"
79075112	2.0 - 3.0"

WARNING

REPLACE ALL SEALS WHENEVER THE CYLINDER IS DISASSEMBLED. FAILURE TO DO SO CAN CAUSE DEATH, SERIOUS INJURY OR EQUIPMENT DAMAGE. REFER TO CRANE PARTS MANUAL FOR CYLINDER SEAL KIT PART NUMBERS.

WARNING

FLAMMABLE CLEANING SOLVENTS POSE FIRE AND HEALTH HAZARDS. READ AND OBEY THE INSTRUCTIONS ACCOMPANYING ANY SOLVENTS. KEEP A SUITABLE FIRE EXTINGUISHER PRESENT WHENEVER USING FLAMMABLE SOLVENTS. USE SOLVENTS IN A WELL VENTILATED AREA. IGNORING THESE WARNINGS WILL CAUSE SERIOUS INJURY OR DEATH. IMT RECOMMENDS USING AN ALKALINE CLEANER.

WARNING

DO NOT USE COMPRESSED AIR TO ASSIST IN WITHDRAWING THE PISTON/ROD ASSEMBLY. COMPRESSED AIR MAY PROPEL THE PISTON/ROD ASSEMBLY OUT OF THE CYLINDER AND MAY CAUSE SERIOUS INJURY OR DEATH.

CAUTION

WHEN SOLVENT IS USED TO CLEAN THE INTERNAL CYLINDER COMPONENTS, ALL TRACES OF SOLVENT MUST BE REMOVED. ANY RESIDUE WILL DAMAGE THE SEALS.

3A-1. CYLINDER DISASSEMBLY

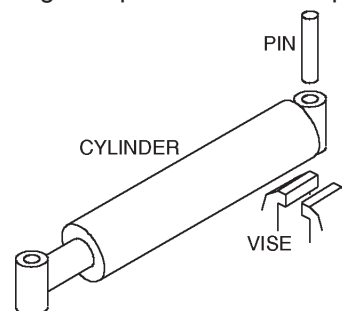
These instructions apply to inner, outer, extension and outrigger cylinders.

1. Thoroughly wash the exterior of the cylinder case. Blow dry with compressed air. Avoid lodging chunks of material in oil passages.

NOTE

AFTER THE CASE HAS BEEN WASHED, PROCEED WITH DISASSEMBLY IN A CLEAN ENVIRONMENT WHICH IS FREE OF DUST AND DIRT.

2. Place the cylinder on a flat surface near a vise. Slip a pin through the pin boss and clamp the pin in a vise.



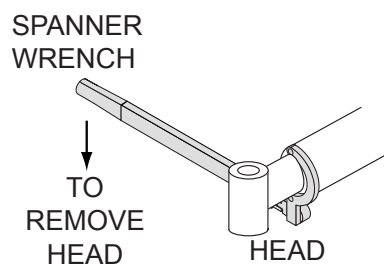
WARNING

RELEASE PRESSURE ON THE CYLINDER. FOR CYLINDERS WITH HOLDING VALVES, SLOWLY UNSCREW VALVES UNTIL PRESSURE IS RELIEVED, THEN REMOVE VALVE. FOR CYLINDERS WITHOUT HOLDING VALVES, SLOWLY REMOVE PLUGS OR CAPS.

CAUTION

CLAMP ONLY THE PIN. DO NOT CLAMP THE CYLINDER IN A VISE. DOING SO WILL DAMAGE THE CYLINDER.

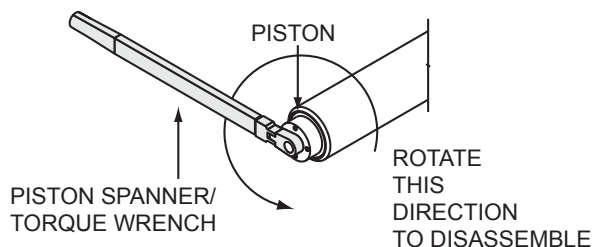
3. Using a spanner wrench, unscrew the head. Withdraw the head from the cylinder case. Pull the rod and piston assembly from the cylinder case using an up-and-down or side-to-side motion. Set the cylinder case to one side.



CAUTION:

DO NOT USE A PIPE WRENCH TO TIGHTEN OR LOOSEN THE HEADS. IT WILL DEFORM THE METAL, DAMAGE THE MATING SURFACES, AND PREVENT PROPER TORQUE MEASUREMENT.

4. Secure the rod pin boss with a pin clamped in the vise. Unscrew the piston using the spanner wrench. Carefully inspect the piston and rod threads for any damage or wear. Replace the part if damaged threads are present.

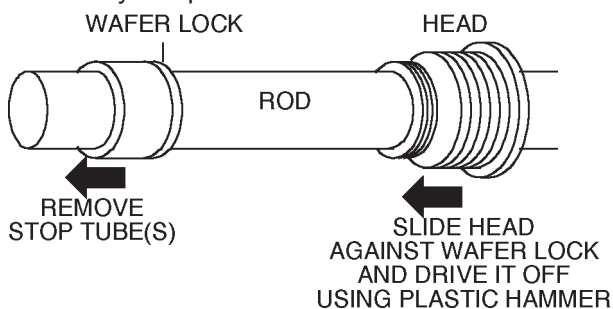
**CAUTION**

DO NOT CLAMP THE ROD IN THE VISE. DAMAGE TO THE ROD WILL RESULT.

CAUTION:

DO NOT USE A PIPE WRENCH TO TIGHTEN OR LOOSEN THE HEADS. IT WILL DEFORM THE METAL, DAMAGE THE MATING SURFACES, AND PREVENT PROPER TORQUE MEASUREMENT.

5. Remove the stop tube(s) from the rod. Slide the head down the rod until it makes solid contact against the wafer lock. Drive the wafer lock from the rod using a plastic hammer against the top of the head. Use only enough force to move the wafer lock while distributing the blows around the head rather than in only one place.



6. Remove the head from the rod.

7. Inspect the cylinder interior and the rod for dents, nicks, scratches, cracks, or other defects which require repair or replacement.

WARNING

REPLACE CRACKED OR DENTED RODS OR CYLINDER CASES!! FAILURE TO DO SO MAY RESULT SERIOUS INJURY, DEATH, OR EQUIPMENT DAMAGE.

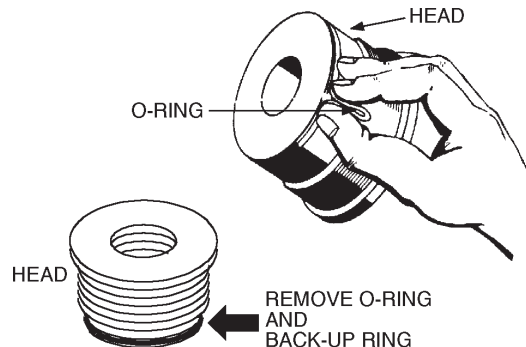
CAUTION

ANY PROTRUSION **WILL** DAMAGE NEW SEALS.

NOTE

FURTHER WORK SHOULD BE PERFORMED IN A WARM ENVIRONMENT OF 70°F OR MORE. THE SEALS WILL BE MORE FLEXIBLE AND EASIER TO MANIPULATE.

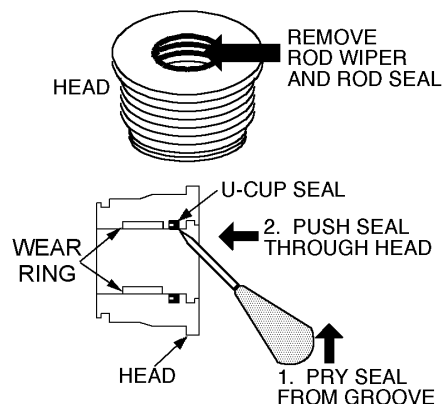
8. Work a slack section into the head seal static o-ring and remove it from its groove. Lift the static back-up ring from the groove using a plastic awl.



9. Position the head on the work surface with the rod wiper at the top.

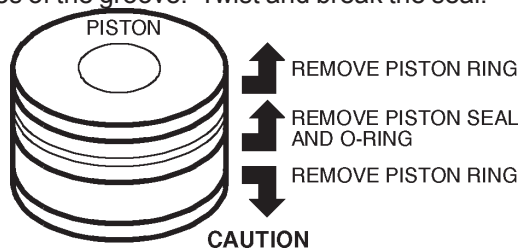
10. Slide the tip of the plastic awl under the rod wiper and remove the rod wiper from the head.

11. Puncture the rod seal using a plastic awl. Pry it out of the groove and push through the head. Remove the rod wear ring(s) using the awl to pry it from the groove and push it through the head.



12. Spread the piston rings/ wear rings and slip them over the lands and off the end of the piston nearest the wear ring.

13. Carefully lift the dynamic piston seal out of its groove using a thin blade. Take care not to nick the edges of the groove. Twist and break the seal.



CAUTION

DAMAGING THE EDGES OF THE GROOVE WILL CAUSE PREMATURE SEAL FAILURE.

14. Remove the companion o-ring and nylon insert using the plastic awl.

15. Attempt to dress any nicks or gouges that may have occurred during disassembly using fine grade emery cloth.

WARNING

REPLACE CRACKED OR DENTED RODS OR CYLINDER CASES!! DO NOT ATTEMPT REPAIRS.

16. Clean all cylinder components before reassembly.

17. See Figure C1-2, Seal Installation Guidelines before replacing seals.

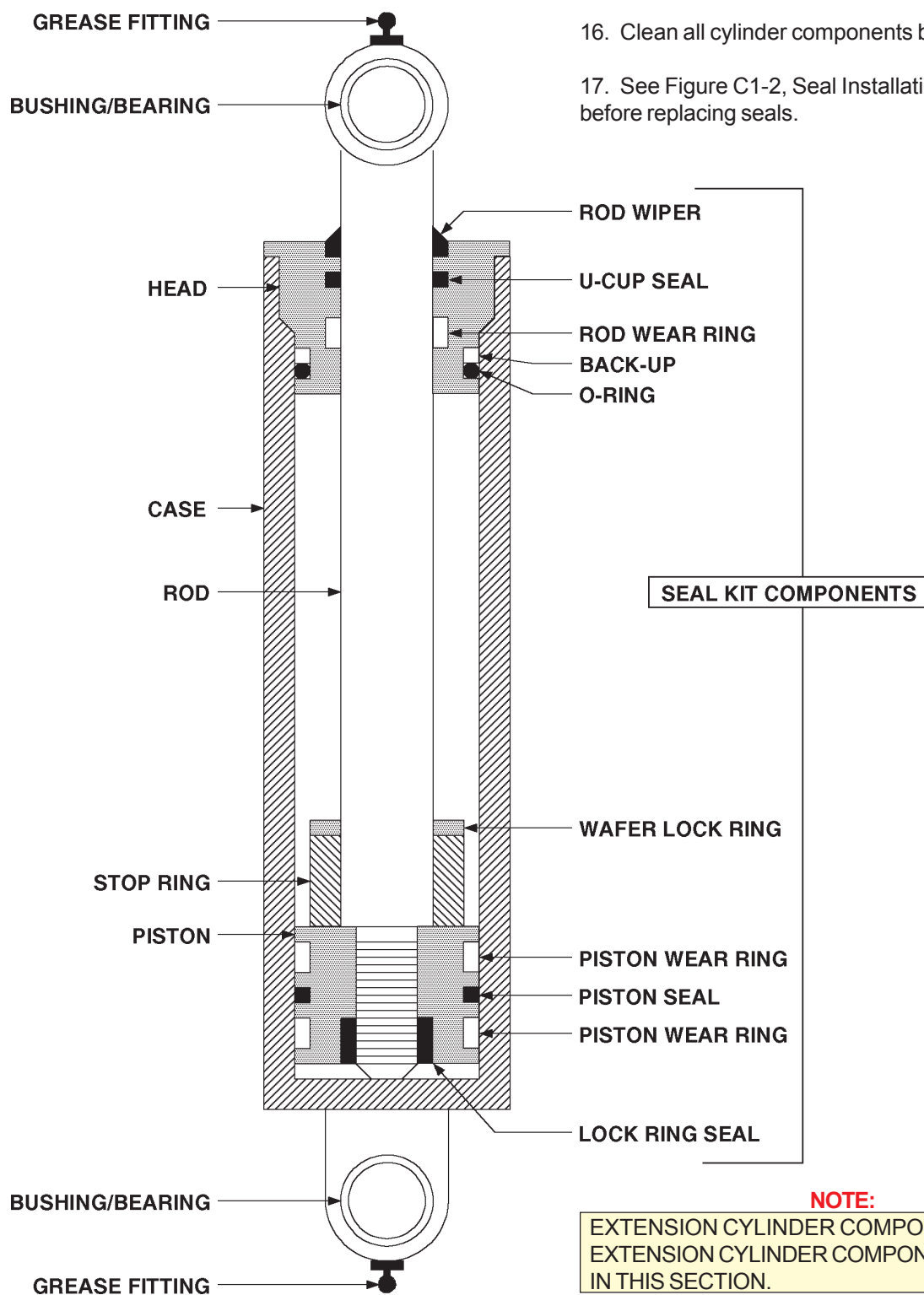


FIGURE C1-1. TYPICAL CYLINDER AND SEAL KIT COMPONENTS

SEAL INSTALLATION GUIDELINES

CAUTION

REPLACE ALL SEALS IN THE SEAL KIT. DOING SO WILL REDUCE EXPENSIVE DOWNTIME IN THE NEAR FUTURE.

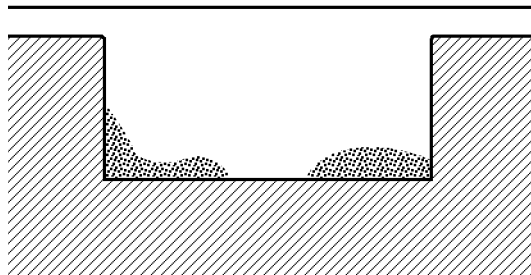
To provide maximum sealing capabilities of cylinder seals, proper installation is required. Improper or careless installation accounts for the failure of seals as much as does wear. The education and training of repair personnel should be a part of any maintenance program.

The installation of seals will vary depending on variations in seal design and whether it slips into an end groove or must snap into a recessed cavity. Whichever variety is to be installed, the following installation guidelines apply:

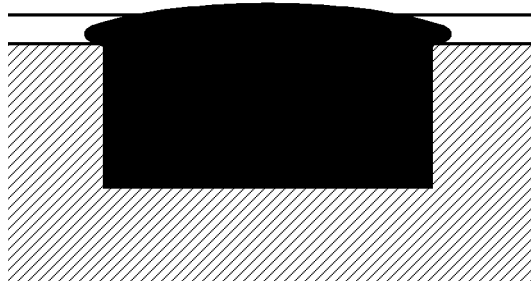
1. Clean the entire sealing device and all surfaces it traverses to its groove of all foreign material. The cleaning method should include a solvent degreasing of the seal, cylinder component and any tools used for installation. After degreasing, all components are to be wiped thoroughly with a clean, lint-free cloth.
2. Lubricate both the seal and its installation path prior to assembly. The lubricant must be selected for compatibility with the seal material and system working fluid. Do not use old or dirty oil which will contain metal particles and other foreign matter. Preferably, use a non-fibrous grease such as Lubriplate.
3. Any nicks or cuts at the seal lip interface or on the groove diameter are potential leak paths when the system is fully pressurized. It is extremely important that all sharp corners which the seal might encounter during installation be dressed. Deburr and polish any area or edge deemed the slightest bit rough or sharp.
4. Make certain all seals and components are replaced. All required seals should be checked-off as installed. The omission of one seal can render the cylinder ineffective.
5. The use of common sense, cleanliness and careful installation is extremely important and can make the difference between a properly working cylinder and one which will require additional maintenance.



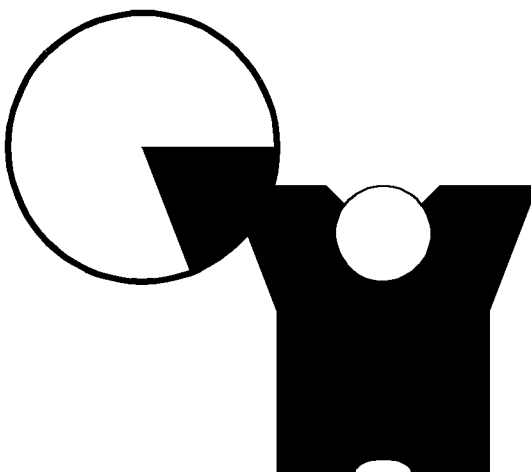
DEBURR AND DRESS ANY SHARP EDGES BEFORE INSTALLING A SEAL.



CHECK SEAL CAVITY FOR THE PRESENCE OF DIRT, METAL CHIPS, OR SCRATCHES. THOROUGHLY CLEAN.



DO NOT USE A SEAL WHICH FITS IMPROPERLY.



INSPECT LIP FOR CLEAN, CONTINUOUS SHARP EDGE.

FIGURE C1-2. SEAL INSTALLATION GUIDELINES

3A-2. CYLINDER ASSEMBLY**NOTE**

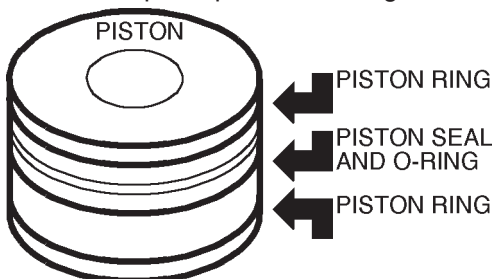
BEFORE ASSEMBLY OF CYLINDER, FAMILIARIZE YOURSELF WITH FIGURE C1-2, SEAL INSTALLATION GUIDELINES.

1. Install the piston seal. Make certain it is free of twists.

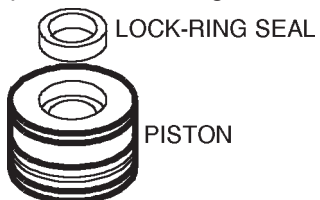
CAUTION

WORK THE PISTON SEAL CAREFULLY INTO POSITION FROM THE TOP OF THE PISTON USING THE ASSEMBLY GROOVE. DO NOT ATTEMPT DOING SO FROM THE BOTTOM OF THE PISTON. YOU MAY SCRATCH IT AND RENDER IT USELESS.

2. Slide the piston wear rings over the lands and allow them to snap into position in the grooves.

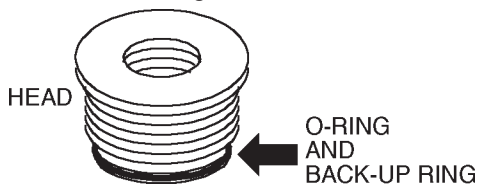


3. Carefully press the lock-ring seal into position.

**CAUTION**

ALWAYS USE A NEW LOCK RING SEAL. A USED OR DAMAGED LOCK RING SEAL MAY PERMIT THE PISTON TO BACK OFF.

4. Install the static back-up and o-ring on the head. Make certain the o-ring is not twisted.



5. Position the head with the rod wiper pocket "down" and insert the rod wear ring into its groove.

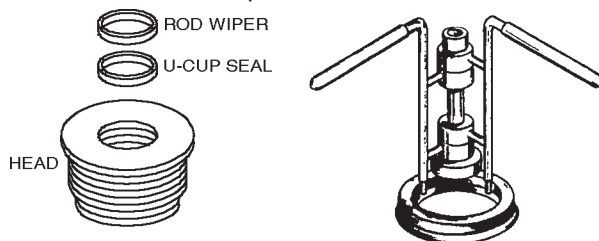


3A-5

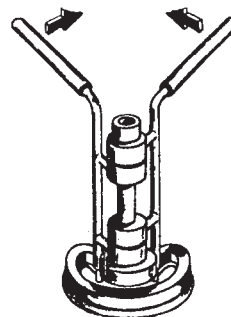
6. Position the head with the rod wiper pocket "up".

7. Using the Rod Seal Installation Tool, install Rod seal as follows:
 - A. Place rod seal on flat surface with seal lip down.

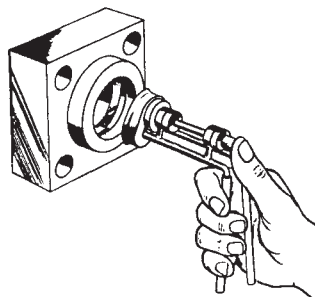
- B. Open tool so that center pin is outside the seal O.D. and the handle pins are inside the I.D.



- C. Rotate handles to deform seal.



- D. Install seal in groove from external end of bore.



- E. Release pressure and remove tool.

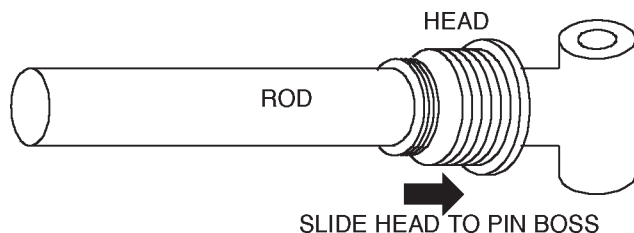
- F. With finger pressure, snap remaining part of seal into groove.

8. Install the rod wiper in the same manner as the rod seal.

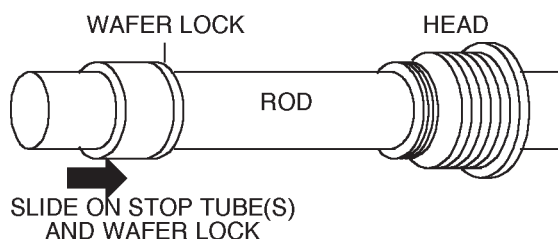
9. Install the wear rings by overlapping the ends to reduce the diameter so they will slide into position.

10. Lubricate the inside diameter of the head with a nonfibrous grease such as Lubriplate.

11. Carefully slide the head onto the rod. Make certain that the rod wiper does not catch on the rod when it is first started. Slide the head all of the way onto the rod and up to the pin boss.



12. Slide the wafer-lock ring and stop tubes onto the rod.



13. Lubricate the entire threaded area of the rod and inside of the piston with non-fibrous grease.

14. Secure the rod in a vise using a pin as was done during disassembly. Screw the piston onto the rod by hand. You should be able to get the piston almost all the way onto the rod before using the spanner wrench.

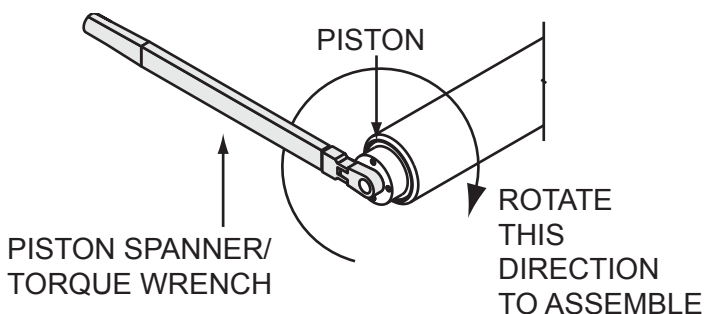
CAUTION

MAKE SURE THAT THE LOCK RING SEAL STAYS IN POSITION. IF IT DOES NOT, LEAKS MAY OCCUR OR THE PISTON MAY BACK OFF, RESULTING IN POOR PERFORMANCE AND POSSIBLE SEPARATION OF THE CYLINDER ASSEMBLY.

15. Using a spanner wrench attachment on a torque wrench, torque the piston onto the rod per the piston torque chart.

PISTON TORQUE CHART

THREAD DIAMETER	TORQUE REQ'MENT
1/2" ID	30- 40 ft-lb
3/4" ID	100-130 ft-lb
7/8" ID	150-180 ft-lb
1-1/16" ID	300-330 ft-lb
1-1/4" ID	500-530 ft-lb
> 1-1/4" ID	710-740 ft-lb



16. Generously lubricate the outside diameter of the head and piston with the non-fibrous grease. Also lubricate the threads and beveled area of the top of the cylinder case.

17. With a side-to-side or up-and-down motion, work the piston into the cylinder past the threads and beveled area at the top of the cylinder case. Avoid allowing the seals to rub across the threads. This will cut them.

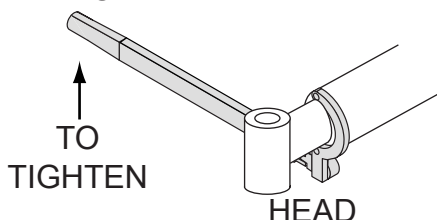
18. Slide the piston into the cylinder. With a rotating motion, work the piston seal and the wear rings past the threads and hand tighten the cylinder head.

19. Secure the cylinder and torque the head per the Head Torque Chart. Use a spanner attachment on a torque wrench to measure the torque.

HEAD TORQUE CHART

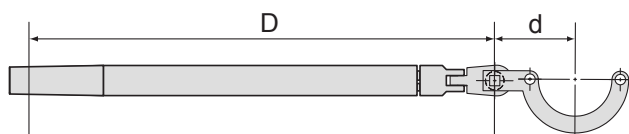
THREAD DIAMETER	TORQUE REQ'MENT
2" OD	200-220 ft-lb
2-1/4" OD	225-245 ft-lb
2-1/2" OD	250-270 ft-lb
3" OD	300-320 ft-lb
3-1/4" OD	325-345 ft-lb
3-1/2" OD	350-370 ft-lb
3-3/4" OD	375-395 ft-lb
4" OD	400-420 ft-lb
4-1/4" OD	425-445 ft-lb
4-1/2" OD	450-470 ft-lb
4-3/4" OD	475-495 ft-lb
5" OD	500-520 ft-lb

SPANNER
WRENCH



NOTE:

CONNECT THE SPANNER WRENCH ATTACHMENT TO THE TORQUE WRENCH AT 90° TO READ THE TORQUE DIRECTLY FROM THE TORQUE WRENCH. IF YOU CONNECT THE ATTACHMENT AT 180° IN A STRAIGHT LINE, YOU MUST CONVERT THE TORQUE. DO NOT CONNECT THE TORQUE WRENCH AT AN ANGLE OTHER THAN 90° OR 180°.



TORQUE CONVERSION FORMULA:

$$\text{ACTUAL TORQUE} = \frac{\text{INDICATED TORQUE}}{\left(1 + \frac{d}{D}\right)}$$

EXAMPLE:

D = Torque wrench handle length

d = 1/2 of pin separation distance + distance from torque wrench mounting hole to first pin hole

Indicated Torque = Torque reading on torque wrench

If D = 18, d = 3, and the Indicated Torque is 360 ft-lb, calculate the Actual Torque using the conversion.

$$1 + d/D = 1 + 3/18 = 1.167$$

$$\text{Actual Torque} = 360 / 1.167 = 308 \text{ ft-lb}$$

20. Install the holding valves and their o-rings. The o-rings must be in good condition and properly positioned.

3A-3. TELESCOPING CYLINDER DISASSEMBLY

WARNING

REPLACE ALL SEALS WHENEVER THE CYLINDER IS DISASSEMBLED. FAILURE TO DO SO CAN CAUSE DEATH, SERIOUS INJURY OR EQUIPMENT DAMAGE.

WARNING

DO NOT USE COMPRESSED AIR TO ASSIST IN WITHDRAWING THE PISTON/ROD ASSEMBLY. COMPRESSED AIR MAY PROPEL THE PISTON/ROD ASSEMBLY OUT OF THE CYLINDER AND MAY CAUSE SERIOUS INJURY OR DEATH.

CAUTION

IF SOLVENT IS USED TO CLEAN THE INTERNAL CYLINDER COMPONENTS, ALL TRACES OF SOLVENT MUST BE REMOVED. ANY RESIDUE WILL DAMAGE THE SEALS.

To disassemble the cylinder:

1. Plug the hose ports and thoroughly wash the exterior of the cylinder case with warm, soapy water. Blow dry with compressed air.

NOTE

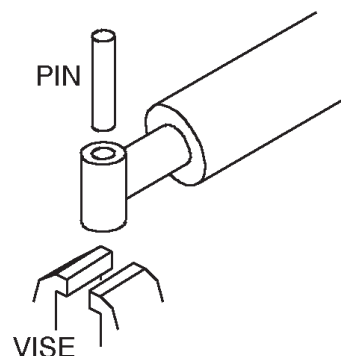
FURTHER WORK SHOULD BE DONE IN A WARM, CLEAN ENVIRONMENT OF 70°F (21°C) OR WARMER.

2. Clamp the 2nd stage mounting ring in a vise and, using a spanner wrench, remove the 2nd stage head. Slide the 2nd stage head/piston/rod assembly out of the 1st stage rod with an up-and-down and side-to-side motion.

NOTE

IT MAY BE NECESSARY TO TAP ON THE MOUNTING RING TO LOOSEN IT FROM THE 1ST STAGE ROD.

3. Slip a pin through the 2nd stage rod pin boss and clamp the pin in a vise. Unscrew the 2nd stage piston from the rod.



4. Slide the head down until it makes contact with the wafer lock ring. Using a plastic mallet, drive the wafer lock from the end of the rod by striking the head.
5. Clamp the 1st stage mounting ring in a vise and unscrew the 1st stage head using a spanner wrench.
6. Work the 1st stage head/piston/rod assembly out of the case using an up-and-down or side-to-side motion.
7. Remove and discard all seals and piston rings. Removal techniques will be similar to that described for single-stage cylinder.

3A-4. TELESCOPING CYLINDER ASSEMBLY

CAUTION

BEFORE BEGINNING ASSEMBLY, DRESS ANY NICKS AND GOUGES WHICH MAY BE PRESENT.

1. Thoroughly clean all cylinder components before reassembly. Wipe clean all parts to remove any solvent residue.

CAUTION

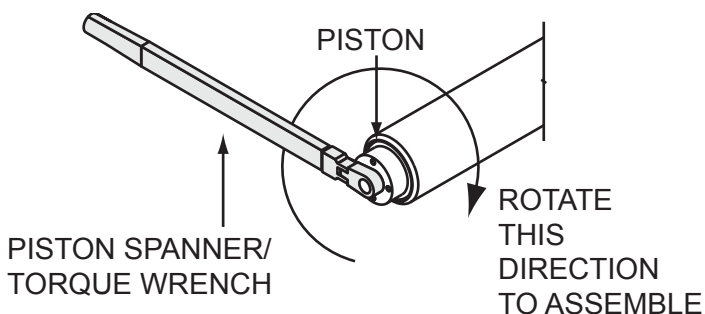
WHEN SOLVENT IS USED TO CLEAN THE INTERNAL CYLINDER COMPONENTS, ALL TRACES OF SOLVENT MUST BE REMOVED. ANY RESIDUE WILL DAMAGE THE SEALS.

2. Install the 1st stage dynamic piston seal and o-ring onto the 1st stage head. Use the assembly groove to make assembly easier. Make certain the o-ring is not twisted.
3. Install the piston rings in their grooves. Work from the end of the piston nearest the respective groove.
4. Install the 2nd stage dynamic piston seal and o-ring onto the 2nd stage piston.
5. Install the lock ring seal in the 2nd stage piston and the o-ring in the 1st stage piston.
6. Install the 1st stage rod wear ring(s), rod seal, rod wiper, static backup and static o-ring in the 1st stage head. Repeat for the 2nd stage head.
7. Liberally apply a coating of a non-fibrous grease such as Lubriplate to the inside of the 1st stage head and slide it over the 1st stage rod.
8. Liberally apply a coating of NEVER-SEEZ to the threaded portion of the piston and the piston end of the 1st stage rod. Hand tighten the piston to the rod.

9. Lubricate the inside of the 2nd stage head and slide it over the 2nd stage rod. Install the mounting ring up to the head.

10. Install the wafer lock ring and stop tube(s) onto the rod. Lubricate the threaded area of the 2nd stage piston and rod with NEVER-SEEZ and hand tighten.

11. Slip a pin through the 2nd stage pin boss and clamp the pin in a vise. Torque the piston per the following chart, using a spanner attachment on a torque wrench.



PISTON TORQUE CHART

THREAD DIAMETER	TORQUE REQ'MENT
1/2" ID	30- 40 ft-lb
3/4" ID	100-130 ft-lb
7/8" ID	150-180 ft-lb
1-1/16" ID	300-330 ft-lb
1-1/4" ID	500-530 ft-lb
> 1-1/4" ID	710-740 ft-lb

12. Liberally lubricate the threaded portion of the 1st stage rod and the outside of the 2nd stage piston with a non-fibrous grease. Work the piston past the threaded area of the rod. Slip the 2nd stage mounting ring over the 1st stage rod. Apply NEVER-SEEZ to the threaded area of the head and rod and then hand tighten.

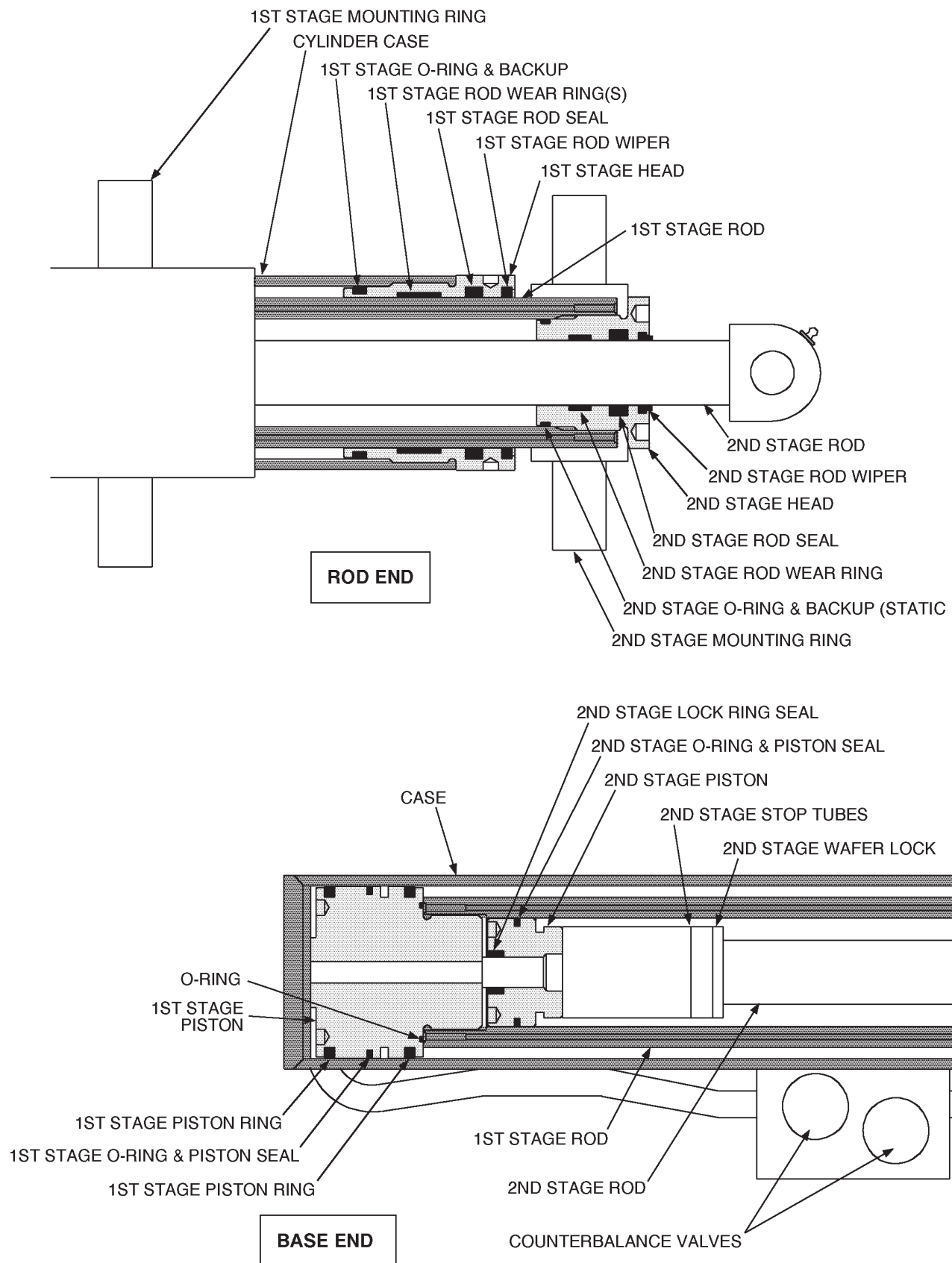


FIGURE C1-3. TELESCOPING EXTENSION CYLINDER COMPONENTS

13. Clamp the 2nd stage mounting ring in a vise and, with a spanner wrench on the 2nd stage head and one on the 1st stage piston, torque both head and piston simultaneously per torque charts.

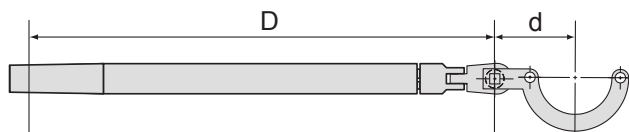
14. Liberally lubricate the outside of the 1st stage piston and the threaded area of the case with a non-fibrous grease. Work the 1st stage piston past the threads and into the case. Apply NEVER-SEEZ to the threads and torque the head per the head torque chart.

HEAD TORQUE CHART

THREAD DIAMETER	TORQUE REQ'MENT
2" OD	200-220 ft-lb
2-1/4" OD	225-245 ft-lb
2-1/2" OD	250-270 ft-lb
3" OD	300-320 ft-lb
3-1/4" OD	325-345 ft-lb
3-1/2" OD	350-370 ft-lb
3-3/4" OD	375-395 ft-lb
4" OD	400-420 ft-lb
4-1/4" OD	425-445 ft-lb
4-1/2" OD	450-470 ft-lb
4-3/4" OD	475-495 ft-lb
5" OD	500-520 ft-lb

NOTE:

CONNECT THE SPANNER WRENCH ATTACHMENT TO THE TORQUE WRENCH AT 90° TO READ THE TORQUE DIRECTLY FROM THE TORQUE WRENCH. IF YOU CONNECT THE ATTACHMENT AT 180° IN A STRAIGHT LINE, YOU MUST CONVERT THE TORQUE. DO NOT CONNECT THE TORQUE WRENCH AT AN ANGLE OTHER THAN 90° OR 180°.



TORQUE CONVERSION FORMULA:

$$\text{ACTUAL TORQUE} = \frac{\text{INDICATED TORQUE}}{\left(1 + \frac{d}{D}\right)}$$

EXAMPLE:

D = Torque wrench handle length

d = 1/2 of pin separation distance + distance from torque wrench mounting hole to first pin hole

Indicated Torque = Torque reading on torque wrench

If D = 18, d = 3, and the Indicated Torque is 360 ft-lb, calculate the Actual Torque using the conversion.

$$1 + d/D = 1 + 3/18 = 1.167$$

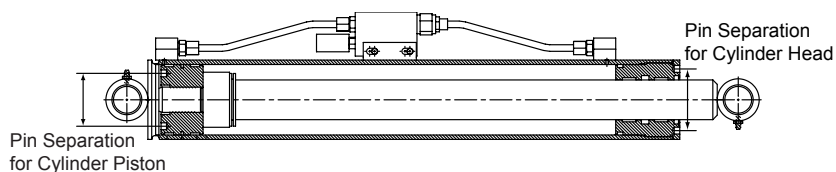
$$\text{Actual Torque} = 360 / 1.167 = 308 \text{ ft-lb}$$

APPENDIX: PISTON & HEAD SPANNER WRENCH ATTACHMENT PART NUMBERS

Use the pin separation distance on the cylinder head or piston to determine the spanner wrench attachment required to torque the head or piston to the correct torque value.

NOTE:

YOU MUST ATTACH THE SPANNER ATTACHMENT TO A STANDARD TORQUE WRENCH.



Piston Pin Separation Distance	Spanner Attachment Part #
1.25"	60125327
1.56"	60125326
2.00" w/ 1/4" holes	60125325
2.00" w/ 3/8" holes	60125323
2.63"	60125322
3.00"	60125321
3.50"	60125320
4.05"	60125319
4.88"	60125318
5.81"	60125317

Head Pin Separation Distance	Spanner Attachment Part #
2.00"	51718092
2.12"	51718093
2.44"	51718094
2.50"	51718095
2.63"	51718096
2.94"	51718097
3.00"	51718098
3.12"	51718099
3.25"	51718100
3.50"	51718101
4.00"	51718102
4.12"	51718103
4.25"	51718104
4.50"	51718105
4.88"	51718106
5.00"	51718107
5.38"	51718108
5.81"	51718109
7.00"	51718110
7.94"	51718111

SECTION 4. CHASSIS PREPARATION FOR INSTALLATION

4-1. GENERAL

This section will provide you with the information necessary to prepare the truck chassis for installation of an IMT frame-mounted hydraulic crane. It contains information regarding PTO and pump installation, and frame reinforcement.

These instructions are intended as a guide to assist you with your particular installation. We cannot cover every make, model and year of truck manufactured worldwide, so these instructions will provide only general information and should be used as a guide only.

For more specific information, the following IMT manuals provide detailed information on subjects which pertain to this section. Also, see your specific crane manual for information specific to your model of crane.

MINIMUM CHASSIS SPECIFICATIONS

For mounting of IMT Truck mounted cranes

Domestic Version - 99900765

Metric Version - 99900764

Instructions and calculations for determining suitable truck frame strength. Also minimum chassis specifications for most IMT cranes.

HYDRAULIC PUMP SELECTION GUIDE

99900698

An aid in the selection of hydraulic pumps for use with cranes and compressors.

PROPORTIONAL REMOTE CONTROL

(Using HED Amp Driver)

99900339

Proportional remote controls as applies to IMT cranes with control kit schematics, conversion kits, cable assemblies and handle assemblies. Also Amp Driver replacement information and crane application charts.

4-2. CHASSIS PREPARATION

Prior to installing the crane, there are certain steps that must be taken to ensure proper installation.

1. Inspect the carrier vehicle to be certain it complies with the minimum chassis specifications given in the Specifications section of Volume 2.
2. Chassis frame must be clear of all obstructions where the crane will rest on the frame. Refer to the Specifications section of Volume 2 for mounting space requirements. Space will be available for gas tanks, etc. after the crane is installed.

NOTE

THE ACTUAL MOUNTING SPACE WILL BE DETERMINED BY THE HEIGHT OF THE CAB. IN ORDER TO PROVIDE CLEARANCE FOR AN ANGLED MAST, THE HIGHER THE CAB, THE GREATER THE MOUNTING SPACE REQUIRED.

3. Install the PTO according to the PTO manufacturer's instructions (paragraph 4-3-1).
4. Install the pump (paragraph 4-3-2 or 4-3-3). Make sure that the pump rotates in the proper direction and tighten the pump mounting bolts.
5. Install the suction-line filter below the top of the truck frame and within 48" (121.9cm) of the pump. Locate it so the vacuum gauge can be read and the filter easily serviced.
6. Spray paint all unpainted surfaces.

4-2-1. FRAME STRENGTH

In order to prevent the overstressing of a truck frame by loads imposed on it by a crane (and its load) it is important to select the proper truck frame. It is also possible, and sometimes necessary, to reinforce the frame. IMT Specification Sheets will specify the RBM (Resistance to Bending Moment) required of a frame for each specific crane model. RBM is a figure of relative strength of a specific frame which is made of a specific grade of steel. RBM is calculated by the multiplication of Frame Section Modulus (in³) by Frame Yield Strength. A frame having a Section Modulus of 10 in³ and made of 50,000 psi steel will have a RBM of 500,000 in-lbs.

4-2-2. FRONT MOUNTED CRANE APPLICATION

The minimum specified RBM value of the crane application must be maintained throughout the entire length of the chassis frame. This can be accomplished by the original chassis frame rails, by adding reinforcement, or by adding subframe. Frame reinforcement must run, as a minimum, from the back of the front shackle to the front of the rear shackle.

4-2-3. REAR MOUNTED CRANE APPLICATION

The minimum specified RBM value of the crane application must be maintained throughout the entire length of the chassis frame. This can be accomplished by the original chassis frame rails, by adding reinforcement, or by adding subframe.

When a rear mount crane application occurs, the following recommendations must be followed to insure maximum stability:

1. Mount the crane as near the rear tires as possible.
2. Any crane having a capacity which exceeds 95,000 ft-lbs should have auxiliary front stabilizers and a torsional sub-frame which connects the rear mounted crane with the front stabilizers.

The torsional sub-frame can be connected to the auxiliary outriggers and crane by welding or by using threaded fasteners. The sub-frame shall be connected to the chassis frame rails by means of shear plates. See Figure D-1.

4-2-4. FRAME REINFORCEMENT

If chassis does not meet minimum RBM requirements listed in the Specifications section in Volume 2, it must be reinforced. See Figure D-2.

CAUTION

IMT DOES NOT RECOMMEND THE USE OF ANY CHASSIS NOT MEETING THE MINIMUM CHASSIS SPECIFICATIONS. THESE INSTRUCTIONS ARE INTENDED FOR THOSE USERS WHO INSIST ON USING A CHASSIS NOT MEETING RBM REQUIREMENT.

NOTE

REFER TO MINIMUM CHASSIS SPECIFICATIONS MANUAL, DOMESTIC VERSION P/N 99900765 OR METRIC VERSION P/N 99900764 FOR ADDITIONAL INFORMATION ON CHASSIS REINFORCEMENT.

NOTE

USE THE SAME TYPE OF MATERIALS AS ARE FOUND IN THE TRUCK FRAME.

4-2

1. Strip truck frame of all steps, tanks, etc. which are attached between the front of the rear spring hanger and the back of the front spring hanger.
2. Clamp a 3/8" thick x 12" wide (0.95cm x 30.4cm) plate to the outside of the truck frame channel and full length between the front spring hanger and the rear spring hanger. Use heavy-duty "C" clamps to secure the plate tight against the frame.
3. Where possible, drill the plate and install the original bolts.

NOTE

SOME BOLTS MAY HAVE TO BE LONGER TO COMPENSATE FOR ADDED THICKNESS OF THE PLATE. MAKE CERTAIN THAT THE REPLACEMENT BOLTS ARE THE SAME GRADE AS THOSE BEING REPLACED.

4. Weld fishplate to "L" reinforcing angles (Figure D-2). Use a 3/8" fillet weld for 6" (14.2cm) and then skip 12" (30.5cm).

WARNING

DO NOT WELD ON HIGH-TENSILE FRAMES. THE HEAT GENERATED BY WELDING WILL CAUSE STRUCTURAL DAMAGE TO THE FRAME RESULTING IN FRAME FAILURE. BOLT FISHPLATE TO FRAME USING PATTERN IN FIGURE D-2. USE 3/4-10 GRADE 6 OR 8 BOLTS, HARDENED FLAT WASHERS BOTH SIDES AND SELF-LOCKING NUTS. TORQUE TO 280 FT-LBS (38.8 KG-M) FOR GRADE 6 OR 296 FT-LBS (40.9 KG-M) FOR GRADE 8.

5. Included with frame mounted crane installation kits are four frame support weldments which fit between the upper and lower frame flanges. See your crane manual for installation instructions for these supports.

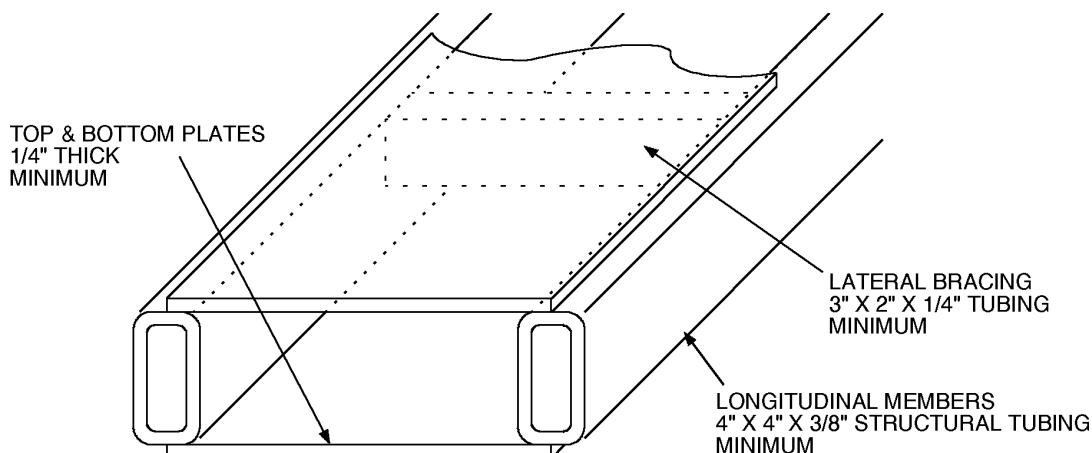
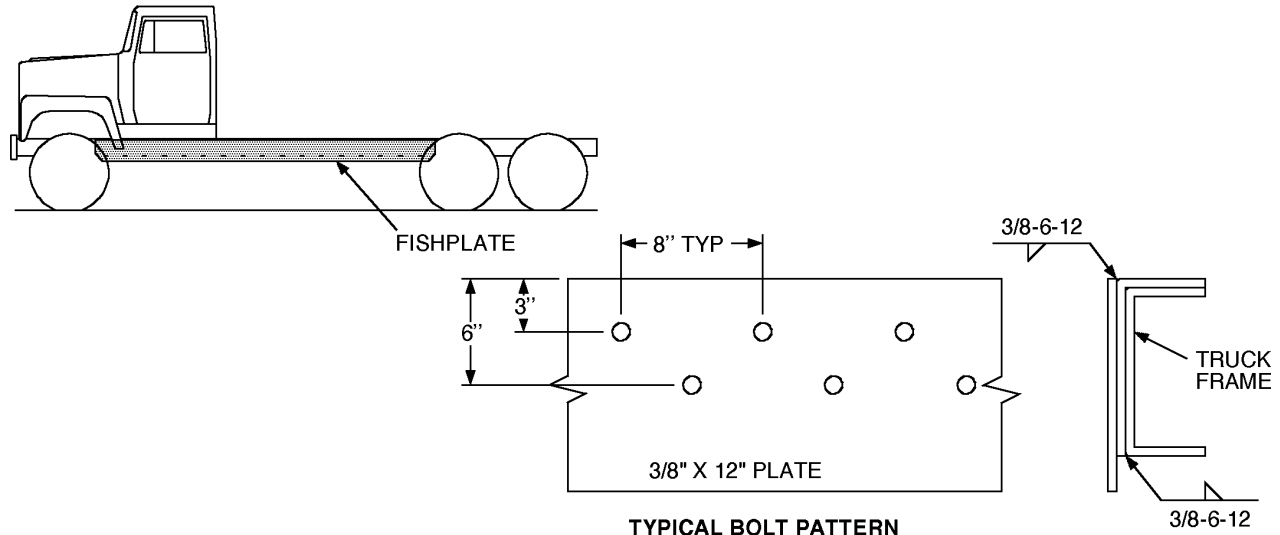


FIGURE D-1. TYPICAL TORSIONAL SUB-FRAME

FIGURE D-2. FRAME REINFORCEMENT

4-3. PTO AND PUMP

4-3-1. PTO INSTALLATION

A Power Take Off (PTO) must be properly matched to the vehicle's transmission as well as the requirements of the crane. In order to properly select a PTO the following information will be needed.

1. Make and model of transmission in the carrier vehicle.
2. Power requirements of the crane being driven.
3. Necessary PTO speed.
4. Direction in which the PTO must turn.
5. PTO torque required.

If possible, use a hydraulic pump directly mounted to the PTO. This will eliminate an auxiliary driveshaft and is easier to install by eliminating driveline angle and phasing errors. It is also quieter operating and should require less maintenance since driveline lubrication will not be necessary.

PTO manufacturers provide specific installation instructions with their products. Their instructions should be followed when installing the PTO. The following steps are provided as an introduction to the installation.

NOTE

IT MAY BE NECESSARY TO REMOVE AND MODIFY EXHAUST COMPONENTS TO PROVIDE SPACE FOR PTO CLEARANCE.

1. Chock the wheels of the vehicle.
 2. Secure any part attached to or on the vehicle which could move or pose a hazard.
 3. Run the engine and transmission in a well ventilated area. Listen for noises which indicate any engine/transmission problems. The engine and transmission should be in good operating condition before the installation of the PTO.
 4. Familiarize yourself with the PTO manufacturer's installation instructions, warnings and precautions.
 5. After the engine and transmission have cooled, drain the transmission fluid. Check the fluid for signs of damage, such as metal chips, etc.
- Do not reuse the transmission fluid unless the vehicle is new. Recycle or dispose of the fluid in a responsible manner.
6. With vehicle engine "OFF", visually inspect transmission for gear damage or foreign particles lodged between gear teeth.
 7. Remove the PTO from its shipping container and inspect for any foreign objects which may have lodged in the PTO cavity.
 8. Mount the PTO per manufacturer's instructions.
 9. Check backlash per manufacturer's specifications.
 10. Refill the transmission with manufacturer's recommended lubricant to the proper level.
 11. Install the shifter cable to suit conditions. Always allow a slight overshift on lever or knob to make certain PTO is fully engaged.

CAUTION

AVOID SHARP BENDS IN THE SHIFTER CABLE. ALL BENDS SHOULD HAVE A MINIMUM 6" RADIUS. TIGHTER BENDS CAUSE DIFFICULT OPERATION OF THE SHIFTER CABLE.

12. Affix all safety and operation decals to the vehicle.

13. Start the engine, engage the PTO and allow to run for 5 to 10 minutes. Check for leaks, unusual noise and proper operation.

14. Check PTO mounting bolts for proper torque as specified by manufacturer.

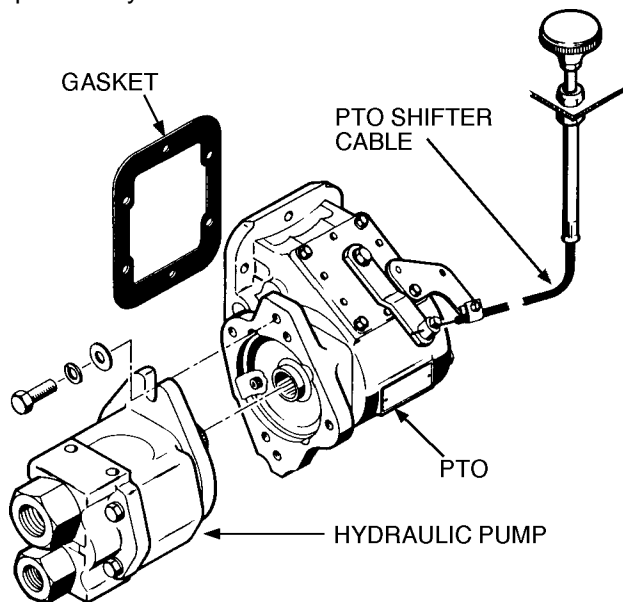


FIGURE D-3. PTO/PUMP INSTALLATION

4-3-2. PUMP INSTALLATION

Install the pump as follows:

1. Check pump rotation and bolt the pump to the PTO. Torque the mounting bolts per Torque Data Chart.
2. Install adapters in the pump inlet and outlet. Use a thread sealer and adequately tighten fittings to prevent leakage. These will vary in size dependent on pump and hose fitting size required.
3. If the pump is mounted directly to the PTO and the weight of the pump exceeds 40 lbs (18 kgs), a bracket must be installed to support the rear of the pump. Install the bracket in a manner which supports the pump from the transmission, not the chassis frame.



4-3-3. DRIVELINE APPLICATION

When the use of a direct mounted pump/PTO is not feasible, an auxiliary driveshaft may be used. To select the auxiliary driveshaft for your installation, consider the following:

1. The driveshaft must be able to transmit the necessary torque and RPM required. Applications operating at less than 1200 RPM may use a driveshaft constructed of solid bar stock. More demanding applications will require tubular shafts.
 2. Auxiliary driveshaft breakage and personal injury can be avoided by not exceeding the critical speed of the selected driveshaft. Critical speed is calculated using operating RPM, shaft material and diameter, and installed centerline to centerline length. Consult the driveshaft manufacturer's instructions for specific information.
- Normally, if calculations indicate a problem, the use of multiple shafts and support bearings is recommended.
3. The careful installation of a driveshaft with concern for recommended driveline angles will minimize vibration and provide trouble-free operation.
 4. The driveshaft must be capable of absorbing any shock loads which may develop.
 5. The driveshaft must be capable of varying its length during installation and while transmitting torque. This is referred to as "slip movement".
 6. NEVER exceed the torque, length, angularity and RPM limits specified by the manufacturer.
 7. Only trained personnel using driveshaft assembly equipment should fabricate a driveshaft.
 8. Tubular driveshafts must be balanced.

Driveshaft installation must be performed by competent, knowledgeable personnel, following manufacturer's instructions. Following are some guidelines to installation:

WARNING

PLACE DRIVESHAFT IN AN UNEXPOSED OR SHIELDED POSITION TO HELP PREVENT ACCIDENTAL ENTANGLEMENT. FABRICATION OF A SHIELD OR FENCE TO ISOLATE ROTATING DRIVESHAFTS WILL HELP PREVENT PERSONAL INJURY OR DEATH.

1. Install the PTO per manufacturer's instructions.
2. Loosely bolt the pump mounting bracket to the adjustable bracket.
3. Bolt the adjustable bracket to the truck frame at a point not exceeding 48" (121.9cm) from PTO and where it will not produce a joint angle greater than that recommended by the manufacturer.
4. Check pump rotation and install pump, pump end yoke and PTO end yoke.

WARNING

The installer of the driveline must inspect the final position of the driveline to determine whether its location provides sufficient protection to an operator, or other personnel, from hazards associated with a rotating driveline. If protection is insufficient, the installation of a guard is required. If you are unsure of methods to guard a rotating driveline, call Iowa Mold Tooling Co., Inc. for instructions. Failure to do so may result in serious injury or death.

! DANGER

CONTACT WITH A ROTATING DRIVELINE
WILL CAUSE

**DEATH OR SERIOUS INJURY
KEEP AWAY**

- Keep clear of rotating drive shaft.
- Never work on or near an installed power take-off or driveline with the engine running.

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4-5

5. If a setscrew protrudes above end yoke hub, replace it with a recessed allen-head set screw.

WARNING

A PROTRUDING SET SCREW OR OTHER HARDWARE IS HAZARDOUS TO PERSONNEL. WHEN THE DRIVESHAFT IS SPINNING, IT PROVIDES A HOOK TO SNAG CLOTHING, SKIN AND HAIR, RESULTING IN PERSONAL INJURY OR DEATH.

6. Size, cut and weld the driveline per manufacturer's instructions.
7. Install driveline and lock set screws, torquing all fasteners as recommended.
8. Lubricate driveshaft per manufacturer's recommendations.

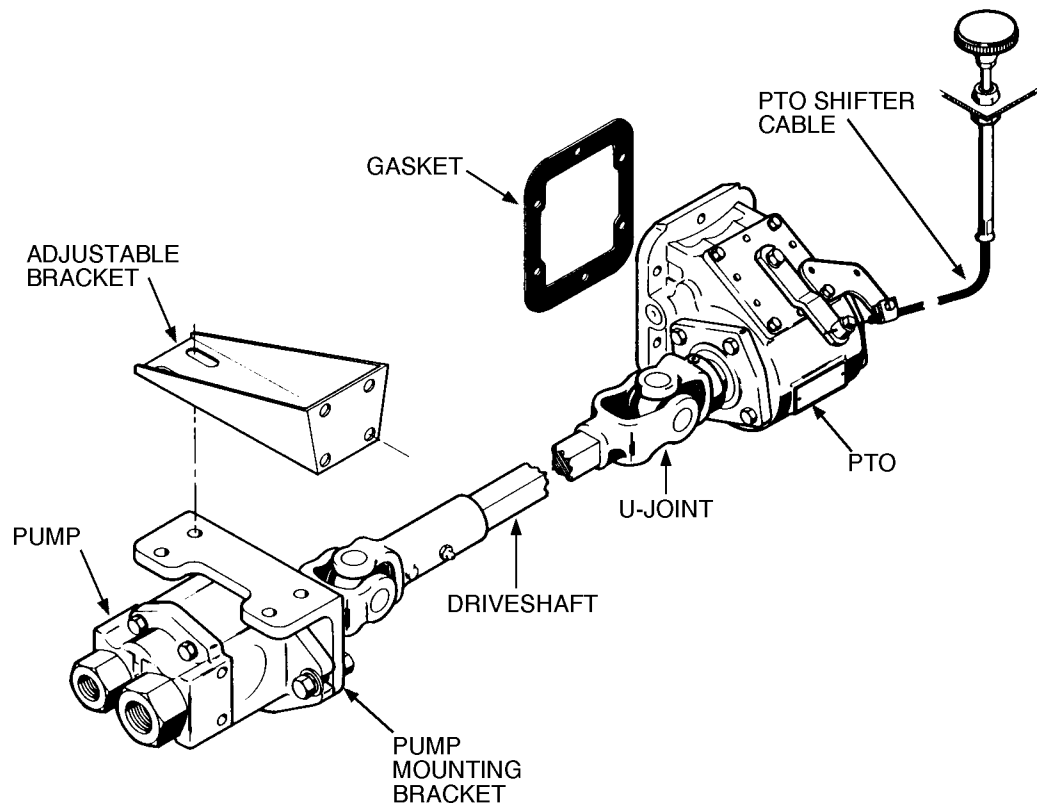


FIGURE D-4. DRIVELINE APPLICATION

NOTICE

The user of this form is responsible in determining that these inspections satisfy all applicable regulatory requirements

OWNER/COMPANY

CONTACT PERSON

CRANE MAKE & MODEL

CRANE SERIAL NUMBER

UNIT I.D. NUMBER

LOCATION OF UNIT

Inspection Checklist**CRANES****1**

REV: 6-18-99

TYPE OF INSPECTION (check one)

☐

DAILY (if deficiency found)

☐

QUARTERLY

☐

MONTHLY

☐

ANNUAL

DATE INSPECTED

HOUR METER READING (if applicable)

INSPECTED BY (print)

SIGNATURE OF INSPECTOR

TYPE OF INSPECTION**NOTES:**

Daily and monthly inspections are to be performed by a "designated" person, who has been selected or assigned by the employer or the employer's representative as being competent to perform specific duties.

Quarterly and annual inspections are to be performed by a "qualified" person who, by possession of a recognized degree in an applicable field or certificate of professional standing, or who, by extensive knowledge, training and experience has successfully demonstrated the ability to solve or resolve problems related to the subject matter and work.

One hour of normal crane operation assumes 20 complete cycles per hour. If operation exceeds 20 cycles per hour, inspection frequency should be increased accordingly.

Consult Operator / Service Manual for additional inspection items, service bulletins and other information.

Before inspecting and operating crane, crane must be set up away from power lines and leveled with outriggers fully extended.

DAILY (D): Before each day of operation, those items designated with a **(D)** must be inspected. This inspection need not be recorded unless a deficiency (**(X)**) is found. If the end user chooses to record all daily inspections and those daily inspections include the monthly inspection requirements, there would be no need for a separate monthly inspection.

MONTHLY (M): Monthly inspections or 100 hours of normal operation (which ever comes first) includes all daily inspections plus items designated with an **(M)**. This inspection must be recorded.

QUARTERLY (Q): Every three to four months or 300 hours of normal operation (which ever comes first) includes all daily and monthly inspection items plus items designated with a **(Q)**. This inspection must be recorded.

ANNUAL (A): Each year or 1200 hours of normal operation (which ever comes first) includes all items on this form which encompasses daily, monthly and quarterly inspections plus those items designated by **(A)**. This inspection must be recorded.

FREQUENCY	ITEM	KEY	✓ = SATISFACTORY ✗ = DEFICIENCY (must be corrected prior to operation)	R = RECOMMENDATION (should be considered for corrective action) NA= NOT APPLICABLE	STATUS ✓ , ✗ R, NA
			INSPECTION DESCRIPTION		
D	1	Labels	All load charts, safety & warning labels, & control labels are present and legible.		
D	2		Check all safety devices for proper operation.		
D	3	Controls	Control mechanisms for proper operation of all functions, leaks & cracks.		
D	4	Station	Control and operator's station for dirt, contamination by lubricants, & foreign materials.		
D	5	Hyd System	Hydraulic system (hoses, tubes & fittings) for leakage & proper oil level.		
D	6	Hook	Presence & proper operation of hook safety latches.		
D	7	Rope	Proper reeving of wire rope on sheaves & winch drum.		
D	8	Pins	Proper engagement of all connecting pins & pin retaining devices.		
D	9	General	Overall observation of crane for damaged or missing parts, cracked welds & presence of safety covers.		
D	10	Operation	During operation, observe crane for abnormal performance, unusual wear (loose pins, wire rope damage, etc.). If observed, discontinue use & determine cause & severity of hazard.		
D	11	Remote Ctrls	Operate remote control devices to check for proper operation.		
D	12	Electrical	Operate all lights, alarms, etc. to check for proper operation.		
D	13	Anti 2-Blocking	Operate anti 2-blocking device to check for proper operation.		
D	14		Other		
D	15		Other		

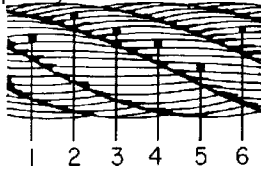
Inspection Checklist**CRANES****2**

FREQUENCY	ITEM	KEY	✓ = SATISFACTORY ✕ = DEFICIENCY (must be corrected prior to operation)	R = RECOMMENDATION (should be considered for corrective action) NA = NOT APPLICABLE	STATUS ✓, ✕, R, NA
			INSPECTION DESCRIPTION		
M	16	Daily	All daily inspection items.		
M	17	Cylinders	Visual inspection of cylinders for leakage at rod, fittings & welds. Damage to rod & case.		
M	18	Valves	Holding valves for proper operation.		
M	19	Valves	Control valve for leaks at fittings & between sections.		
M	20	Valves	Control valve linkages for wear, smoothness of operation & tightness of fasteners.		
M	21	General	Bent, broken or significantly rusted/corroded parts.		
M	22	Electrical	Electrical systems for presence of dirt, moisture & frayed wires.		
M	23	Structure	All structural members for damage.		
M	24	Welds	All welds for breaks & cracks.		
M	25	Pins	All pins for proper installation & condition.		
M	26	Hardware	All bolts, fasteners & retaining rings for tightness, wear & corrosion		
M	27	Wear Pads	Presence of wear pads.		
M	28	Pump & Motor	Hydraulic pumps & motors for leakage at fittings, seals & between sections.		
M	29	PTO	Transmission/PTO for leakage, abnormal vibration & noise.		
M	30	Hyd Fluid	Quality of hydraulic fluid and for presence of water.		
M	31	Hyd Lines	Hoses & tubes for leakage, abrasion damage, blistering, cracking, deterioration, fitting leakage & secured properly.		
M	32	Hook	Load hook for abnormal throat distance, twist, wear & cracks.		
M	33	Rope	Condition of load line.		
M	34	Manual	Presence of operator's manuals with unit.		
M	35		Other		
Q	36	Daily	All daily inspection items.		
Q	37	Monthly	All monthly inspection items.		
Q	38		Condition of wear pads		
Q	39	Rotation Sys	Rotation bearing for proper torque of all accessible mounting bolts.		
Q	40	Hardware	Base mounting bolts for proper torque.		
Q	41	Structure	All structural members for deformation, cracks & corrosion.		
	42		● Base		
	43		● Outrigger beams & legs		
	44		● Mast		
	45		● Inner boom		
	46		● Outer boom		
	47		● Extension(s)		
	48		● Jib boom		
	49		● Jib extension(s)		
	50		● Other		
Q	51	Hardware	Pins, bearings, shafts, gears, rollers, & locking devices for wear, cracks, corrosion & distortion.		
	52		● Rotation bearing(s)		
	53		● Inner boom pivot pin(s) & retainer(s)		
	54		● Outer boom pivot pin(s) & retainer(s)		
	55		● Inner boom cylinder pin(s) & retainer(s)		
	56		● Outer boom cylinder pin(s) & retainer(s)		
	57		● Extension cylinder pin(s) & retainer(s)		
	58		● Jib boom pin(s) & retainer(s)		
	59		● Jib cylinder pin(s) & retainer(s)		
	60		● Jib extension cylinder pin(s) & retainer(s)		
	61		● Boom tip attachments		
	62		● Other		
Q	63	Hyd Lines	Hoses, fittings & tubing for proper routing, leakage, blistering, deformation & excessive abrasion.		
	64		● Pressure line(s) from pump to control valve		
	65		● Return line(s) from control valve to reservoir		
	66		● Suction line(s) from reservoir to pump		
	67		● Pressure line(s) from control valve to each function		
	68		● Load holding valve pipe(s) and hose(s)		
	69		● Other		

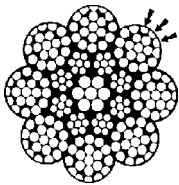
WIRE ROPE INSPECTION

Wire rope with any of the deficiencies shown below shall be removed and replaced immediately.

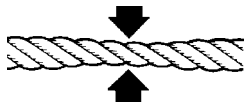
- A. Corrosion can be cause for replacement. Any development of corrosion must be noted and monitored closely.
- B. When there are either 3 broken wires in one strand or a total of six broken wires in all strands in any one rope lay.



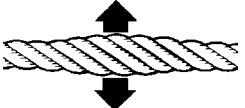
- C. When flat spots on the outer wires appear and those outside wires are less than 2/3 the thickness of the unworn outer wire.



- D. When there is a decrease of diameter indicating a core failure.



- E. When kinking, crushing, birdcaging or other distortion occurs.



- F. When there is noticeable heat damage (discoloration) of the rope by any means.



- G. When the diameter is reduced from nominal size by 1/32" or more.



- H. If a broken wire protrudes or loops out from the core of the rope.

**HOOK INSPECTION**

Hooks having any of the listed deficiencies shall be removed from service unless a qualified person approves their continued use and initiates corrective action. Hooks approved for continued use shall be subjected to periodic inspection.

A. DISTORTION**Bending/Twisting**

A bend or twist exceeding 10° from the plane of the unbent hook.

Increased Throat Opening

HOOK WITHOUT LATCH: An increase in throat opening exceeding 15% (Or as recommended by the manufacturer)

HOOK WITH LATCH: An increase of the dimension between a fully-opened latch and the tip section of the hook exceeding 8% (Or as recommended by the manufacturer)

B. WEAR

If wear exceeds 10% of the original sectional dimension. (Or as recommended by the manufacturer)

C. CRACKS, NICKS, GOUGES

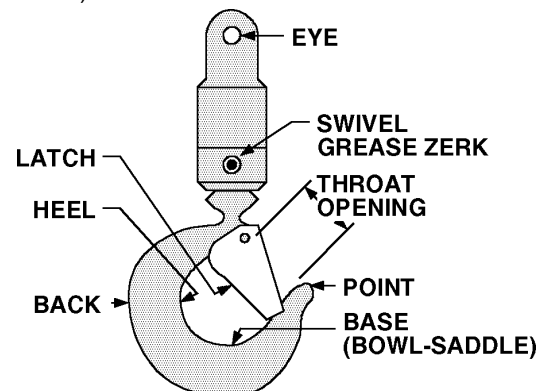
Repair of cracks, nicks, and gouges shall be carried out by a designated person by grinding longitudinally, following the contour of the hook, provided that no dimension is reduced more than 10% of its original value. (Or as recommended by the manufacturer) (A qualified person may authorize continued use if the reduced area is not critical.)

D. LATCH**Engagement, Damage & Malfunction**

If a latch becomes inoperative because of wear or deformation, and is required for the service involved, it shall be replaced or repaired before the hook is put back into service. If the latch fails to fully close the throat opening, the hook shall be removed from service or "moused" until repairs are made.

E. HOOK ATTACHMENTS & SECURING MEANS

If any indication of distortion, wear, cracks, nicks or gouges are present, unless a qualified person authorizes their use. (Or as recommended by the manufacturer)



HOLDING VALVE INSPECTION

The cylinders are equipped with holding valves that prevent sudden movement of the cylinder rods in the event of a hydraulic hose or other hydraulic component failure. The valve is checked in the following manner:

1. With a full rated load, extend the cylinder in question and kill the engine.
2. Operate the control valve to retract the cylinder. If the cylinder "creeps", replace the holding valve. If the cylinder does not "creep", the valve is serviceable.

ANTI-TWO BLOCKING DEVICE INSPECTION

(See Vol. 1, Operation, Maintenance and Repair for a complete description)

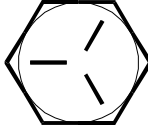

The anti two block system should be checked daily as follows:

1. Examine flexible rod and weight to insure free unrestricted mechanical operation
2. Examine cord for damage, cuts or breaks. Grasp cord and pull to check operation of cord reel. The cord should retract on reel when released.
3. Start vehicle, engage PTO and slowly winch loadline up until anti-two block weight comes in contact with the hook end of the loadline cable. At the moment the weight is fully supported, a marked difference in winch operation should be noted. At this point, the winch up function should become very sluggish or non-functioning and have very little pull capability. Slowly increase truck engine speed while simultaneously actuating the winch up function. The winch characteristics should remain sluggish with little or no tensioning of the cable. If operation other than as described occurs, stop immediately and investigate. Failure to do so will risk damage to the cable or the crane. If all is well at this point, actuate the boom extend function slowly, and gradually increase to full actuation. Once again the function should be sluggish or non-existent with no tightening of the winch cable. If operation other than described occurs, stop immediately and reverse the function.

The final check involves actuating both the winch up and extend functions together and checking for proper operation of the anti two blocking circuit. Once again, start slowly and stop if it appears the cable is being tensioned.

If the anti two block function appears to be functioning normally, winch the cable down until the sensing weight swings free.

COARSE THREAD BOLTS

SIZE (DIA-TPI)	BOLT DIA (INCHES)	TIGHTENING TORQUE			
		 SAE J429 GRADE 5		 SAE J429 GRADE 8	
		PLAIN (FT-LBS)	PLATED (FT-LBS)	PLAIN (FT-LBS)	PLATED (FT-LBS)
5/16-18	0.3125	17	13	25	18
3/8-16	0.3750	31	23	44	33
7/16-14	0.4375	49	37	70	52
1/2-13	0.5000	75	57	105	80
9/16-12	0.5625	110	82	155	115
5/8-11	0.6250	150	115	220	160
3/4-10	0.7500	265	200	375	280
7/8-9	0.8750	395	295	605	455
1-8	1.0000	590	445	910	680
1 1/8-7	1.1250	795	595	1290	965
1 1/4-7	1.2500	1120	840	1815	1360
1 3/8-6	1.3750	1470	1100	2380	1780
1 1/2-6	1.5000	1950	1460	3160	2370

When using the torque data in the charts above, the following rules should be observed.

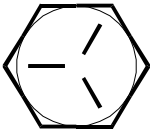
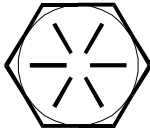
1. Bolt manufacturer's particular specifications should be consulted when provided.
2. Flat washers of equal strength must be used.
3. All torque measurements are given in foot-pounds. To convert to inch-pounds, multiply by 12.
4. Torque values specified are for bolts with residual oils or no special lubricants applied. If special lubricants of high stress ability, such as Never-Seez compound graphite and oil, molybdenum disulphite, colloidal copper or white lead are applied, multiply the torque values in the charts by the factor .90. The use of Loctite does not affect the torque values listed above.
5. Torque values for socket-head capscrews are the same as for Grade 8 capscrews.

WARNING

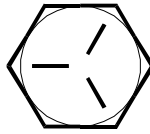
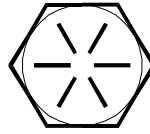
Anytime a gear-bearing bolt is removed, it must be replaced with a new bolt of the identical grade and size. Once a bolt has been torqued to 75% of its proof load and then removed, the torque coefficient may no longer be the same as when the bolt was new thus giving indeterminate clamp loads after torquing. Failure to replace gear-bearing bolts may result in bolt failure due to metal fatigue causing serious injury or DEATH.

TORQUE DATA CHART - DOMESTIC

FINE THREAD BOLTS

SIZE (DIA-TPI)	BOLT DIA (INCHES)	TIGHTENING TORQUE			
		 SAE J429 GRADE 5		 SAE J429 GRADE 8	
		PLAIN (FT-LBS)	PLATED (FT-LBS)	PLAIN (FT-LBS)	PLATED (FT-LBS)
5/16-24	0.3125	19	14	27	20
3/8-24	0.3750	35	26	49	35
7/16-20	0.4375	55	41	78	58
1/2-20	0.5000	90	64	120	90
9/16-18	0.5625	120	90	170	130
5/8-18	0.6250	170	130	240	180
3/4-16	0.7500	300	225	420	315
7/8-11	0.8750	445	325	670	500
1-12	1.0000	645	485	995	745
1 1/8-12	1.1250	890	670	1445	1085
1 1/4-12	1.2500	1240	930	2010	1510
1 3/8-12	1.3750	1675	1255	2710	2035
1 1/2-12	1.5000	2195	1645	3560	2670

COARSE THREAD BOLTS

SIZE (DIA-TPI)	BOLT DIA (INCHES)	TIGHTENING TORQUE			
		 SAE J429 GRADE 5		 SAE J429 GRADE 8	
		PLAIN (FT-LBS)	PLATED (FT-LBS)	PLAIN (FT-LBS)	PLATED (FT-LBS)
5/16-18	0.3125	17	13	25	18
3/8-16	0.3750	31	23	44	33
7/16-14	0.4375	49	37	70	52
1/2-13	0.5000	75	57	105	80
9/16-12	0.5625	110	82	155	115
5/8-11	0.6250	150	115	220	160
3/4-10	0.7500	265	200	375	280
7/8-9	0.8750	395	295	605	455
1-8	1.0000	590	445	910	680
1 1/8-7	1.1250	795	595	1290	965
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When using the torque data in the charts above, the following rules should be observed.

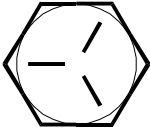
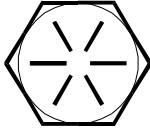
1. Bolt manufacturer's particular specifications should be consulted when provided.
2. Flat washers of equal strength must be used.
3. All torque measurements are given in foot-pounds. To convert to inch-pounds, multiply by 12.
4. Torque values specified are for bolts with residual oils or no special lubricants applied.
If special lubricants of high stress ability, such as Never-Seez compound graphite and oil, molybdenum disulphite, colloidal copper or white lead are applied, multiply the torque values in the charts by the factor .90. The use of Loctite does not affect the torque values listed above.
5. Torque values for socket-head capscrews are the same as for Grade 8 capscrews.

WARNING

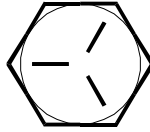
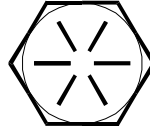
Anytime a gear-bearing bolt is removed, it must be replaced with a new bolt of the identical grade and size. Once a bolt has been torqued to 75% of its proof load and then removed, the torque coefficient may no longer be the same as when the bolt was new thus giving indeterminate clamp loads after torquing. Failure to replace gear-bearing bolts may result in bolt failure due to metal fatigue causing serious injury or DEATH.

TORQUE DATA CHART - METRIC

FINE THREAD BOLTS

SIZE (DIA-TPI)	BOLT DIA (INCHES)	TIGHTENING TORQUE			
					
		SAE J429 GRADE 5		SAE J429 GRADE 8	
		PLAIN (KG-M)	PLATED (KG-M)	PLAIN (KG-M)	PLATED (KG-M)
5/16-24	0.3125	3	2	4	3
3/8-24	0.3750	5	4	7	5
7/16-20	0.4375	8	6	11	8
1/2-20	0.5000	12	9	17	12
9/16-18	0.5625	17	12	24	18
5/8-18	0.6250	24	18	33	25
3/4-16	0.7500	41	31	58	44
7/8-11	0.8750	62	45	93	69
1-12	1.0000	89	67	138	103
1 1/8-12	1.1250	123	93	200	150
1 1/4-12	1.2500	171	129	278	209
1 3/8-12	1.3750	232	174	375	281
1 1/2-12	1.5000	304	228	492	369

COARSE THREAD BOLTS

SIZE (DIA-TPI)	BOLT DIA (INCHES)	TIGHTENING TORQUE			
					
		SAE J429 GRADE 5		SAE J429 GRADE 8	
		PLAIN (KG-M)	PLATED (KG-M)	PLAIN (KG-M)	PLATED (KG-M)
5/16-18	0.3125	2	2	3	2
3/8-16	0.3750	4	3	6	5
7/16-14	0.4375	7	5	10	7
1/2-13	0.5000	10	8	15	11
9/16-12	0.5625	15	11	21	16
5/8-11	0.6250	21	16	30	22
3/4-10	0.7500	37	28	52	39
7/8-9	0.8750	55	41	84	63
1-8	1.0000	82	62	126	94
1 1/8-7	1.1250	110	82	178	133
1 1/4-7	1.2500	155	116	251	188
1 3/8-6	1.3750	203	152	329	246
1 1/2-6	1.5000	270	210	438	328

When using the torque data in the charts above, the following rules should be observed.

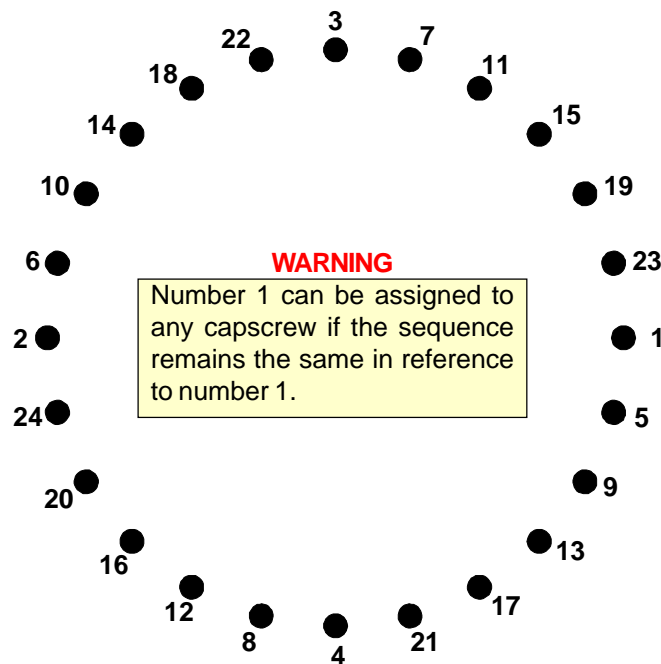
1. Bolt manufacturer's particular specifications should be consulted when provided.
2. Flat washers of equal strength must be used.
3. All torque measurements are given in kilogram-meters.
4. Torque values specified are for bolts with residual oils or no special lubricants applied.
If special lubricants of high stress ability, such as Never-Seez compound graphite and oil, molybdenum disulphite, colloidal copper or white lead are applied, multiply the torque values in the charts by the factor .90. The use of Loctite does not affect the torque values listed above.
5. Torque values for socket-head capscrews are the same as for Grade 8 capscrews.

WARNING

Anytime a gear-bearing bolt is removed, it must be replaced with a new bolt of the identical grade and size. Once a bolt has been torqued to 75% of its proof load and then removed, the torque coefficient may no longer be the same as when the bolt was new thus giving indeterminate clamp loads after torquing. Failure to replace gear-bearing bolts may result in bolt failure due to metal fatigue causing serious injury or DEATH.

TURNTABLE BEARING FASTENER TIGHTENING SEQUENCE

Refer to the diagram below for proper tightening/torquing sequence of the turntable bearing to the crane base and crane mast. The total quantity of cap screws varies dependent on crane model.



TIGHTENING PROCEDURE:

1. Refer to the Torque Data Chart to determine the proper torque value to apply to the size of capscrew used.
2. Follow the tightening sequence shown in the diagram. Note that the quantity of capscrews may differ from the diagram, but the sequence must follow the criss-cross pattern as shown in the diagram.
3. Torque all capscrews to approximately 40% of the specified torque value, by following the sequence.
(EXAMPLE: .40 x 265 FT-LBS = 106 FT-LBS)
(EXAMPLE-METRIC: .40 x 36 KG-M = 14.4 KG-M)
4. Repeat Step 3, but torquing all capscrews to 75% of the specified torque value. Continue to follow the tightening sequence.
(EXAMPLE: .75 x 265 FT-LBS = 199 FT-LBS)
(EXAMPLE-METRIC: .75 x 36 KG-M = 27 KG-M)
5. Using the proper sequence, torque all capscrews to the listed torque value as determined from the Torque Data Chart.

TURNTABLE BEARING INSPECTION FOR REPLACEMENT

Before a bearing is removed from a crane for inspection, one of the following conditions should be evident:

1. Metal particles present in the bearing lubricant.
2. Increased drive power required to rotate the crane.
3. Noise emitting from the bearing during crane rotation.
4. Rough crane rotation.
5. Uneven or excessive wear between the pinion gear and turntable gear.

If none of the above conditions exists, the bearing is functioning properly and need not be replaced. But, if one or more of the above conditions exists, inspection may be required. Limits are measured in "TILT" which is dependent on the internal clearances of the bearing. TILT is the most practical determination of a bearing's internal clearance once mounted on a crane.

Periodic readings indicating a steady increase in TILT may be an indicator of bearing wear. Note that a bearing found to have no raceway cracks or other structural irregularities should be reassembled and returned to service.

TEST PROCEDURE

STEP 1.

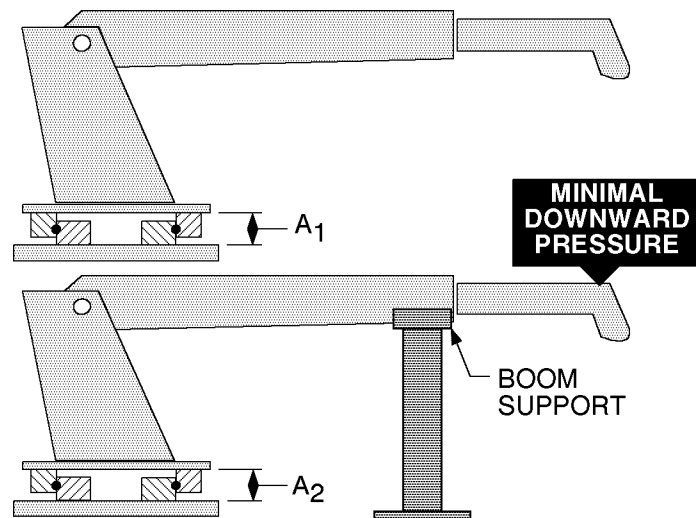
With the crane horizontal and fully extended, measure between the top and bottom mounting surfaces of the turntable bearing (A_1), using a dial indicator for accuracy.

STEP 2.

Reverse the load by applying minimal downward pressure on the boom while the boom is in the boom support or on a solid surface. Again measure A_2 .

STEP 3.

Subtract A_1 from A_2 to determine tilt and compare the result with the accompanying chart.



COMPARISON CHART - MODEL TO MEASURED TILT DIMENSION

<p>NOTE</p> <p>THE FIGURES LISTED IN THIS CHART ARE SERVICE GUIDELINES AND DO NOT, IN THEMSELVES, REQUIRE THAT THE BEARING BE INSPECTED.</p> <p>IF THERE IS REASON TO SUSPECT AN EXCESS OF BEARING WEAR AND THE MEASURED TILT DIMENSION EXCEEDS THE DIMENSION LISTED, REMOVE THE BEARING FOR INSPECTION.</p>	<p>IMT CRANE, LOADER OR TIREHAND MODEL</p>	<p>1007 1014 1014A 1015 2015/2020 2109 3000 3816/3820 3016/3020 421/425 4300 5016/5020 6016/6020 TH7 BODY ROT'N TH1449 BODY ROT'N TH15B CLAMP TH2551B CLAMP TH2557A CLAMP</p>	<p>5200 5200R 5217 5800 7020 7025 7200 7415 9000 TH10 BODY ROT'N TH14 BODY ROT'N</p>	<p>16000 32018 32027 32030 T30 T40</p>	<p>9800 12916 13031 13034 14000 15000 18000 20017 8000L H1200 H1200RR T50 TH2551B BODY ROT'N TH2557B BODY ROT'N TH2557A BODY ROT'N</p>
	<p>BALL DIA. (REF)</p>	<p>.875" (22mm)</p>	<p>1.00" (25mm)</p>	<p>1.18"-1.25" (30-32mm)</p>	<p>1.75" (44mm)</p>
	<p>TILT DIM. (A₁-A₂)</p>	<p>.060" (1.524mm)</p>	<p>.070" (1.778mm)</p>	<p>.075" (1.905mm)</p>	<p>.090" (2.286mm)</p>

CONVERSION FACTORS

TO CONVERT	INTO	MULTIPLY BY
bars	Pounds/sq in (PSI)	14.5
centimeters	inches	0.3937
cubic centimeters	cubic inches	0.06102
cubic feet	cubic centimeters	28,320.0
cubic feet	cubic inches	1,728.0
cubic feet	cubic meters	0.02832
cubic inches	cubic centimeters	16.39
cubic meters	cubic feet	35.31
cubic meters	cubic inches	61,023.0
degrees (angle)	radians	0.01745
degrees centigrade	degrees fahrenheit	$(^{\circ}\text{C} \times 9/5) + 32$
degrees fahrenheit - 32	degrees centigrade	$5/9$
feet	centimeters	30.48
feet	meters	0.3048
foot-pounds	ton-meters	.0001383
gallons	liters	3.785
horsepower (metric)	horsepower	0.9863
horsepower	horsepower (metric)	1.014
inches	centimeters	2.540
inches	millimeters	25.40
kilograms	pounds	2.205
kilogram-meters	foot-pounds	7.233
liters	gallons (US)	0.2642
meters	centimeters	100.0
meters	feet	3.281
meters	inches	39.37
meters	millimeters	1,000.0
meters/second	feet/second	3.281
millimeters	centimeters	0.1
millimeters	inches	0.03937
millimeters	meters	0.001
pounds	kilograms	0.4536
pound/sq inch	kgs/sq meter	703.1
radians	degrees	57.30
tons (metric)	pounds	2,205.0

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IOWA MOLD TOOLING CO., INC.
BOX 189, GARNER, IA 50438-0189
TEL: 641-923-3711
TECHNICAL SUPPORT FAX: 641-923-2424
www.imt.com