



ARVA AR16520M CRANE

SERIAL NO. 1804-A171535



OPERATOR'S, MAINTENANCE, SPARE PARTS & SERVICE PACK MANUAL

SO. 09060

ARVA INDUSTRIES INC. Manual No. A172180 Book 1 of 1

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OPERATOR'S MANUAL REVISION LIST

A172180 Issued October 14th 2009

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<u>REVISION</u>	<u>DATE</u>	<u>DESCRIPTION</u>
A	09/11/27	Replace revision page In section 1, replace pages 1.5-1.8 In section 8, replace pages 8.115-8.116
B	10/05/06	Replace revision page In section 5, replace pages 5.i-5.iv, 5.11, 5.15, 5.29, 5.33-5.36, 5.39, 5.45-5.48 & 5.55 In section 8, replace pages 8.81, 8.87 & 8.105-8.108 In section 9, replace pages SP-10 In section 9, remove Drawing A115111& replace it with Drawing A115256
C	12/03/07	Replace revision page In section 8, replace pages 8.i-8.ii, 8.3-8.6, 8.9-8.24, 8.39-8.42, 8.79-8.82 & 8.85-8.88

INTRODUCTION

Proper maintenance and operation should be well planned and executed with any mechanical device. Not only does proper maintenance and operation ensure that the device is always in good working order, it also helps the equipment hold its value and helps to ensure the safety of personnel operating and working in the areas surrounding the equipment being used.

This manual has been compiled to provide the proper information to perform operations as well as servicing and ordering of spare parts that may be required over the life of the machine.

The definitions of DANGER, WARNING, CAUTION, and NOTE as used in this manual apply as follows.

DANGER

DANGER INDICATES AN IMMEDIATE HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY. The colour associated with Danger is RED.

WARNING

A WARNING IS USED TO EMPHASIZE THAT IF AN OPERATION, PROCEDURE, OR PRACTICE IS NOT FOLLOWED EXACTLY, DEATH OR INJURY TO PERSONNEL MAY RESULT. The colour associated with Warning is ORANGE.

CAUTION

A CAUTION IS USED TO EMPHASIZE THAT IF AN OPERATION, PROCEDURE, OR PRACTICE IS NOT FOLLOWED EXACTLY, MINOR OR MODERATE INJURY OR EQUIPMENT DAMAGE MAY RESULT. The colour associated with Caution is YELLOW.

NOTE

A note is used to emphasize an important procedure or condition.



THIS SAFETY ALERT SYMBOL INDICATES IMPORTANT SAFETY MESSAGES IN THIS MANUAL. WHEN YOU SEE THIS SYMBOL, CAREFULLY READ THE MESSAGE THAT FOLLOWS AND BE ALERT TO THE POSSIBILITY OF DEATH OR SERIOUS INJURY.

There are several parts to this manual including a general description, operation, safety, lubrication, spare parts lists as well as service packages supplied by component manufacturer on their components that make up the unit.

There are several TABLE OF CONTENTS in the manual for ease in locating the applicable information needed.

- a) A main table of contents.
- b) A table of contents at the front of each section.

If an error is suspected, please contact ARVA INDUSTRIES INC., so that the necessary corrections can be made and the revised information forwarded for your manuals.

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TO ORDER PARTS

OR ANY INQUIRES

IT IS ESSENTIAL TO SUPPLY THE FOLLOWING INFORMATION ON PARTS ORDERS TO ENSURE YOUR ORDER IS PROPERLY EXPEDITED.

1. Give Model and Serial Number of your machine. This information is found on the machine serial plate.
2. Give complete information on the Part(s) requested including the part number, description, and quantity.
3. Give complete `Ship-to` address and specify exact method of shipment wanted, giving a billing address if different from ship to address.
4. Specify the urgency of the parts order by designating the priority (emergency or stock), include preference for shipper if applicable.
5. Provide the purchase order number.

NOTE: When placing telephone order, please record with whom you spoke and date, so that follow-up telephone conversations are processed without confusion.

PARTS CAN BE ORDERED THROUGH THE FOLLOWING;

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There are no warranties, express or implied, made by either the distributor or the manufacturer on new Arva Industries Inc.'s equipment, except the manufacturer's warranty against defects, material and workmanship set out below.

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ARVA Industries Inc. warrants each new product to be free from defects in material and workmanship. It's obligation and liability under this warranty being limited to replacing free of charge at it's factory, any part proving defective under normal use and service within twelve (12) months 2,000 hours which ever occurs first from the date of initial sale. This warranty is in lieu of all other warranties express or implied. The obligation and liability of the Manufacturer under this warranty shall not include any transportation or other charges or the cost of installation or any liability for direct, indirect or consequential damages or delay resulting from defect. Any operation beyond rated capacity or the improper use or application of the product or the substitution upon it of parts not approved by the Manufacturer shall void this warranty. This warranty covers only the products of ARVA Industries Inc. The products of other Manufacturer's are covered only by such warranties as are made by their Manufacturers.

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GLOSSARY

The following is a glossary of technical terms and definitions particular to this manual and associated Arva Industries Inc. publications.

2WD	Stands for two wheel drive
ACCESSORY	A secondary part or assembly of parts which contributes to the overall function and usefulness of a machine.
ANGLE INDICATOR (BOOM)	An accessory which measures the angle of the boom above horizontal.
ANGLE OF APPROACH	Is the angle from the tangent of the front wheel to the lowest point of any object in front of that wheel measured to the horizontal plane of the ground.
ATTACHMENT (BOOM)	A designation for equipment installed on, or attached to the boom.
AXIS OF ROTATION	The vertical line through the axis around which a structure rotates.
AXLE	The shaft or spindle about which a wheel revolves. On wheel mounted machines it refers to an automotive type of axle assembly including housing gearing, differential, bearings and mounted hardware.
BASE	See SUPERSTRUCTURE
BATTERY DISCONNECT	Is the control lever which disconnects the batteries from rest of the machine. See also Master Switch.

BECKET	See WEDGE SOCKET
BOOM ANGLE	The angle above horizontal of the longitudinal axis of the boom.
BOOM	A telescoping arm pivot-mounted on the superstructure and adjustable as to angle by means of hydraulic cylinders
BOOM LENGTH	The straight line through the centre line of boom pivot pin to the centre line of the dipper nose pin, measured along the longitudinal axis of the boom.
BOOM NOSE	The outer most portion (tip) of the boom, comprised of sheaves and attaching hardware for reeving cable.
BRAKE SHOE	The part of a shoe-type brake or clutch which makes contact with the brake drum or clutch.
BRAKE	A device for retarding or stopping motion by means of friction or power.
BREAK OVER ANGLE	Is the angle measured between two lines tangent to the front and rear tire static loaded radius and intersection at a point on the underside of the vehicle which defines the largest ramp over which the vehicle can roll.
BUCKET	See CLAMSHELL BUCKET
CAB	A housing which holds the operator and machine controls.
CABLE	See WIRE ROPE

CARRIER	The traveling base upon which the superstructure is mounted.
CHASSIS	Is the main frame structure to which all other substructures of the vehicle are mounted.
CLAMSHELL BUCKET	A bucket used with the clamshell attachment.
CLAMSHELL	Two or more similar scoops hinged together, used for digging or holding material.
CLUTCH	A friction, electromagnetic, hydraulic, pneumatic or mechanical locking device for engagement or disengagement of power.
COUNTERWEIGHT	Weight used to supplement the weight of the machine in providing stability for lifting working loads; attached to the rear of the superstructure.
CTI	Stands for Central Tire Inflation, which is a type of system available to inflate the tires on the machine using its own air supply.
DRUM (HOIST)	A rotating cylinder with side flanges on which cable used in pulling/winning operation is wrapped.
ECU	Stands for Electronic Control Unit
EO	Stands for Engine Oil
EPGL (SCL)	Stands for Extreme Pressure Gear Lubricant Sulpho-Chloro-Lead

EPGL	Stands for Extreme Pressure Gear Lubricant
EP-MPG	Stands for Extreme Pressure Multi-purpose Grease
GOVERNED SPEED	Engine revolutions per minute controlled by the power plant governor.
GRADABILITY	The slope which a machine can climb expressed as a percentage.
GRADIENT	Refers an upward or downward slope, usually set over a distance.
GROUND CLEARANCE	Is the minimum dimension measured from the sprung vehicle to the ground.
HEADACHE BALL	A heavy (overhaul) ball used with single line lifting to provide weight required to unwind cable from hoist drum.
HOIST	A hydraulically operated drum used for pulling loads.
HOOK BLOCK	Block with hood attached used in lifting service. It may have a single sheave for two-part line, or multiple sheaves or more parts of line.
HYDO	Stands for Hydraulic Oil
JIB	An extension attached to the boom nose used to provide added boom length for handling specified loads.

KING PIN	Is a pivot pin that secures an axle to an axle beam and allows a vehicle to be steered.
LINE PULL (AVAILABLE)	The line pull in pounds (lbs) developed by pulling mechanism with specified pitch diameter drum, for the first layer of rope, not exceeding that developed by the driving mechanism torque.
LINE PULL (PERMISSIBLE)	A line pull, less than the available pull, restricted by rope strength, clutch or brake ability, or other limitation in machinery or equipment.
LINE SPEED (AVAILABLE)	The line speed in feet per minute (fpm) developed by hoisting mechanism with specified pitch diameter drum, for the first layer of rope, developed by power plant output speed.
MASTER SWITCH	Is the control lever which disconnects the batteries from rest of the machine. See also Battery Disconnect.
NATO	Stands for North Atlantic Treaty Organization
OPERATING PRESSURE	The pressure that the pump delivers, determined by main and circuit relief valves.
OUTRIGGERS	Extendible or fixed arms attached to the mounting base, which rests on supports at the outer ends to provide stability.
PRIME MOVER	Internal combustion engine or electric motor used a main power supply for the machine.

RADIUS (OF LOAD)	Operating radius is the horizontal distance from the axis of rotation to the load.
RATED LOAD	Rated loads at specified radii with the subject equipment are the lesser of the machine's hydraulic or structural competence as established by the manufacturer, and the maximum loads at those radii covered by the manufacturer's warranty.
REAR END RADIUS	(TAIL SWING) Clearance distance from the centre of rotation to maximum rear extension of revolving parts.
RESERVOIR	Is a receptacle or container for storing a fluid.
ROPE	Refers to wire rope unless otherwise specified. See also WIRE ROPE.
ROPS	Stands for Roll Over Protective Structure
ROTATION BEARING	A combination of rings with balls or rollers capable of sustaining radial, axial, or overturning loads of the revolving superstructure.
RUN FLAT	Is a type of tire which contains a special insert that allows the tire to be used even if there is no air in the tire.
SIDE LOADING	A load applied at an angle to the vertical plane of the boom.
SMP	Stands for Standard Military Pattern

STABILITY	The ability of a mobile machine to resist tipping. Does not normally apply to a stationary mounting.
STRUCTURAL STRENGTH	The ability of the machine and its components to withstand the stresses imposed by applied loads.
SUPERSTRUCTURE	The frame and components installed therein for operating the machine.
SWING	The function of the revolving parts like the boom.
SWING GEAR	Splined, gear (integral with rotation bearing) with which swing pinion meshes to provide swing motion.
SWING MECHANISM	The machinery involved in providing directional rotation of the revolving superstructure.
SWING PINION	Splined, external gear (driven by rotation gear box) which meshes with swing gear and provides swing motion.
SWING SPEED	The speed, in revolutions per minute, at which the boom will rotate.
TAIL SWING	See REAR END RADIUS
TELESCOPING BOOM	A Boom from which one or more boom extensions are telescoped to vary the length.

TIPPING CONDITION	A machine is considered to be at the point of tipping when a balance is reached between the over turning moment of the load and the stabilizing moment of the machine when on firm, level supporting surface, or on outriggers.
TIRE SIZES	These are specified by diameter of casing, diameter of wheel and ply rating, ie.) 14.00 x 20-10 ply is a 14 inch diameter casing on a 20 inch diameter wheel or rim, and is of 10 ply construction.
TRAVEL	The function of the machine moving from one location to another.
TRAVEL SPEED	Is the speed the vehicle can go under it's own power.
TRUNNION	Is a pin, especially either of two small cylindrical projections forming an axis on which a part will pivot.
TURNING RADIUS	Is the distance from the turning centre to the centre of tire contact with the road of the wheel describing the largest circle, while the vehicle is executing its sharpest practicable turn (usually to the outside front wheel).
TWO-BLOCK	(TWO BLOCKING) A condition encountered when hook block or headache ball contacts boom nose or jib tip.
VISCOSITY	The degree to which a fluid resists flow under an applied force, measured by the tangential friction force per unit area divided by the velocity gradient under conditions of streamline flow.

WBG	Stands for Wheel Bearing Grease
WEDGE & SOCKET	Hardware attached to working end of hoist cable, which provides means of securing cable to boom nose or jib tip anchor.
WHEEL BASE	Distance between centre line of front and rear axles.
WHEEL GAUGE	Is the distance between the wheels on the vehicle from one side of the vehicle to the other side, middle of the tire to middle of the tire.
WINCH	See HOIST.
WIRE ROPE	A flexible, multi-wire member usually consisting of core member around which a number of multi-wired strands are “laid” or helically bent.
WORKING WEIGHT	Refers to the weight of machine in working order with complete front end equipment.



SECTION 1

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SPECIFICATIONS

GENERAL DESCRIPTION

The Arva Model AR16520M is a hardwire remote controlled hydraulic crane, with a capacity of 30,000 lbs @ 40 ft radius and 17,000 lbs @ 60 ft. It has been designed for use on a pedestal structure. The crane is powered via a 100 hp electric/hydraulic power pack. Hydraulic hoses with a hydraulic swivel at the center of rotation act as the power source for the crane. The controls are hardwired remote mounted on the cab seat arm rests.

CRANE DESCRIPTION

Controls

Hardwire remote controls are cab seat mounted with dual axis joystick and are infinitely variable. For emergency operations, handles are installed on the control valve located within the turret through the inspection door.

Boom Lift

The boom is a one piece double tapered hydraulically lifted boom. The boom lift function is controlled by two (2) cylinders, positioned to give maximum clearance when handling loads with a fully raised boom. The boom maximum lifted angle is +80°

Holding valves are bolted to the cylinders to prevent accidental boom lowering due to hose or tube damage.

Swing

Crane rotation is 360° continuous however it is limited for this application. A shear ball type swing bearing is used for turret rotation that is driven by two low speed high torque motors which are directly coupled to the planetary gear reduction driving the large internal gear on the slew bearing. Function speed is 1/2 rpm.

The slew bearing is a large diameter shear ball type bearing sized for sturdiness and long life. High strength bolts hold the upper turret structure to the shear ball bearing and to the pedestal base mount plate.

A fail safe hydraulically released spring applied disc brake is located between each drive motor and planetary reduction.

Boom Head

The boom head has positions for three (3) load sheaves with a dead end for a two part reeving on the main (centre) sheave.

Winch and Cable

See section 3 for information

Hook Block

A 15 ton hook block is supplied with the crane. It has one (1) sheave for two part reeving.

Overhaul Ball

A five (5) ton capacity overhaul ball for single part reeving is supplied for the two whip hoists. A swivel hook is supplied with rotation resistant type wire rope for the whip hoists.

Load Monitor System

The load moment indicating system with anti two block cut-off is incorporated into the crane controls. See controls section for more details

Power Source

A 100 HP, 460V ac, motor drives the pressure and flow compensated pump. Pump supplies hydraulic power on demand. The oil reservoir is mounted below the pump. The hydraulic power unit assembly with return filter, suction screen and filler breather is located below deck.

A hydraulic swivel, which supplies hydraulic power from the power pack to the crane along with the electrical collector ring, is located within the swing bearing support structure.

Mounting

The crane base supplied is for mounting on to either a pedestal mount or base mount. The crane is secured to the pedestal base by 48 1-1/4" diameter capscrews, which are torqued to 1200 ft/lbs. The torque on swing bearing bolts and capscrews is to be checked at 100 hours of operation.

Counterweight

The crane structure does not require counterweight for stability or structural integrity.

Hydraulic System

The hydraulic system consists of a pressure compensated load sensing variable displacement pump with a capacity of 50 GPM. Pump is driven by a 100 hp electric motor. The pump supplies oil flow to a directional control valve stack located within the turret. It provides function and direction for the Swing, Boom lift and hoists. The functions may only be operated with the crane attached to an externally provided electrical power source.

Electrical System

The electrical control system is 24 volts DC. Main power is 460 Volt AC. The power unit is started at the switch box located between the two cabs. A maintenance start switch is also located on the power unit main switch box

Emergency stop buttons are located on both switch boxes described above and in both cabs.

The 24 volt DC power source transformer is located in the power unit's main switch box.

Crane control power may be turned ON and OFF within the respective cab. The boom flood lights contactor is located in electrical box #2.

WARNING

ELECTRICAL PANEL HAS DUAL VOLTAGE.

CONTROLS

The controls for all crane functions are controlled by joystick and provide infinitely variable control with manual control for emergency operation from the turret through the inspection door. See controls section.

Cab controls and manual controls have all functions required for complete crane operation. See controls for description of respective functions.

DIMENSIONAL DATA**AR16520M CRANE**

Capacity:	30,000 lbs at 40 ft radius 17,000 lbs at 60 ft radius
Working Radius:	
Crane	12'4" to 60'0"
Boom Angle	0 to 80 degrees
Height: (Boom Horizontal)	
From bottom of swing bearing to top of whip hoists	105"
From bottom swing bearing to top of boom tip at 80 deg	64'5"
Length: (Boom Horizontal)	64'2"
Width: (Boom Horizontal & Retracted)	76"
Swing: (limited by ships structure)	capable of 360 degree continuous
Tail Swing	38"

PERFORMANCE DATA**AR16520M CRANE**

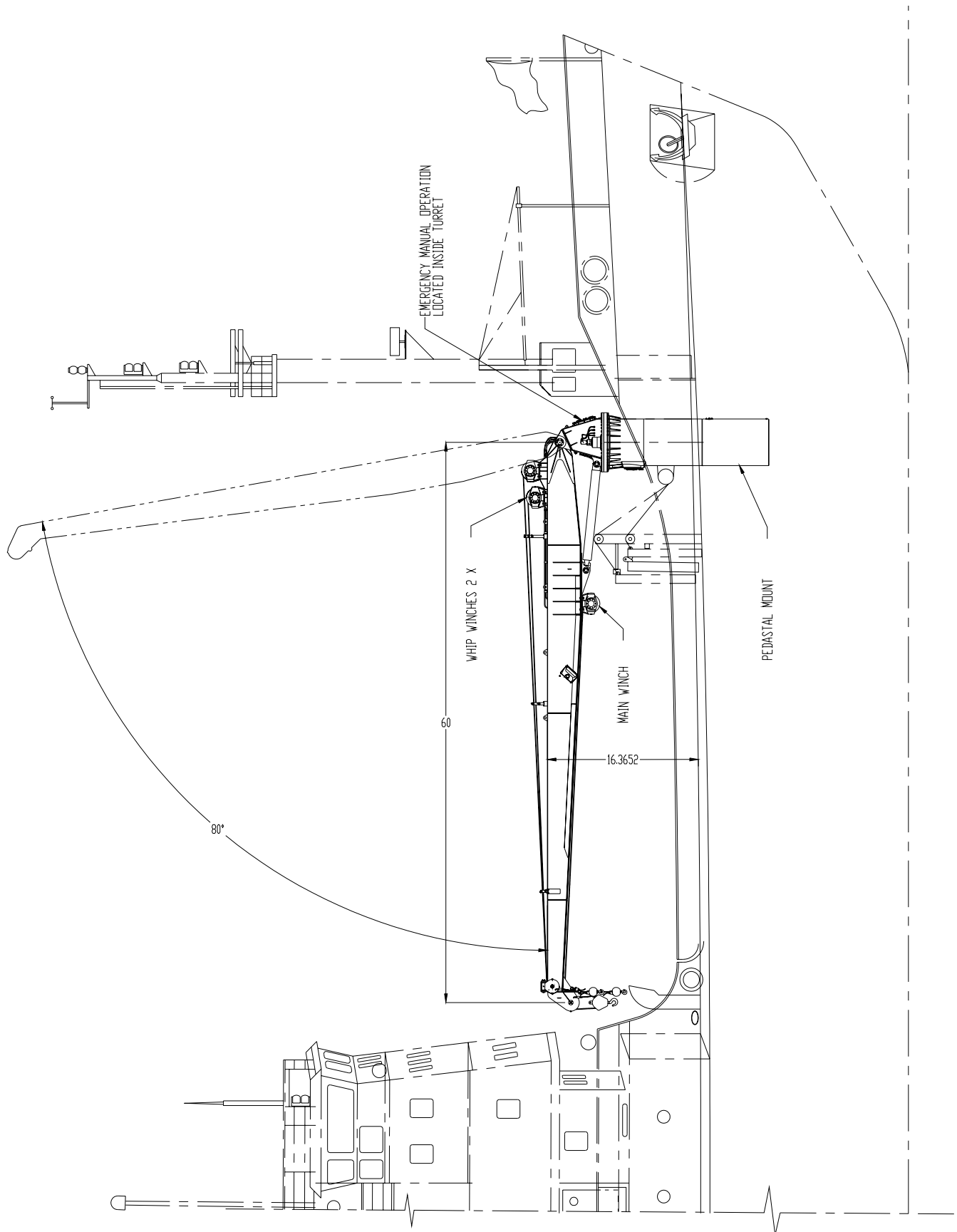
Main Hoist: (Hook speed 2-part reeved)	26 fpm
Cable	420 ft 7/8" Dyform 18
Line Pull, Single Line	15,000 lbs
Whip Hoists:	140 fpm
Cable	320 ft 3/4" 19 x 7 non-rotating
Line Pull, Single Line	10,000 lbs
Swing Speed	1/2 rpm
Boom Lift:	
up time	35 seconds
down time	30 seconds

See capacity chart for rated line pull data.

COMPONENT WEIGHTS

Crane Assembly (includes boom, turret, swing bearing, hoists, cables, hook block and overhaul balls)	38,500 lbs
Pedestal Assembly	12,000 lbs
Turret Weldment (less swing drive & valving)	6,500 lbs
Boom Weldment (less hoists and fairleads)	17,381 lbs
Boom Lift Cylinders	2,450 lbs
Main Hoist (A171543)	1,543 lbs
Auxiliary Hoist (A171544)	1,212 lbs
Hook Block	346 lbs
Overhaul Ball	166 lbs
Swing Drive (with brake & motor)	551 lbs
Swing Bearing	2,400 lbs
Boom Pivot Pins	100 lbs
Main Hoist Cable	656 lbs
Auxiliary Hoist Cable	408 lbs
Hydraulic Control Valve Assembly	180 lbs
Hydraulic Swivel & Collector Ring	210 lbs
Boom Lift Cylinder Pins	40 lbs
Power Unit Assembly (with oil)	3,960 lbs
Electrical Box (motor control)	220 lbs
Cab Seat Assembly	160 lbs each

CONFIGURATION



CAPACITY CHART

CAPACITY CHART - ARVA Model AR16520M

Load Radius Ft.	Boom Angle Deg.	85% Rated Load 1000's lb.	100% Rated Load 1000's lb.	115% Rated Load 1000's lb.
		(1)	(2)	(3)
12	80	30.0	30.0	30.0
15	76	30.0	30.0	30.0
20	71	30.0	30.0	30.0
25	66	30.0	30.0	30.0
30	61	30.0	30.0	30.0
35	55	27.6	30.0	30.0
40	50	24.5	30.0	30.0
45	43	22.0	27.0	30.0
50	35	20.0	25.0	30.0
55	25	17.7	22.0	27.7
58	15	16.0	20.0	25.5
60	0	13.0	17.0	21.5

NOTES TO CHART:

- (1) Loads shown are maximums to 85% Rated, Green light.
- (2) Loads shown are maximum for 85-100% Rated, Yellow light.
- (3) Loads shown are overload 100-115% Rated, Red light.
- (4) Control function inducing more load moment will be cut at overload.
- (5) Capacities shown in chart are total rating for crane.
- (6) Main hoist alone may provide capacity per chart.
- (7) Each whip line hoist has capacity up to 9400 lb.
- (8) Combination of main and whip hoists not to exceed chart above.
- (9) Capacities shown are combined line loads - hook, balls, rigging and load handling equipment are to be considered part of the load.
- (10) Capacity shown is based on horizontal deck; trim and list angles may vary the capacity shown and warning/cutoff limits due to change in load radius.



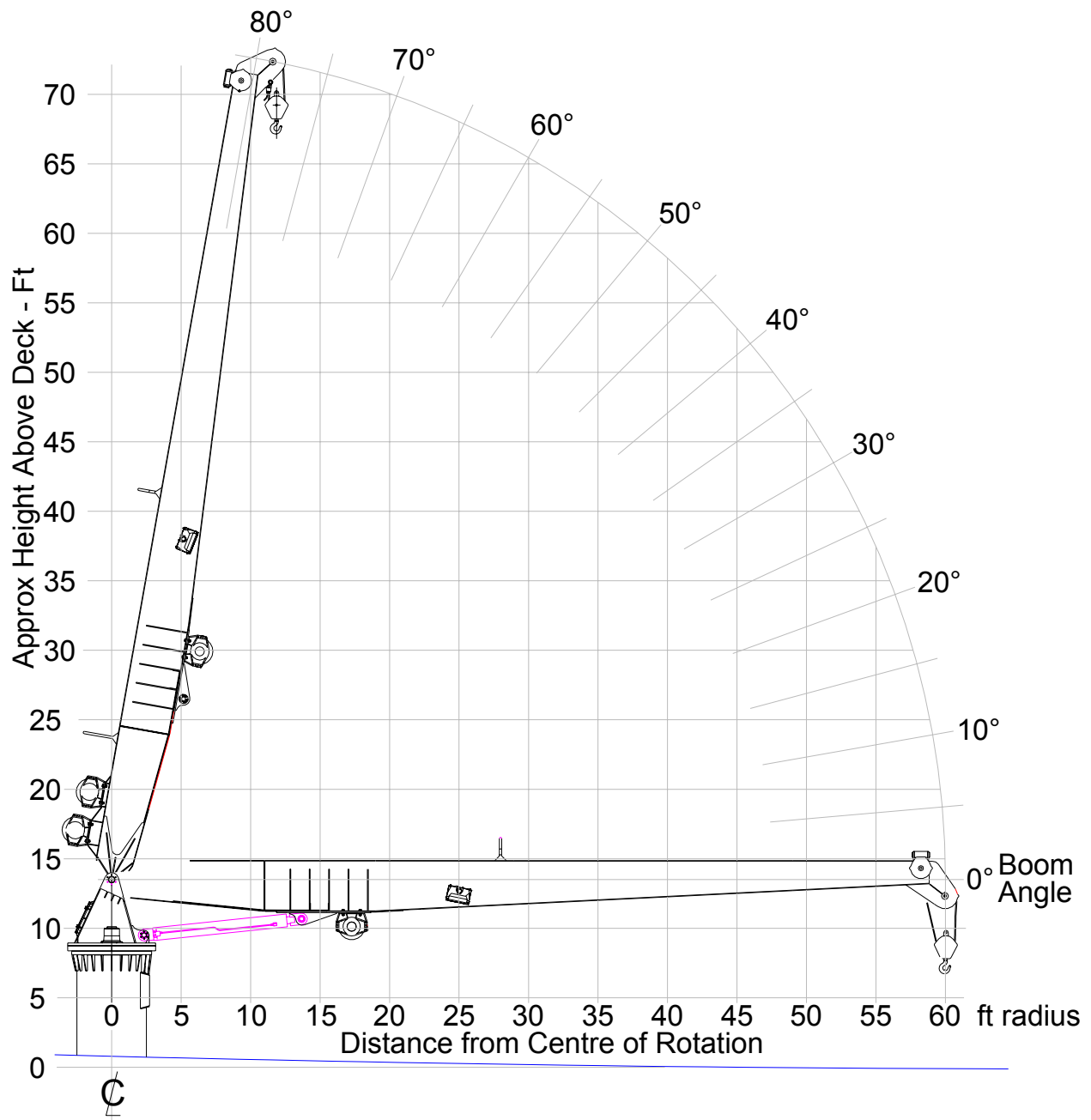
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CAPACITY RANGE CHART

RANGE CHART - ARVA Model AR16520M



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SAFETY PRECAUTIONS **FOR PEDESTAL & MOBILE CRANES**

It is impossible to compile a list of safety precautions covering all situations, however, there are basic safety precautions that **MUST** be followed during your daily routine. Safety is **YOUR PRIME RESPONSIBILITY**, since any piece of equipment is only as safe as **THE PERSON AT THE CONTROLS**.

With this in mind, this information has been provided to assist you, the operator, in promoting a safe working atmosphere for yourself and those around you. It is not meant to cover every conceivable circumstance which could arise. It is intended to present basic safety precautions that should be followed in daily operation.



Because you, the operator, are the only part of the crane that can think or reason, your responsibility is not lessened by the addition of operational aids and warning devices. Indeed you must guard against acquiring a false sense of security when using them. They are there to assist, NOT direct the operation. Operational aids or warning devices can be mechanical, electrical, electronic or a combination thereof. They are subject to failure or misuse.

You the operator, are the only one who can be relied upon to assure the safety of yourself and those around you. Be a PROFESSIONAL and follow the RULES of safety.

REMEMBER, Failure to follow just one safety precaution can cause an accident to people or equipment.

You are responsible for the safety of yourself and those around you.

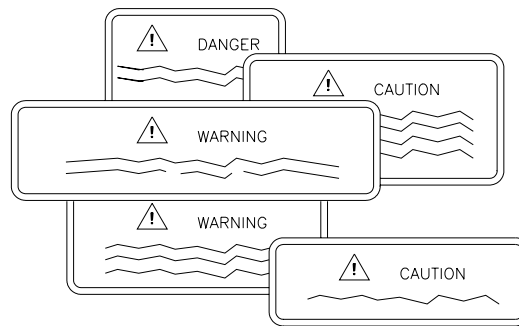
Ensure you and those working with you are aware of any special dangers where you are operating the crane. Be especially careful of dangerous ground and objects, including buildings near the crane.

Be aware at all times that you are responsible for the safety of yourself, your co-workers, the crane and everything around it. Make certain the crane is properly maintained, and then pay special attention to winds, boom deflection, rope sway, and any unusual things which you, as a crane operator, may notice which may be important to others.

Know and abide by the basic safety rules

Read and understand the operation and safety section of this manual before operating the Crane.

Follow directions on all placards. Know what they mean and follow their instructions.



Inspect the machine every day (before operation). Ensure that routine maintenance and lubrication are being dutifully performed. Do not operate a damaged or poorly maintained machine. You risk lives by operating faulty machinery, including your own.

Operator's must be thoroughly familiar with safe crane operating practices and have a complete understanding of all operation and maintenance instructions provided. Operator's should be physically fit and thoroughly trained, with related experience, not be easily excitable, not be subject to epileptic seizures, and not using any drug that could impair physical, visual, or mental reactions or capabilities.

Wear the proper clothing for the job. Wear personal protective equipment such as required by local or job regulations.

Inspect the crane before use each day. Ensure service and lubrication is properly maintained. Don't operate a damaged or poorly maintained crane. You risk lives when operating faulty machinery, including your own.

Know the area in which you are working. Familiarize yourself with work-site obstructions and other potential hazards.

Use caution when in the vicinity of overhanging banks or edges.

Keep your shoes clean. Before entering the cab, clean any mud or grease from you shoes. This will reduce the possibility of your shoe slipping off of a control pedal.

Since certain shoe sole materials are more slip resistant than others, all operating and service personnel should wear high resistant sole material.

Avoid a dirty or greasy crane. Keep the cab, deck, foot and hand holds free of mud and grease for operator safety.

Observe and heed possible pinch points while performing maintenance and other work.

Check for warning tags placed on the crane. If found, refuse to operate the crane until repairs are made and warning tags are removed by authorized personnel.

Before performing maintenance, disconnect the battery, remove the ignition key, and place warning signs in the cab.

Proper lubrication is required in heavy machinery operation. Follow the factory recommendations regarding the lubrication time intervals and type of lubricant used. Adjust intervals accordingly, when working under severe conditions.

When adding oil to the hydraulic system, follow the manufacturer's recommendations. Mixing the wrong fluids could destroy seals, causing machine failure.

When performing maintenance refer to the appropriate manual for instructions. Consult the factory if there is any question regarding procedures or specifications.

Do not attempt repairs that you do not understand.

BEFORE performing maintenance on the crane, remove all weight from outrigger jack cylinder, and lower attachments to the ground and place them on suitable blocking.

Pressurized air and hydraulic oil can cause serious injury. Be certain that all lines, components and fittings are tight. Use cardboard or wood to search for leaks.

Never exceed the manufacturer's recommended relief valve pressure settings.

Always replace the guards or other safety devices which may have been removed during servicing of the crane.

Have a fire extinguisher available and ensure that it is fully charged and operable.

A spark or flame could cause a battery explosion. Don't short across the posts to check the charge.

Do NOT smoke while performing battery maintenance.

Disconnect the grounded battery clamp first when removing a battery and connect it last when installing.

Avoid battery acid contact with the skin and eyes. If accidentally contacted, flush the area with water and consult doctor immediately.

Be careful when checking the coolant level. Shut down engine and allow radiator to cool before removing the radiator cap.

Unless authorized by Arva Industries Inc. do NOT make any modifications, alterations, or changes to the crane, which could effect its original design. Such action invalidates all warranties and capacity charts, and makes the owner/user liable for resultant accidents.

Keep the crane properly maintained and adjusted at all times. Shut down the crane while making adjustments or repairs.

Keep your fingers away from potentially hazardous areas.

Keep brakes properly adjusted. Keep brake linings free from oil and grease. Do not over lubricate the bearings or brake anchor pins. Refer to the Service Manual.

Use cleaning solutions that are non-flammable and approved for the work being performed.

Always perform a functional check after repairs have been made to ensure proper operation. Load tests should be performed when structural or lifting members are involved.

Do not store flammable materials on crane at any time.

Never get off a moving crane.

When getting on or off a stationary crane, use both hands and handrails and steps provided.

Allow no one other than the operator to be on the crane while the crane is in motion unless they are seated within a two-man cab.

Inspect the tires for nicks and cuts embedded stones and abnormal wear. Ensure all lug nuts are properly torqued.

Check the tire pressure daily. When inflating or adding air to the tires, use a tire cage and clip in inflator. Use an extension hose, which will permit standing behind the tire tread when inflating.

In freezing weather, park the crane in an area where it cannot become frozen to the ground. The driveline can become damaged when attempting to free a frozen crane.

When shutting down a crane adhere to the following:

- Engage parking brake
- Lower the boom and the load.
- Place the controls in neutral.
- Chock the wheels.
- Ensure the swing lock is engaged.
- Remove the ignition key.
- Lock the machine.

Do NOT touch metal surfaces that could freeze you to them.

TRAVEL OPERATION

Check the load limits of bridges before travelling over them to ensure that they can carry the load of the crane.

Watch clearances when travelling. Do not take a chance of running into overhead or side obstructions. When moving in tight quarters, post a look-out to help guard against collision or bumping structures.

Never back up without the aid of a signalman to verify that the area behind the crane is clear of obstructions and/or personnel.

When travelling, the boom should be fully retracted, lowered, and stowed in its travel position.

Do not attempt to move the crane until brake system air pressure is at operating level. (If Applicable).

Secure the hook block and other items before moving the crane.

When travelling, keep the lights on, use traffic flags and sign, and use front and rear flag vehicles. Check local and state rules and regulations.

Drive carefully and avoid speeding.

Before travelling a crane, check suitability of proposed crane route with regard to crane height, width and length.

Secure the turntable before moving the crane, use the swinglock. (If applicable).
Since certain shoe materials are more slip resistant than others, all operation and service personnel should wear footwear with high slip resistant sole material.

Stay alert at the wheel.

When parking on a grade, apply the parking brake and chock the wheels.

CRANING OPERATION

Check the crane stability before lifting loads. Ensure the outriggers (or tires if lifting on rubber) are positioned on solid surfaces. Ensure the crane is level and the parking brake is set, and the load is properly rigged and attached to the hook. Lift the load slightly off the ground and recheck stability before proceeding with the lift. Determine the weight of the load before you attempt the lift. Check the load chart against the weight of the load.

Most accidents involving mobile cranes are caused by the following:

- Crane out of level.
- Bad surface conditions.
- Outriggers used improperly or not used.
- Inadequate blocking under outrigger floats.
- Improper crane position.

After the crane has been properly set-up, make a dry run before making the first lift. Become familiar with all factors peculiar to that job site. Know what moves to make before attaching the first load. Plan ahead.

Unless lifting within “on Rubber” capacities, outrigger beams must be fully extended, jack cylinder extended and safety locks set, to provide maximum levelling in the crane. Remove all weight from tires before lifting on outriggers.

Use adequate cribbing under outrigger floats to distribute weight over a greater area. Check frequency for setting.

Use a sight level bubble indicator to ensure crane levelling.

Use the loadline to determine the levelness of the crane. It should lie in the centre of the boom. Check at two points 90 degrees apart.

Be sure the hoist line is vertical before starting the lift. Do NOT subject the crane to side loading.

Measure the load radius before making lifts and stay within the approved lifting areas. Check your load chart.

The importance of properly levelling a crane cannot be over-stressed. A crane only slightly out-of-level can quickly encounter a tipping condition.

Barricade the area around which the crane is working.

Do NOT interfere with the proper functioning of operational aids or warning devices. Monitor them regularly and see that they get proper care.

Always refer to the capacity on the load chart in the cab BEFORE making any lift. Position the hoist line to the radius required, then lift the load. Stay within the approved working area for the load being lifted.

Remember, all rigging equipment must be considered as part of the load. Lifting capacities vary within working areas. Permissible working areas are posted on the crane cab. When swinging from one working area to another, ensure that load chart capacities are not exceeded. Know your crane!

Operate the engine at or near governed RPM during performance of all crane operations.

Extend boom sections equally. Keep lifting lines and the boom as short as the load will permit. Remember, the load chart capacities are normally based on equally extended boom sections.

Do NOT exceed crane rating. Do not rely on the crane tipping stability to determine the maximum lifting capacity. Do NOT exceed capacities shown on the load chart in the cab. REMEMBER: all lifting devices (Headache ball, block, jib, etc.) are part of the LOAD.

Always check the capacity of the crane as shown on the load chart before making any lifts.

Always keep the load near to the crane and as close to the ground as possible.

Know the weight of all loads before you attempt a lift. Ensure the load to be lifted is within the rated capacity of the crane.

Never exceed the rated lifting capacity shown on the load chart. Always check the load chart to ensure the load to be lifted at the desired radius is within the rated capacity of the crane.

Never use the crane stability to determine capacity it may be too late when you find out.

Multiple crane lifts are not recommended. The use of more than one crane to make a lift requires the ultimate in equipment, engineering, operational skill, and lift co-ordination.

But, if it is necessary to perform a multi-crane lift, the operator shall be responsible for assuring that the following minimum safety precautions are taken.

1. Secure the services of a qualified engineer to direct the operation.
2. Use one signal person and be sure that they are qualified.
3. Co-ordinate lifting plans with the operator, engineer and signal person prior to beginning the lift.

4. Use cranes and rigging of equal capabilities and use the same boom length. Be certain cranes are of adequate lifting capacity.
5. Use outriggers on cranes so equipped.
6. Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.
7. Lift only from a stationary position. DO NOT TRAVEL.
8. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
9. Ensure the load lines are directly over the attach points to provide side loading cranes.

Always use enough parts-of –line to accommodate heavy lifts. Provide a safety allowance and reeve more parts of line, rather than fewer parts, than you need. Refer to the values on the load capacity chart for the line weight ratios.

Watch the tail swing of a revolving superstructure, especially if there are people or obstacles in the area.

Always make daily inspections of the wire rope and replace worn, rusty or frayed ropes.

Always place the load on the ground when lubricating or adjusting.

A qualified signalman should be available at all times and especially when;

- working in the vicinity of power lines.
- The crane operator cannot clearly see the load at all times.
- Moving the crane in a direction or area in which the operator cannot clearly see the path of travel.

At all times use standardized hand signals previously agreed on and completely understood by the operator.

If communication with the signalman is lost, crane movement must be stopped until contact is regained.

Watch the load at all times. Watch the signalman and/or load while it is moving. In case you must look in another direction, stop the operation immediately.

Use only one qualified signalman whenever vision is obscured and follow his direction only, but obey a signal to stop from anyone.

KEEP THE BOOM SHORT. Swinging loads with a long line can create an unstable condition and possible structural failure of the boom.

Sound a warning before moving the crane or when approaching personnel.

Always move toward the load and move slowly. Use a tagline to control the load.

Stay clear of sheave wheels, holes, and lattice work in telescoping booms and other potentially dangerous areas whenever the crane is in operation.

Pinch points are impossible to eliminate. Keep all portions of your body away from cable drums, sheave, pulleys, lift cylinders and other moving parts of the crane. Be extremely careful when performing maintenance on the crane.

Use extreme caution when lifting with more than one hoist.

Do not strike any obstruction with the boom. If the boom should accidentally contact an object; stop immediately. Inspect the boom. Remove the crane from service if the boom is damaged.

Never push or pull with a crane boom.

Do not add to the counterweight to increase capacity.

When lifting loads, lift slowly and proceed with caution.

Maintaining a steady tension may free the load without shock loading the crane.

Cranes are designed and rated to handle freely suspended loads. Do not pull post, piling, or submerged articles that may have an accumulation of mud, silt or sand.

When lifting loads the crane will lean toward the boom and the load will swing out, increasing load radius. Ensure the load chart capacity is not exceeded when this happens.

Wind and other factors such as boom length, angle, size and weight of load, etc., can affect crane stability and crane structures. Practical working loads for each particular job and lift shall be established by the user depending on conditions. Appropriate capacity reductions shall be made whenever such conditions exist. Be extremely cautious of winds exceeding 20 miles per hour.

Exercise caution when swinging loads.

Never swing or lower the boom into the carrier cab.

Stop the hook block from swinging when unhooking a load.

Swinging rapidly can cause the load to swing out and increase the load radius. Swing the load slowly. Swing with caution and keep the load lines vertical.

Operate the crane from only the operator's seat. Operating from any other position, such as reaching into the cab, constitutes a safety hazard. Operator's using cable remote controls or radio remote controls for the crane, need to be aware of their positions relative to the operation of the crane, to ensure their safety.

Never operate the crane with less than two wraps of rope on the hoist drum.

Check the hoist brake by raising the load a few inches and holding it there. Be sure the hoist brake is working properly before continuing the lift.

When using a controlled free-fall hoist, slowly return the host to normal lowering speed before stopping the descent of a load. Quick stops could cause the machine to fail. Also refer to CONTROLLED FREE-FALL HOIST information in this section.

Do not attempt to change/shift speeds, on multiple speed hoist, with hoist in motion.

Never pull sideways with the boom. Booms and swing systems are not designed to side pull and may be damaged if subjected to excessive side loading. Booms are designed for lifting only freely suspended loads.

Never permit anyone to ride loads, slings, hooks, etc., for any reason.

Look before you swing the crane. Even through original setup may have been checked, situations can change without notice.

Never stand or work on or near the superstructure while the crane is moving or swinging.

Keep everyone away from suspended loads. Allow no one to walk under a load. Ensure that all slings, ties, and hooks are correctly placed and secured before raising or lowering the load.

Use tag lines, as appropriate, for positioning and restraining load. Check the load slings before lifting.

Be sure everyone is clear of the crane and work area before making lifts.

Check all braking and holding devices before operation. Perform an operational check of all braking (wheel and swing) and safety holding devices before starting any crane or travelling operations.

Be sure the load is well secured and attached to the hood with rigging of proper size and in good condition.

Allow no one to ride on the crane, carrier deck, engine compartment, etc.

Tag line personnel must guide the load from the ground. Use only slings or other rigging devices rated for the job and use them properly. Never wrap the hoist cable around a load.

Check all tackle, hardware, and slings before use. Refuse to use faulty equipment.

Never work on a crane when darkness, fog or other visibility restrictions make operations unsafe.

Exercise extreme caution when picking and carrying a load. Never pick and carry a load with a crane that is not authorized for such operation.

When performing pick and carry operations or operating on sloping ground, carry loads much less than capacity. Keep the load low, carry the load uphill from the crane, swing only to keep the load uphill, and always place the loads on the high side.

When travelling with a load, the boom should be carried in line with the direction of motion.

Report any crane damage immediately.

Check all pin connections, bolts, latches, locks, braking and restraining devices, and operational aides before operation. Perform visual inspection and replace/retighten any damages or loose devices prior to initiating any crane or travelling operations.

Never leave the cab with the load suspended. Should it become necessary to leave the crane, lower the load to the ground and stop the engine before leaving the cab.

Be ALERT, STAY ALERT.

Never swing over personnel, regardless of whether load is suspended from or attached to the boom.

When shutting down the crane adhere to the following:

- Engage the parking brakes.

- Lower the boom and load

- Place the controls in neutral.

- Chock the wheels.

- Ensure the swing lock is engaged.

- Remove the ignition key

- Lock the machine and install vandal guards, if used.

Sling jib sections from the main chords or the end fittings.

When assembling and disassembling jib sections, use blocking to adequately support each section and to provide proper alignment.

Stay outside of jib sections.

Avoid falling or flying pins as they are freed or removed.

WIRE ROPE AND SHEAVES

The following is taken from a National Consensus Standard referenced by Federal Government Agencies.

All wire rope will eventually deteriorate to a point where it is no longer usable. Wire rope shall be taken out of service when the following conditions exist:

1. In running ropers, six randomly distributed broken wires in one lay or three broken wires in one strand in one lay.
2. Wear of one-third the original diameter of outside individual wires. Kinking, crushing, bird-caging, or any other damage resulting in distortion of the rope structure.
3. Evidence of heat damage from any cause.
4. Reductions from nominal diameter of more than;
1/16 inch for diameters up to and including 5/16"
1/32 inch for diameters 3/8 to 1/2" inclusive
3/64 inch for diameters 9/16 to 3/4" inclusive
1/16 inch for diameters 7/8 to a 1 1/8" inclusive
3/32 inch for diameters 1 1/4 to 1 1/2" inclusive
5. In standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.

Refuse to work with worn or damaged rope.

Demand to see the rope inspection record required by law and inspect the wire rope yourself. Do NOT take another persons word.

Never handle wire rope with your bare hands.

Inspect the boom nose and hook block sheaves for wear. Damaged sheaves cause rapid deterioration of wire rope.

Use the wire rope that is specified by the manufacturer.

LIFT ONE LOAD AT A TIME. Do not lift two or more separately rigged loads at one time, even if the loads are within the rated crane capacity.

USE ENOUGH PARTS OF LINE FOR HEAVY LIFTS AND CHECK ALL LINES, SLINGS, AND CHAINS FOR CORRECT ATTACHMENT. To obtain maximum lifting capacities the hook block must be set up with enough parts of line. NOT LESS THAN TWO WRAPS of wire rope should remain on the hoist drum. When slings, ties, hooks, etc., are used, make certain they are correctly positioned and secured before raising or lowering the loads.

Ensure hoist cable (wire rope) is properly routed.

Two-blocking MUST BE AVOIDED, to prevent damage to your crane and to avoid creating a safety hazard. Two-blocking exists whenever a load block, headache ball, rigging, etc., come into physical contact with the boom, boom nose, sheave, jib, etc. Two-blocking can cause hoist lines (wire rope) rigging, reeving, and other components to become highly stressed and overloading in which case the wire rope may fail allowing the load block, etc., to free fall.

If your crane is equipped with an anti-two block warning system, and the system has been damaged, removed from crane, or a malfunction is suspected, refuse to operate the crane if the warning system is not installed and operating satisfactorily.

Caution must be used when lowering or extending the boom, let out cable simultaneously to prevent two-blocking the boom nose and hook block. The closer the load is carried to the boom nose the more important it becomes to let out cable simultaneously as the boom is lowered. Keep the hook block, etc., at least 12 inches (30.48 cm) away from the nose at all times.

CONTROLLED FREE-FALL HOIST

When using your crane during controlled free-fall hoisting operations, the following recommendations are offered:

Exercise caution when using (optional) controlled free-fall hoist – smooth and gradual snubbing of load is necessary to avoid high shock loads.

Use single-part (line) reeving only.

Fully extend and set outriggers.

Ensure that the crane is level and on a firm supporting surface.

Use main boom whenever feasible.

Reduce load values to 30% of the cranes rated load values or 50% of the permissible line pull values as indicated on the crane load capacity chart or the hoist manufacturer's maximum allowable rating, whichever is less.

ELECTRICAL HAZARDS

Read and abide by this warning decal.


Crane operation is extremely dangerous when close to an electrical power source. A mobile hydraulic crane is more vulnerable due to the natural manoeuvrability and versatility of the crane.

Extreme caution must be exercised by all personnel when working with and around your crane when in the area of an energised power source or power lines.

All personnel must be adequately warned of safety procedures.

Assume all power sources are electrically energised (“HOT” or “LIVE”) until you have absolutely reliable information to the contrary.

When operating in the vicinity of power lines, have the power company cut off the power and ground the lines. Obey the following rules, at all times, whether the power is cut off or not.



DANGER

ELECTROCUTION HAZARD

- TO AVOID DEATH OR SERIOUS INJURY, KEEP ALL PARTS OF THIS MACHINE, THE RIGGING, AND MATERIALS BEING LIFTED AT LEAST 20 FEET AWAY FROM ALL ELECTRICAL POWER LINES AND EQUIPMENT.
- KEEP AWAY FROM THIS MACHINE IF IT IS BEING OPERATED NEAR ELECTRICAL POWER LINES OR EQUIPMENT.
- BEFORE OPERATING THIS CRANE IN THE VICINITY OF POWER LINES OR EQUIPMENT, NOTIFY THE POWER UTILITY COMPANY. HAVE POWER TURNED OFF.
- FOLLOW INSTRUCTIONS IN OPERATOR’S AND SAFETY HANDBOOK.

Position the crane far enough away from power sources to ensure that no part of the crane can reach within an unsafe zone. This includes the crane boom (fully extended to maximum height, radius and length) and all attachments (jibs, boom extensions, rigging, tag lines, etc.)

Erect a suitable barricade to physically restrain the crane and all attachments (including the load) from entering into an unsafe distance from the power source.

Obtain positive and absolute assurance that power has been turned OFF.

Anytime there is the possibility of the boom, or any part of the crane, coming in contact with or close proximity to the overhead electrical lines, cables, or other obstructions, such as bridges, gantries, pipe work, scaffolding or buildings, the crane operator must work under the direction of a signal person with a clear view of the work area. The observer must check for adequate clearances, and stop crane operations when clearances are not available.

When working near overhead power sources, the crane frame must be positioned no closer (to vertical plumb line of the nearest cable) than a distance equal to the maximum main boom and jib length plus 20 feet (6m) as measured along the ground. Call the power company if you must work in this restricted area.

Precautions must be taken to ensure that the crane is not working or parked over underground services (gas, water, electrical) or where this is necessary the service must be protected.

IMPORTANT – always consider the wire rope, hoist cable, pendant cables, tag lines, etc., as conductors.

EXERCISE EXTREME CAUTION AND PRUDENT JUDGEMENT WHENEVER ELECTRICAL HAZARDS EXIST – OPERATE SLOWLY AND CAUTIOUSLY.

Comply with federal, state, and local laws and regulations.

It is not necessary to touch a power line or power source to become electrocuted. Electricity, depending on magnitude, can jump or become induced into a crane. “Low” voltage can also be dangerous.

BE ALERT!

Slow down crane operations.

Keep all parts of crane (ropes, load block, and load) at least 20 feet from the line.

Whenever a load, wire rope, crane boom or any portion of the crane contacts or approaches too closely to an electrical power source, everyone in, on, and around the crane can be seriously injured or killed!!

THE ONLY SAFE WAY TO OPERATE A CRANE IS TO STAY AWAY FROM ELECTRICAL SOURCES.

Assume that every line is “HOT”.

Appoint a reliable and qualified signalman, equipped with a load signal whistle or horn and voice communication equipment, to warn the operator when any part of the crane or load moves near a power source. This person should have no other duties while the crane is working.

Warn all personnel of danger. Allow no unnecessary personnel in the area. Permit no one to lean against or touch the crane. Permit no one to hold the load, lines or rigging gear.

Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.

The use of boom guards, proximity devices, industrial hooks, links, or mechanical stops do not assure safety. Even if codes and regulations require the use of such devices, failure to follow rules listed here may result in serious injury or death. You should be aware of some of the limitations of these devices.

Boom cage/guards afford limited protection from the electrocution hazards. They are designed to cover only the boom-nose/point, and a portion of the boom. Performance of boom cage/guards is limited by their physical lengths, insulating characteristics, and the operating environment (eg. Dust, dirt, moisture, etc.).

Insulating links installed into the load-line afford limited protection for those handling the load. Links have limited lifting, insulating, and other properties that affect their performance. Moisture, dust, dirt, oils, etc., can cause a link to conduct electricity. Due to their capacity ratings, some links are not effective for large cranes and/or high voltages/currents. The only protection afforded by a link is that which is obtained below the link- electrically downstream, provided the link has been kept clean and free of contamination and periodically (right before use) tested for dielectric integrity.

Proximity sensing devices are available in different types. Some use boom nose (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, etc., located outside of the sensing area. Much reliance is placed upon you, the operator, in selecting and properly setting the sensitivity of these devices.

Never rely solely on a device to protect you and your fellow workers from danger!

Some variables which you must be aware of are;

1. Proximity devices are supposed to detect the existence of electricity – not it's quantity or magnitude.
2. Some proximity devices will detect only alternating current (AC) not direct current (DC).
3. Some detect radio frequency (RF) energy, others do not.
4. Most proximity devices simply provide a signal (audible, visual, or both) for the operator, the signal MUST NOT be ignored.
5. Sometimes the sensing portion of the proximity device becomes confused by complex or differing arrays of power line/sources.

Plan ahead and plainly mark a safe route before travelling under power lines. Erect rider poles on each side of the crossing to assure sufficient clearance is maintained.

Overhead lines will tend to blow with the wind. Allow for this when determining safe operating distances.

DO NOT store material under power lines or close to electrical sources.

DO NOT depend on grounding! Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the (wire) conductor used, the condition of the ground, the amount of voltage and current present. Power source contacts have been known to cause serious arcing due to grounding.

Tag lines should always be made of non-conductive material.

Any tag line that is wet or dirty enough can conduct electricity.

Working in the vicinity of radio frequency/transmission sources may cause a crane to become electrically “charged”. Survey the work site and develop specific safety precautions and operating procedures, prior to commencing operations.

If contact is made with a power source – THINK, DO NOT PANIC.

1. Warn everyone to stay away from the crane.
2. Attempt to free the crane by operating the crane functions.
3. Stay in the crane until the power source has been de-energized.

Only as a last resort should the operator attempt to leave the crane upon contacting a power source.

If necessary to leave, JUMP COMPLETELY CLEAR OF THE CRANE – DO NOT STEP OFF. Hop away from the crane with both feet together. Do NOT walk or run.

When operating cranes equipped with electromagnets you must take extra precautions.

1. Permit no one to touch the magnet or the load.
2. Alert personnel by sounding a warning signal when moving a load.
3. Do not allow the cover of the electromagnet power supply to be opened during operation or at any time the electrical system is activated.
4. Shut down the crane completely and open magnet control switch prior to connecting or disconnecting magnet leads.
5. Use only non-conductive devices when positioning a load.
6. Lower magnet to stowing area and shut off power BEFORE leaving the cab.

Follow any contact with an energized source, thoroughly inspect the wire rope and all points of contact.

Advise your distributor of the incident and consult the factory for advise and crane inspection instructions prior to resuming operations.

PERSONNEL PLATFORMS

NOTE:

Platform as used herein is defined as any attachment made to a crane boom which is intended to elevate or position people and includes workbaskets, cages, or other devices for handling personnel.

Handing of personnel from the boom is not authorized except with equipment furnished and installed by ARVA INDUSTRIES INC.

Written approval shall be obtained from ARVA INDUSTRIES INC. prior to handling personnel.

COLD WEATHER OPERATION

Cold weather operation requires additional caution on the part of the operator.

Check operating procedures for cold weather starting.

Do NOT touch metal surfaces that could freeze you to them.

Clean the crane, especially the boom, of all ice and snow.

Allow ample time for hydraulic oil to warm up.

During freezing weather, frequently check all air tanks for water.

Always handle propane tanks according to supplier's instructions.

Never store flammable materials on crane.

Before lifting, ensure that the load is not frozen to the ground or other cold surfaces.

If cold weather starting aids are provided on your crane, use them. The use of aerosol spray or other types of starting fluids containing ether/volatilise can cause explosions or fire.

DON'T FORGET

Load charts represent the absolute maximum allowable loads, which are based on either tipping or structural limitations under specific conditions. Knowing the precise radius of operation, boom length, and angle should be part of your routine planning and operation. Actual loads, including necessary allowances, should be kept below these figures.

Working areas must be adhered to when determining allowable load from load chart(s).

If the crane is not level, load charts are reduced when lifting on the low side. Do NOT be misled by optical illusions. Use your level bubble.

If you should encounter a tipping condition, start by lowering the load with the hoist line and retractor to elevate the boom to bring the load in. Never lower or extend the boom, this will aggravate the condition.

When using the hoist line avoid sudden stops. Increased loading will result and could cause tipping or a structural failure to occur.

Maximum lifting capacity is available at the shortest radius, minimum boom length and highest boom angle.

Proper lubrication is a requirement in any heavy equipment operation. Follow the factory recommendations regarding the lubrication time intervals and types of lubricant used. Adjust time intervals accordingly when working under severe conditions.

When performing maintenance, refer to the appropriate section of this manual for instructions. Consult the factory if there is any question regarding procedures or specifications.

Do not attempt repairs you do not understand.

Be certain that all lines, components, and fittings are tight and serviceable. Use a piece of cardboard to check for leaks in the hydraulic system.

Have an appropriate fire extinguisher available and know how to use it. Inspect as required to ensure that it is fully charged and operable.

Unless authorized and approved by Arva Industries Inc., do not make any modifications, alterations, or changes to the machine which could in any way effect the original design. Such action invalidates all warranties, and makes the owner/user liable for any resultant accidents.

Keep your fingers away from potentially hazardous areas.

Always perform a functional check after repairs have been made to ensure proper operation.

In freezing weather, do not touch metal surfaces that could freeze you to them.

Pinch points are impossible to eliminate. Keep all body parts away from moving parts. Be extremely careful when performing maintenance.

Refuse to operate faulty equipment.

Report any damage to the machine immediately.

Check all pin connections, bolts, and operational aids before operation. Perform a visual inspection and replace/tighten any damaged or loose devices prior to operation.
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Maintain battery electrolyte at the proper level. Check the state of charge indicator with a flashlight.

A spark or flame could cause a battery explosion. Don't short across the posts to check the charge.

Check battery condition only with proper test equipment. Batteries shall not be charged except in an open, well ventilated area free of flame, smoking sparks and fire.

Do Not smoke while performing battery maintenance.

Disconnect the grounded battery clamp first when removing a battery and connect it last when installing battery.

Follow standard safety precautions when refuelling. FUEL IT SAFELY.

Be careful when checking the coolant level. Shut down the engine and allow the radiator time to cool before removing the radiator cap.

Allow NO ONE other than the operator to be on the machine while the machine is functioning or moving.

Inspect the tires for nicks and cuts, imbedded stones, and abnormal wear. Ensure all lug nuts are properly torqued.

When shutting down machine adhere to the following: engage the parking brakes, lower the tower and the load, place the controls in neutral, chock the wheels, remove the ignition key, put the cable control console in storage box, lock the machine and install vandal guards as appropriate

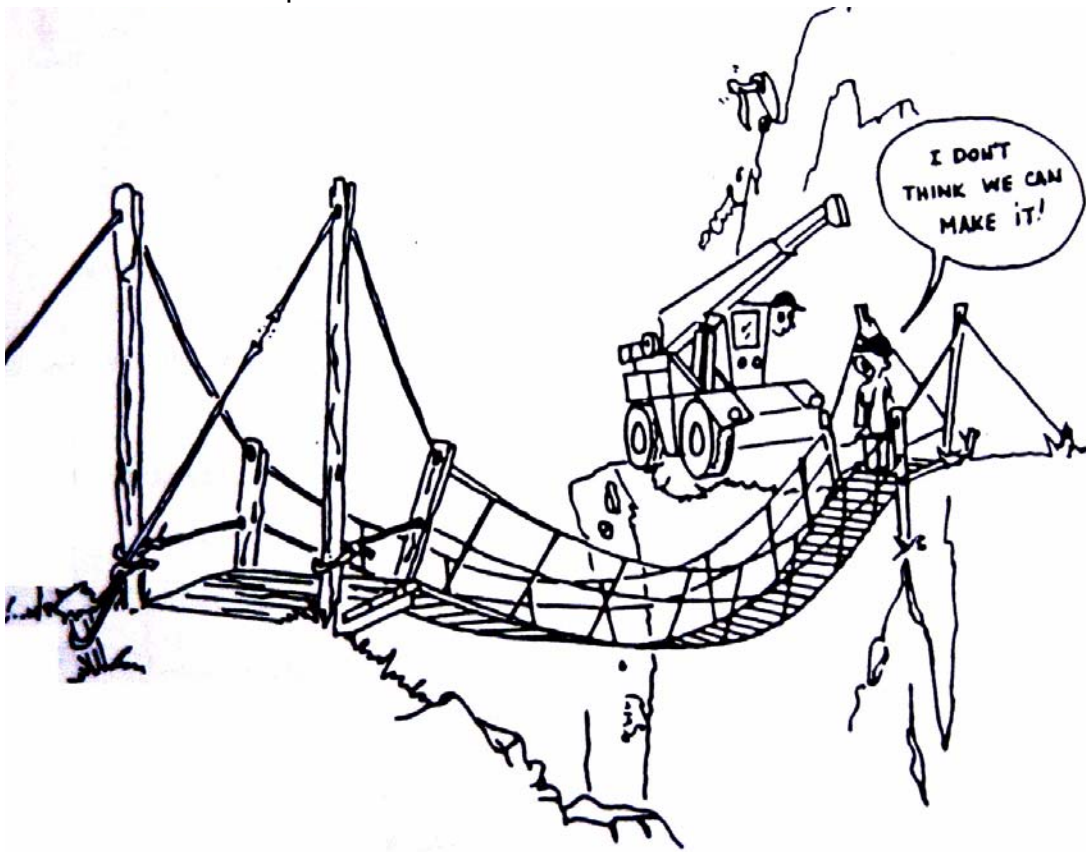
During travel operation, check load limit of bridges. Before travelling across bridges, ensure they will carry a load greater than the machines weight and the decking is suitable for wheel loads.

When driving from central station on platform deck, always use a spotter person to verify clearance and direct operator.

Watch clearances when travelling. Do not take a chance of running into overhead or side obstructions.

When moving in tight quarters, post a look-out to help guard against collisions or bumping structures.

Never backup without the aid of a signalman to verify the area behind the machine is clear of obstructions and/or personnel.



When travelling, the tower should be completely lowered and stowed in its travel position.

Secure loose items like tools, hooks and lines before moving the machine.
Drive carefully and avoid speeding.

Use adequate cribbing under outrigger floats to distribute weight over a greater area. Check frequently for settling.

Use the sight level bubble indicator to ensure machine levelling. The importance of properly levelling the machine cannot be over-stressed, if only slightly out of level a tipping condition could be encountered.

Ensure that load on platform is properly placed to avoid platform overload and ensure that loads are secure prior to travel or raising or lowering platform.

HANDLING THE LOAD

Safety of the operator and ground personnel holds top priority in load handling operations. The following rules should take precedence with the operator:

1. Do not lift a load if machine is not firmly positioned on rubber or fully extended outrigger.
2. Assure that ground personnel, above and below the load are clear and kept clear of all obstructions and personnel.
3. Always use proper chains or slings applicable to type of load.
4. Assure that all ground personnel are wearing approved safety hats and shoes!
5. Refer to rated capacity on load charts before lifting loads.
6. When operating with single or multi-part line, no less than three (3) wraps should remain on the hoist drum.

OPERATING PRECAUTIONS

1. Do not perform any crane operations with engine idling. Operate engine at specified rpm during performance of all operations.
2. Always keep load as close to the crane and to the ground as possible when swinging the boom.
3. Keep distance between boom nose and load as short as possible to prevent excessive load swing.
4. Never shift load with cylinders fully retracted (Bottomed).
5. When lowering or extending boom, let out cable simultaneously to prevent two-blocking boom nose and hook block.
6. Always operate crane control levers with slow even pressure. Never jerk lever.
7. Never suddenly release a control lever to stop a function. Always return lever to neutral in smooth, even manner.

SECTION 3

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EQUIPMENT DESCRIPTION & LOCATION

GENERAL DESCRIPTION

The Arva Model AR16520M crane is an electrically driven, hydraulic powered machine designed to attach to a pedestal or base.

The AR16520M crane has a single piece luffing boom, consisting of a double tapered rectangular boxed section design.

The boom is controlled through the use of two (2) boom lift cylinders. The boom lift cylinders are positioned to give maximum clearance when handling loads with a fully raised boom.

The crane turret is mounted on a shear ball type swing bearing and is powered by two (2) hydraulic Gerotor style motors through planetary style gear reducers with hydraulically released, spring applied, wet disc brake. Swing function has 360 degrees continuous capability but is limited due to the ships equipment location.

The crane is operated by two (2) joystick dual axis control units that are mounted in the operators seat arm rests.

The crane has three (3) hoists. The main hoist (M) is reeved with a two part line has 30,000 lb capacity. The left (L) and right (R) whip hoists are both mounted on top of the boom and are rated for 10,000 lbs lift with a single part line. The rear hoist is reeved to the left boom tip fairlead. The front hoist is reeved to the right boom tip fairlead.

The electro/hydraulic power unit (HPU) is located remotely below the ships upper deck. The power unit consists of a 100 horsepower 460 VAC, 60 hz, 116 amp, 3 phase, 1,800 rpm, TEFC motor with soft start switching. The motor is directly coupled to a Danfoss variable displacement, horsepower limiting 50 gpm pump. The pump only supplies oil on demand. If the crane is not operating oil does not circulate and heat up.

The HPU is mounted on top of a 200 US gallon reservoir with a 10 micro return oil filter, suction screen and filler/breather. The reservoir is bolted to the ships deck on all four corners.

On demand oil flows from the power unit through the cranes support pedestal then through a hydraulic swivel which permits 360 degree rotation to the electronically controlled directional control hydraulic valve. Oil then flows to the required function

CRANE CONTROLS & INDICATORS

CAB CRANE CONTROLS

The crane functions are mainly controlled by two multi-function joysticks, which are mounted on the arm rests of both cabs, which control all three (3) hoists, boom luffing, and swing functions.

Only two hoists may be operated simultaneously and there is a hoist mode switch, which permits selection of hoist operations, the switch is located on the inboard corner of the cabs.



The hoist mode switch has three (3) positions, modes #1, #2 and #3. The positions are as follows.

- Position #1 Permits operation of main hoist from left control and right whip hoist from right control
- Position #2 Permits operation of left whip hoist from left control and right whip hoist from right control.
- Position #3 Permits operation of main hoist from left control and left whip hoist from right control

HOIST CONTROL

Select hoist and hoist mode. Movement of the hoist control away from operator lowers the load and movement of the control towards operator raises load. The operation is the same for all hoists.

BOOM LUFFING CONTROL

The boom luffing control is located on the right joystick. Moving the controller to the left (inboard) raises the boom and moving the control to the right (outboard) lowers the boom.

SWING CONTROL

The swing control is located on the left joystick. Moving the control to the left will cause the crane boom to swing left. Moving the control to the right will swing the crane boom to the right.

Any of the controls may be operated simultaneously within the hydraulic pump oil supply capacity.

HYDRAULIC POWER UNIT (HPU)

The crane is powered by a 460 VAC/50 GPM electro/hydraulic power pack, with soft start controls, which is located below deck. The electric motor and pump are located on top of the 200 US gallon reservoir with return filter, suction screen and filler/breather. Motor with pump must rotate clockwise when looking at motor end opposite pump.

The power unit may be started from two different locations. For crane operations the start/stop location is located between the two cabs. For maintenance purposes, the start/stop switch is located on the HPU electro starter box at the power unit.

The emergency stop switches are located on top of both cab crane control panels. If the crane has been stopped by one of the emergency stop switches located in either cab or at the remote start position (main start), the stop switch must be reset (twisted and pulled out) before the HPU may be restarted from either the main HPU starter box or from the maintenance start location at the HPU.



CAB SEAT ASSEMBLY

The cab seats have a joystick mounted within each arm rest. Crane functions are electronically controlled via movement of the joystick for respective function as described within the controls section of the manual. All crane functions are infinitely variable. Moving the controller from neutral in a direction will cause function to start to move and will increase in speed or power as control is moved further away from neutral. Moving the joystick in a diagonal direction will cause the respective function to move.

The operator seat is adjustable as follows:

- Rotate with 90 degree lock positions
- Height adjustment
- Fore and Aft adjustment

CAB PANEL CONTROLS (see lights and controls figure on page 3.5)

1. Green Light on indicates that HPU is running.
2. Green Light is ON when ready to operate from respective cab.
3. Push Button switch to activate respective cab controls and cab joysticks. Turns ON Green Light #2 indicating respective cab controls are ON.

NOTE: HPU can not be started and cab can not be turned ON if opposite cab controls are not turned OFF.
4. Push Button switch to turn OFF respective cab controls. Green light #2 will go OFF.
5. Light when ON indicates that crane boom is approaching interference point on ship.
6. Hoist Mode Switch permits operation of hoists as required. See page 3.2 for descriptive detail.
7. Switch turns ON or OFF boom flood light. Light may be turned ON or OFF from either cab.
8. Green Light indicates load on crane is within rated capacity.
9. Amber Light indicates 85% to 100% of rated capacity load on crane.
10. Red Light indicates 100% to 115% of rated capacity load on crane.
11. 2nd Red Light indicates overload when ON. Lifting is shut down. Reduce load.
12. Emergency Stop Button push down to stop HPU. Must be reset before HPU can be restarted. Twist and lift up emergency stop button to reset.



LOAD MONITOR SYSTEM LIGHTS AND CONTROLS

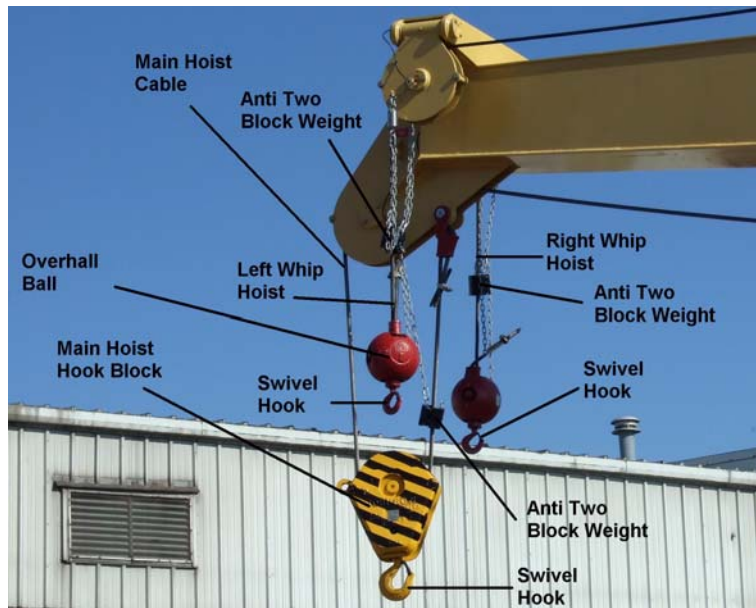
The crane is supplied with a load monitor light system.

The load monitor system on the crane measures load moment as determined by the pressure in the boom lift cylinders. With the load chart and boom angle indicator, the permissible load to be lifted may be determined. See cab panel controls section (page 3.4) for load light description.

ANTI-TWO BLOCK

The Arva model AR16520M crane is equipped with an anti-two block switch and weight assembly on each hoist unit.

It is pre-assembled on the crane prior to shipping. The theory of operation is to prevent sheave block or overhaul ball from being drawn up into the boom sheave, by means of a weighted switch. When the anti-two block weight is lifted via contact with the hook block or overhaul ball, the switch will open and the crane hoist up function will be stopped. Hoist function may be reversed. The other hoist functions are not effected if one hoist anti-two block is activated.



MAIN HOIST WINCH & CABLE

The main hoist is mounted on the bottom of the boom in front of the boom lift cylinders. The winch is a Lantec model LHS 170 which has a planetary reduction with dynamic and integral disc holding brake and is driven by a gear style hydraulic motor. The winch utilizes an over-center load valve for dynamic braking which incorporates an adjustable flow control that controls the application speed of the load holding brake.

The winch has 15,400 pound single line pull capability on top cable layer. The maximum line speed is 53 fpm on the first layer.

The cable supplied is 420 ft of 7/8 inch Dyform 18 with 45.4 tons breaking strength.

See Lantec LHS 170 in the Service Pack Section for data sheets for hoist troubleshooting.

WHIP HOIST WINCHES & CABLE

There are two (2) whip hoists which are mounted on top and toward the back of the boom. Both winches are Lantec model LHS 100 which have a planetary reduction with dynamic and integral fail safe holding brakes and is driven by a gear style hydraulic motor. The winch utilizes an over-center load valve for dynamic braking which incorporates an adjustable flow control that controls the application speed of the load holding brake.

The winches have 10,000 pound single line pull on the top cable layer. The maximum line speed is 140 fpm on the first layer.

The cable supplied is 320 ft of 3/4 inch 19 x 7 non-rotating structure with 32.8 tons breaking strength.

See Lantec LHS 100 in the Service Pack Section for data sheet for hoist troubleshooting.

MANUAL ANGLE INDICATOR

There is a visual angle indicator located on both sides near the base end of the boom.

It is to be used as a visual reference guide for the operator.

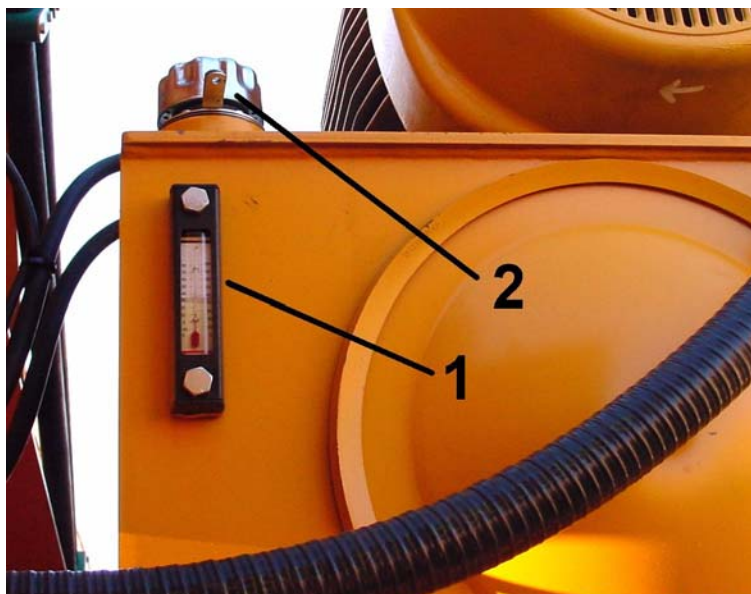


OIL LEVEL INDICATOR

The oil level indicator (1) is located on the HPU oil reservoir which is located below deck. It is part of the HPU package. The indicator is a thermometer style gauge indicating oil temperature. Maximum permissionable oil temperature is 140 degrees F.

The oil level should always be checked after crane has run and all functions have been operated. Place the crane in the cradle and check oil level in the tank.

The hydraulic oil tank fill and vent filter is also located on the tank. Do not overfill tank. Always leave approximately one (1) inch expansion space.



OPERATING PROCEDURES

PRE-OPERATIONAL CHECKS

WARNING

ALL PRE-OPERATIONAL CHECKS MUST BE COMPLETED PRIOR TO PERFORMING ANY OPERATIONS WITH THIS MACHINE.

DEATH OR INJURY TO PERSONNEL COULD RESULT IF PRE-OPERATIONAL CHECKS ARE NOT PERFORMED.

GENERAL

A complete walk-around visual inspection of the machine should always be made with special attention to structural damage, loose equipment, leaks, or other conditions that would require immediate correction for safety of operation. The following checklist items are suggested specifically for the operator's benefit to make certain the machine is prepared for starting the days work.

The machine should be inspected at the beginning of each day to ensure that it is in proper working condition.

- a) The operator's first check is the hydraulic oil supply. Ensure that hydraulic fluid levels are sufficient for operation. With all systems shut down (cylinders fully retracted) check level in the hydraulic reservoir; fill to upper 'FULL' mark. Check breather for cleanliness and security.
- b) Assure that all components requiring daily lubrication have been serviced. (refer to lubrication chart for specified lubricants)
- c) Inspect wire rope in accordance with applicable Federal Regulations. Sheaves, guards, guides, drums, flanges, and any other surfaces that come in contact with the rope should be inspected for any condition that could cause possible damage to the rope.
- d) Hook block and overhaul ball hooks should be inspected for nicks, gouges, cracks, and evidence of any other damage. Replace a hook containing cracks or showing evidence of excessive deformation of the hook opening (including twist). Be sure the safety latch is free and aligned.
- e) A visual inspection of the machine will allow for inspection for leaks at all valves, cylinders, hydraulic lines and fittings.

VISUAL INSPECTION

- a) Look for signs of scuffed paint on the frame which could indicate that the machine has come in contact with an obstruction or a load. Check for cracked welds and deformation.
- b) Look for tags which may indicate that the machine is under repair. Refuse to operate the machine until authorized personnel remove these tags.
- c) Check the entire machine for visibly loose or missing bolts and pins.

FUNCTIONAL CHECKS**WARNING**

PRIOR TO ANY FUNCTIONAL CHECKS THE OPERATOR SHOULD CHECK FOR OBSTRUCTIONS WITHIN THE OPERATING ZONE. THIS MAY BE IN THE FORM OF PERSONNEL IN THE AREA OR SERVICE EQUIPMENT. KEEP ALL PORTIONS OF YOUR BODY AWAY FROM PINCH POINTS, LIFT CYLINDERS, GEARING, AND OTHER MOVING COMPONENTS UNLESS THE MACHINE IS SHUT DOWN.

After the crane has been readied for service, an operational check of all crane functions (with no load applied) should be performed

NOTE

Carefully read and become familiar with all crane operating instructions before attempting a pre-load check and operating the crane under load.

1. The operator should be alert to any of unusual noises, loss of power or poor response to controls while operating the machine. These symptoms could be a sign of malfunction of a component. If the machine does exhibit unusual characteristics it should be shut down until a cause is found and corrected.
2. Items which operators should be attentive to and would necessitate shut down include:
 - a) Controls which bind or do not work freely
 - b) Oil leaks which develop while operating
 - c) Unusual noise from the hydraulic system
 - d) Erratic operation of any control function.
3. The operator has the responsibility to check that all functions are working correctly. The operator should shut down the machine if any function does not perform as required.
4. If the machine is operated by more than one operator, be sure to notify the next operator and the supervisor of any malfunction when changing shifts.

OPERATIONAL CHECKS**NOTE**

The crane should be allowed to warm up for several minutes before the operation check is performed. This allows the hydraulic oil to circulate through the system, warming it and preventing system damage and erratic operations. It is important to engage the hydraulic cylinders slowly during cold weather since severe shock loading could occur if cold oil in cylinders is not displaced slowly.

Remember any other load handling devices such as hook block, chains, slings or spreader bars must also be considered and the weight of these devices must be added to the weight of the load.

The following functions are to be checked;

- a) **Control Lever Operation** Start the crane according to the Operating procedures. Check that control levers maintain a crane function at a desired position by, releasing the function lever to its neutral position. Should any of the levers not respond as indicated in the operation section, notify person of authority and do not operate crane until situation is corrected.
- b) **Boom Lift Lower Function** Check crane lift/lower function raise, lower a minimum of 45 degrees. Is operation smooth?

CAUTION
BE SURE SUFFICIENT SPACE AVAILABLE BEFORE RAISING AND SWINGING THE BOOM, DAMAGE TO EQUIPMENT OR PERSONNEL MAY RESULT.

- c) **Hoist Function** Check hoist up and down function. Is operation smooth?
- d) **Swing** Check swing CW & CCW function. Is operation smooth? Checking that swing position ALERT light works.
- e) **Anti-Two Block** Check that anti two-block is working by bringing hook up and activating ATB switch. Up function must stop. This is applicable for all three (3) hoists.
- f) **Overload** Check overload system every week with load for proper operation.

Green Light - indicates load on crane within rated capacity.

Amber Light - indicates 85% to 100% of rated capacity on crane.

Red Light - indicates 100% to 115% of rated capacity on crane.

2nd Red Light - indicates overload when ON. Lifting is shut down. Reduce load.

If the machine passes all pre-operational checks then further preparation for work may proceed.

OPERATING CRANE

NOTE:

When Starting or Re-Starting power unit let the power unit run for one minute to permit control pilot pressure to stabilize before operating controls.
Power unit is designed to run continuously.

HYDRAULIC POWER UNIT (HPU)

A 100 HP, 460V AC, motor drives the pressure and flow compensated pump. Pump supplies hydraulic power on demand. The oil reservoir level indicator is below the pump. Power unit assembly with return filter, suction screen and filler/breather is bolted to the ships lower deck. Hydraulic swivel and valving is located in centre of slew bearing. Electric slip ring assembly for controls permit 360 degree (continuous) swing and is also located in swing bearing support structure.

STARTING HYDRAULIC POWER UNIT (HPU) AND CHECKING CRANE FUNCTIONS

1. Be sure that all safety measures required have been followed (ie, clear area, no obstructions for crane, etc.)
2. Twist pull out all E-stop pushbuttons located in the two (2) cabs and at power unit start/stop box between cabs.
3. Push hydraulic power unit (HPU) start button located on electrical start box between cabs. Green light will activate indicating hydraulic power unit (HPU) is running.
4. Go to the cab that the crane is to be operated from. Green light (#1) should be on indicating that hydraulic power unit (HPU) is running.
5. Push switch (#3) to activate respective cab. This turns ON green light (#2) indicating selected cab controls are activated. Push switch (#4) to deactivate respective cab. Carefully check that the joysticks have been deactivated.

<p style="text-align: center;">NOTE</p>
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<p>Cab can not be turned ON if opposite cab controls are ON. If opposite cab is ON, go turn OFF opposite cab by pushing the OFF button.</p>

6. Select hoist control mode for the hoist units to be operated.
7. Pay out all hoist cables so that hook block (main winch) and overhaul ball hooks (whip hoists) may be unhooked from secure position.
8. Luff boom up and check operation of all three (3) anti two-block mechanisms. Each anti two-block should stop respective hoist up function.
9. Swing boom left and right to check operation of swing ALERT (CAUTION) amber light at top centre of cab panel.
10. Push the 'Emergency Stop' pushbutton. Be sure no functions can be activated with the 'Emergency Stop' pushbutton depressed. HPU will be shut down , visually check that green light (#1) is OFF.

CAUTION

THE MACHINE FUNCTIONS WILL OPERATE DURING THIS CHECK. BE CERTAIN THAT THERE ARE NO OBSTICLES NEAR THE MACHINE

CAUTION

IF ANY FUNCTION OF THE CONTROL ACTIVATES WITH THE 'EMERGENCY STOP' ENGAGED, THE CRANE MUST NOT BE USED UNTIL IT IS REPAIRED.

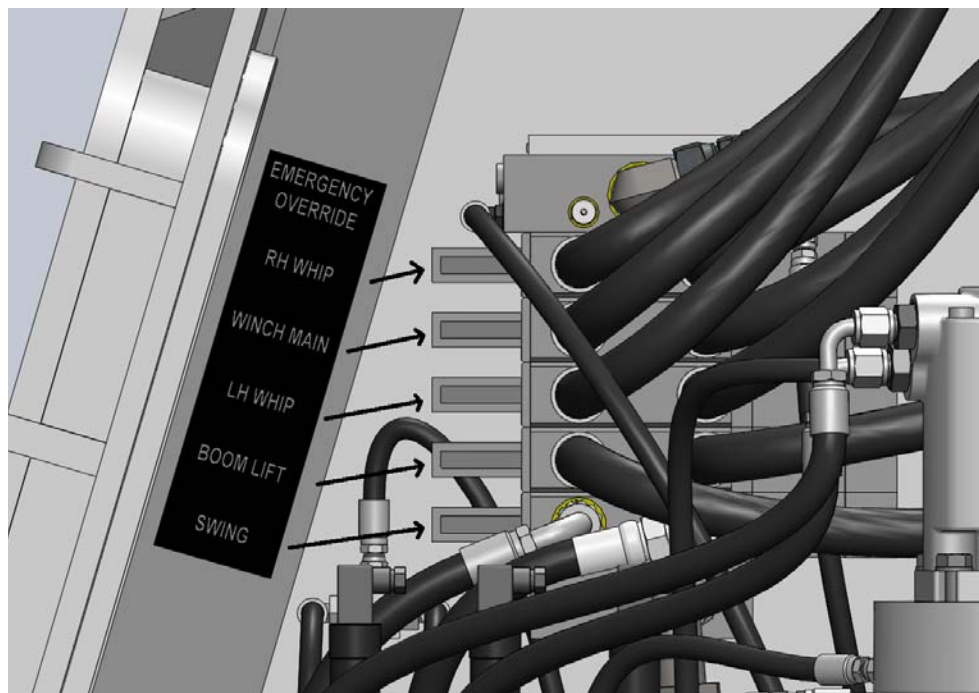
11. Twist pull out the 'Emergency Stop' pushbutton.
12. The crane is now ready for operation. Restart the HPU and activate the respective cab for operation.

CAUTION

TO AVOID ACCIDENTAL START-UP, ALWAYS ENGAGE THE E-STOP PUSHBUTTON WHEN BOOM HAS BEEN PLACED INTO CRUTCH AND HOOKS SECURED. THE E-STOP PUSHBUTTON STOPS THE POWER UNIT AND DISABLES CAB FUNCTIONS

MANUAL EMERGENCY CONTROLS

For emergency or maintenance operation, there is a set of manual control levers located inside of the turret.



To use emergency controls the HPU must be started from the HPU start location located between cabs. Light comes ON indicating HPU is running.

NOTE:

HPU may be stopped from emergency control location or either cab,

In the event that the use of manual controls is required, open the turret inspection door and clip safety harness securely while operating or working on crane components. With HPU running, push and hold the emergency override enable button, which is located on the electrical box inside the turret inspection door, then move the function lever in the direction required, as labeled, to activate the respective function. Function speed increases as the lever is moved from the neutral position.

All functions are infinitely variable from zero movement to maximum speed.

FUNCTION CONTROLS

Function and function direction decals are mounted on the cab control boxes and joysticks.

Crane functions are controlled by moving the lever in the direction of desired function to activate the function. Function speed increases as lever is moved from the neutral position.

All crane functions are infinitely variable from zero movement to maximum speed and are dead man style.

SWINGING THE BOOM**CAUTION**

BEFORE INITIATING ANY SWING OPERATIONS, ASSURE THAT THE AREA IN SWING PATH OF HOOK AND/OR LOAD IS CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL

The swing control lever is located on the left joystick and is marked with swing right and swing left decals. Swing is operated by moving the control lever to the right for swing right, and moving the lever to the left for swing left. Function will hold position when lever is in neutral position.

RAISING & LOWERING THE BOOM**WARNING**

BEFORE RAISING OR LOWERING BOOM, ASSURE THAT THE AREA ABOVE AND/OR BELOW BOOM IS CLEAR OF OBSTRUCTIONS AND PERSONNEL.

The boom lift is operated by moving the right control lever to the right for downward boom motion, and pulling the lever to the left for boom raise. Function will hold position when lever is in neutral position.

LOWERING & RAISING THE HOIST CABLE (LOAD)

WARNING

BEFORE LOWERING OR RAISING THE CABLE (LOAD), ENSURE THE AREA BENEATH THE LOAD IS CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

NOTE

When the load is stopped at the desired height, the automatic brake will engage and hold the load as long as the control lever remains in neutral.

Lowering the Cable (Load)

To lower the cable, move respective lever forward. The function will hold its position when the lever is returned to its neutral position. Refer to hoist mode for respective hoist to be operated and position of hoist mode switch.

Raising the Cable (Load)

To raise the cable, pull the lever back. The function will hold its position when the lever is returned to its neutral position. Refer to hoist mode for respective hoist to be operated and position of hoist mode switch.

ANTI-TWO BLOCK

The anti-two block system supplied with the AR16520M crane consisting of a switch and weight assembly on the nose of the boom, which helps prevent the operator from damaging sheaves and hook block. When the hook block reaches the weight attached to the switch, cable (load) motion will stop.

Reverse function to eliminate anti-two block condition. Each hoist has an anti-two block system. Each system is independent.

USING YOUR LOAD CHART

NOTE:

The most important tool of every crane is the load chart. There is a copy in this manual (see capacity in Section 1), and there is a decal of the load chart on the electrical panel up in each cab and one located on the crane pedestal.

The load chart contains a large amount of information, which must be thoroughly understood by the operator. The load chart contains a range diagram, as well as charted numbers.

The range diagram illustrates the tip height which can be achieved at each angle and radius. If the operator knows the radius required for a specific lift and the tip height necessary, he can calculate the required angle needed for the lift. The operator then checks the capacity chart (for the specific boom length if applicable) to find out if the crane is capable of performing the lift safely.

Be sure to read all notes to lifting capacities carefully so you understand what each one means.

Remember any other load handling devices such as hook block, chains slings, or spreader bars must also be considered and the weight of these devices must be added to the weight of the load.

OVERLOAD

Should an overload occur, the crane functions stopped will be the hoist up and boom lower. When overload occurs the RED light on the cab console will come ON. When in overload mode opposite crane functions may be operated (hoist down, boom up and swing).

EMERGENCY OPERATING PROCEDURES

(WHEN EQUIPPED WITH BOOM LIFT EQUALIZER LINE)

Although highly improbable, if proper maintenance and frequent inspections are made, there remains the possibility that the boom lift cylinders hydraulic equalizer line could become damaged. If this occurs, there are restricting devices provided to allow continued operation of the crane. All crane functions remain operable until the hydraulic oil in the reservoir is depleted. The most important thing is to get the boom and load in a safe position so, that repairs can be made. The following procedures are recommended for getting the boom to a safe position, should the equalizer line fail.

1. Remain at the operator's controls as all functions can be accomplished from this position.
2. Maintain the desired boom angle by pulling lift control lever (9) back, as necessary. Fittings have orifices to minimize oil loss.
3. While maintaining the boom at this angle, activate swing and operate the hoist as necessary until the load is safely lowered to the ground.

Crane may be re-oriented or boom lowered in the event that the controls have been damaged, but power unit is still running.

NOTE:

In the event the use of manual controls is required, use 3 point contact climbing ladder and clip harness on securely when on platform.

RECOMMENDED CRANE SHUTDOWN PROCEDURES

The following procedure will extend serviceable life of various crane components, reduce vandalism and accidents during crane shutdown periods or anytime the crane is left unattended.

1. Remove load from hook.
2. Lower boom to lowered position resting in crutch.
3. Secure hook blocks.
4. Ensure all operating controls in neutral.
5. Turn off power unit
6. Close and lock, if applicable, covers, and doors.

SECTION 4

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LUBRICATION

Following the designated lubrication procedures is important in ensuring maximum lifetime and utilisation. The procedures and lubrication chart in this section includes information on the types of lubricant used, the location of lubrication points and the frequency of lubrication. The service intervals specified are for operation where humidity and atmospheric conditions prevail.

Lubrication Points

CAUTION
THE MULTIPURPOSE GREASE INSTALLED DURING MANUFACTURE IS OF A LITHIUM BASE. USE OF A NON-COMPATIBLE GREASE COULD RESULT IN DAMAGE TO EQUIPMENT.

A regular frequency of lubrication must be established for all lubrication points. Normally this is based on component operating time. The most efficient means of keeping track of lubrication requirements is by maintaining a job log indicating machine usage. Lubrication requirements must be made on a time basis, ie, weekly, monthly.

All grease fittings are SAE STANDARD 1/8-27 NPT. Grease non-sealed fittings until grease is seen protruding from the shaft or bushing.

Over lubrication on non-sealed fittings will not harm the fittings or components, but under lubrication will definitely lead to a shorter component lifetime.

Unless otherwise indicated, items not equipped with grease fittings, such as linkages, pins, levers, etc., should be lubricated with oil once a week. Motor oil, applied sparingly, will provide the necessary lubrication and help prevent the formation of rust.

Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced.

Where wear pads are used, cycle the components and re-lubricate to ensure complete lubrication of the entire wear area.

Check oil level in oil tank before operating, to ensure sufficient oil is there.

HYDRAULIC OIL RECOMMENDATIONS

When replenishment of the oil becomes necessary, or when replacement of the oil is required as a result of contamination or operation outside the recommended temperature range for the factory fill oil, the following types of oil are suitable under most operating conditions.

1. Tractor Hydraulic Fluids of suitable viscosity.
2. Good quality anti-wear hydraulic oils of suitable viscosity and specifically formulated to provide chatter-free operation of wet brakes.

The most important factor in selecting an oil for hydraulic service are;

1. Viscosity
2. Anti-wear additives

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. Cold weather start-up procedures should allow for a gradual warm-up until the oil reaches a reasonably fluid state.

Oil too light may cause the following conditions in the system.	Oil too heavy may cause the following conditions in the system.
Excessive leakage. Lower volumetric efficiency of the pump. Increased component wear. Loss of system pressure. Lack of positive hydraulic control. Lower overall efficiency.	System pressure drop. Increases system temperature. Sluggish system operation Low Mechanical efficiency. Higher power consumption.

The following oil viscosity characteristics are recommended.

- 80 to 180 SUS optimum at system operating temperature
- 60 SUS minimum at system operating temperature
- 7500 SUS maximum at starting temperature
- 90 Viscosity Index (VI), minimum
- Pour point at least 20 degrees F (11 degrees C) below start-up temperature

The following grades will usually meet the viscosity requirements.

METRIC DESIGNATION	SAE VISCOSITY DESIGNATION	TEMPERATURE - °F (°C)
ISO32	5W-20	-10 to 180 (-23 to 82)
ISO46	10W	+10 to 180 (-12 to 82)
ISO68	10W-30	+10 to 210 (-12 to 99)

Arctic Conditions (Below 0 degrees F (-18 degrees C))

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as hydrogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and war bands. If you are in doubt about the suitability of a specific fluid, check with crane manufacturer.

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

Anti-wear Additives

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

OPERATOR MAINTENANCE CHECKS & LUBRICATION

AR16520M



LUBRICATION SCHEDULE

ITEM	LOCATION	TYPE	PETRO CANADA*	QTY	FREQUENCY		
					LUBE	CHECK	CHANGE
1	Swing Bearing	EP-Lithium Grease	Precision XL EP2		50 hrs	100 hrs	
2	Swing Gear Planetary Drive**	EP 80/90 Gear Oil	Traxon 80/90	6 L		50 hrs	500 hrs
3	Swing Gear Teeth	Open Gear Lube	Tex Clad 2		50 hrs	50 hrs	
4	Boom Pivot Shaft (2)	EP-Lithium Grease	Ultra Lithium EP2		50 hrs	200 hrs	
5	Lift Cylinder pins (4)	EP-Lithium Grease	Ultra Lithium EP2		50 hrs	200 hrs	
6							
7	Hoist LHS170A***	Spartan EP 150	Enduratex EP150	6.8 US Gal		100 hrs	1000 hrs
8	Hoist LHS100A*** (2)	Spartan EP 150	Enduratex EP150	2.2 US Gal		100 hrs	1000 hrs
9	Hydraulic Oil Reservoir	Hydraulic Oil ISO 32	Petro Can Hydrex 32	200 US Gal		Daily	1000 hrs
10	Return Oil Filter	10 Micron Element	See Spare Parts List			Daily	500 hrs
11	Wire Rope (3)	See Section 5 for recommendations				Daily	
12	Hinges (2) Turret & (2) Pedestal	Light Oil			As Required		
13	Hook Block Sheave & Swivel	EP-Lithium Grease	Precision XL EP2		50 hrs	Daily	
14	Cable Followers (3)	Oil like type pivot bearings	Lifetime sealed on roller		50 hrs		
15	Whip Hoist Fairlead Bearings	EP-Lithium Grease	Precision XL EP2		50 hrs		
16	Whip Hoist Sheaves	EP-Lithium Grease	Precision XL EP2		50 hrs		
17	Main Hoist Sheave	EP-Lithium Grease	Precision XL EP2		50 hrs		
18	Overhaul Ball Swivel	EP-Lithium Grease	Precision XL EP2		50 hrs		

*Or factory approved equivalent

**Swing Gear Drive unit initial oil should be changed at 50 hours of service and then every 500 hours of service thereafter.

***The initial oil change for the LHS100A and LHS170A hoists should be at 50 hours of service and then every 250 hours of service until contaminate levels indicate that extended intervals in between oil changes are appropriate.

Note: If equipment is not in continuous/regular service then hours may be converted as follows:

50 hrs = monthly, 500 hrs = yearly, 1000 hrs = 2 years

See individual service packages for more detailed lubrication information in section 9 of this manual.

LUBRICATION DIAGRAM





SPARE PARTS

PART NUMBER	DESCRIPTION	QUANTITY	ASSEMBLY
A115220	SEAL KIT, BRAKE-SWING	1	A115062
A115221	SEAL KIT, SWING MOTOR	1	A115063
A115190	SEAL KIT, SWING DRIVE	1	A115102
A172182	FILTER ELEMENT, RETURN OIL	1	A115103
A115107-1	COIL, VALVE PVG100-PWM	1	A115107
A115193	SEAL KIT, LIFT CYLINDER	1	A115110
H00851-14A	HOSE ASSEMBLY 3/8"	2	A115118
H00851-22A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-23A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-25A	HOSE ASSEMBLY 3/8"	2	A115118
H00851-29A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-32A	HOSE ASSEMBLY 3/8"	2	A115118
H00851-33A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-36A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-22A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-38A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-40A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-45A	HOSE ASSEMBLY 3/8"	1	A115118
H00888-25A	HOSE ASSEMBLY 1/2"	2	A115118
H00888-29A	HOSE ASSEMBLY 1/2"	1	A115118
H00888-30A	HOSE ASSEMBLY 1/2"	1	A115118
H00902-29A	HOSE ASSEMBLY 3/4"	1	A115118
H00902-31A	HOSE ASSEMBLY 3/4"	2	A115118
H00906-29A	HOSE ASSEMBLY 3/4"	1	A115118
H00906-36A	HOSE ASSEMBLY 3/4"	2	A115118
H15679-29A	HOSE ASSEMBLY 1"	7	A115118
H15679-32A	HOSE ASSEMBLY 1"	1	A115118
H16569-38A	HOSE ASSEMBLY 3/8"	1	A115118
H16736-54A	HOSE ASSEMBLY 1-1/4"	1	A115118
H16764-43A	HOSE ASSEMBLY 1"	3	A115118
H16764-50A	HOSE ASSEMBLY 1"	3	A115118
H16766-27A	HOSE ASSEMBLY 1-1/2"	1	A115118
H16768-36A	HOSE ASSEMBLY 1/2"	2	A115118
H00851-165A	HOSE ASSEMBLY 3/8"	1	A115118/A171602
H00900-165A	HOSE ASSEMBLY 3/4"	1	A115118/A171602
H16763-165A	HOSE ASSEMBLY 1-1/4"	1	A115118/A171602
A111137	VALVE, SHUTTLE 6SAE (GRESEN)	1	A115158
H00883-18A	HOSE ASSEMBLY 1/2"	1	A115161
A123068-1	PRESSURE SWITCH, 2050 +50/-0 PSI	1	A115163
A123068-2	PRESSURE SWITCH, 2400 +50/-0 PSI	1	A115163
A123068-3	PRESSURE SWITCH, 2800 +50/-0 PSI	1	A115163
A123057	BULB, LAMP, 400W METAL HALIDE	2	A123056
A123082	FUSE ATQR.5 (600V 050A)	2	A123091
A123101	RELAY 3PDT, A-B 700HF33Z24	2	A123091
A123104	FUSE, 6 AMP	2	A123092
A123126	RELAY, SQUARE BASE 24 VOLT	2	A123092
A123110	BUTTON, PILOT PUSH, GREEN	1	A123093/A123094

SPARE PARTS

PART NUMBER	DESCRIPTION	QUANTITY	ASSEMBLY
A123111	BUTTON, PILOT PUSH, RED	1	A123093/A123094
A123115	LED, OP, RED	2	A123093/A123094
A123116	LED, OP, GREEN	2	A123093/A123094
A123117	LED, OP, AMBER	2	A123093/A123094
A123118	PUSH-PULL TWIST, PALM TYPE E-STOP	1	A123093/A123094
H16767-165A	HOSE ASSEMBLY 1-1/2"	1	A171602
A115111	VALVE, C.B., 60GPM	2	A171635
A123073	JOYSTICK CONTROL ASSEMBLY	1	A171981
A171925	ROPE, WIRE, 7/8" X 420', WR 7/8 19 X 19 RRL DYPAC-CC	1	A172002
A171926	ROPE, WIRE, 3/4" X 330', WR 3/4 19 X 7 IWRC RRL	2	A172002
H15503-15A	HOSE ASSEMBLY 1/4"	3	A172002
H15503-20.5	HOSE ASSEMBLY 1/4"	3	A172002
H15503-27A	HOSE ASSEMBLY 1/4"	3	A172002
A123070	ATB SWITCH C/W 85 FT CORD	1	A172031
A172213	SPRING, 5" .2070 WIRE DIA STAINLESS STEEL	2	A172079/A172091
A121116	LIMIT SWITCH (COMPLETE WITH ARM)	1	A172176

SECTION 5

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TROUBLESHOOTING & MAINTENANCE DATA**NOTE**

YOUR HYDRAULIC SYSTEM MAY OR MAY NOT INCLUDE SOME OF THE HYDRAULIC COMPONENTS REFERRED TO IN THIS SECTION OF THE MANUAL.

THESE ARE GENERAL HYDRAULIC SYSTEM PROBLEMS ENCOUNTERED BY A CRANE DURING IT'S LIFETIME AND ARE TO BE USED AS A GUIDELINE ONLY.

GENERAL TROUBLESHOOTING

Prior to removing any suspect defective component, perform the following checks to the crane's system.

- a) Note the conditions such as temperature, ice build up, type of operation, etc.
- b) Inspect the entire hydraulic system for leakage and ensure that the hydraulic reservoir is at the full mark.
- c) Replace the return filter element.
- d) Replace the suction strainer element.
- e) Check hydraulic pressure at directional valves to ensure proper operating pressure. Refer to schematic for various system pressures.
- f) Check the crane controls for possible defective control valve or valves.

FAULT ISOLATION

To isolate the defective component perform the following:

- a) Find the system most closely resembling the problem encountered.
- b) Note possible problem from the centre column on the troubleshooting charts.
- c) Check hydraulic connections to suspect components for leakage.
- d) Adjust or replace component as noted in the remedy column.

GENERAL MAINTENANCE

CLEANLINESS

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

Whenever hydraulic hoses and tubing are disconnected, inspect all passages and holes to ensure that they are free from debris. Check replacement parts when they are being installed to ensure that they are clean.

REMOVAL AND INSTALLATION

When performing maintenance, do not attempt to manually lift heavy parts when hoisting equipment should be used. Never locate or leave heavy parts in an unstable position. When lifting a portion of a machine or a complete machine, ensure the machine is blocked securely and the weight is supported by blocks rather than by lifting equipment.

When using hoisting equipment, following the hoist manufacturer's recommendations, use lifting devices that will allow you to achieve the proper balance of the assemblies being lifted and to ensure safe handling.

Unless otherwise specified, all removals requiring hoisting equipment should be accomplished using an adjustable lifting attachment. All supporting members (chains and cables) should be parallel to each other and as near perpendicular as possible to the top of the object being lifted.

CAUTION
THE CAPACITY OF AN EYE BOLT DIMINISHES AS THE ANGLE BETWEEN THE SUPPORTING MEMBERS AND THE OBJECT BECOMES LESS THAN 90 DEGREES. EYE BOLTS AND BRACKETS SHOULD NEVER BE BENT AND SHOULD ONLY HAVE STRESS IN TENSION.

Some removals require the use of lifting fixtures to obtain proper balance. The weights of some components are given in the specification section of this manual.

If a part resists removal, check to be certain all nuts and bolts have been removed and that an adjacent part is not interfering.

DISASSEMBLY AND ASSEMBLY

When assembling or disassembling a component or system, complete each step in turn. Do not partially assemble one part and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see that nothing has been overlooked. Recheck the various adjustments by operating the machine before returning it to the job.

PRESSING PARTS

When pressing one part into another, use an anti-seize compound or a molybdenum disulphides based compound to lubricate the mating surfaces.

Assemble tapered parts dry. Before assembling parts with tapered splines, be sure the splines are clean, dry and free from burrs. Position the parts together by hand to mesh the splines before applying pressure.

Parts, which are fitted together with tapered splines are always very tight. If they are not tight inspect the tapered splines and discard the part if the spines are worn.

LOCKS

Lock washers, flat metal locks, or cotter pins are used to lock nuts and bolts.

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

Always use new locking devices on components, which have moving parts.

When installing lock washers on housings made of aluminium, use a flat washer between the lock washer and the housing.

WIRES AND CABLES

Batteries should always be disconnected with the BATTERY DISCONNECT SWITCH prior to working on the electrical system.

When removing or disconnecting a group of wires or cable, tag each one to ensure proper identification during assembly.

SHIMS

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

BEARINGS

Antifriction Bearings

When an antifriction bearing is removed, cover it to keep out debris and abrasives. Wash bearings in non flammable cleaning solution and allow them to drain dry. The bearing may be dried with compressed air, BUT do not spin the bearing.

Discard the bearings if the races and balls or rollers are pitted, scored or burned. If the bearing is serviceable, coat it with oil and wrap it in clean waxed paper. Do not unwrap new bearings until time of installation.

The life of an antifriction bearing will be shortened if not properly lubricated. debris in an antifriction bearing can cause the bearing to lock resulting in the shaft turning in the inner race or the outer race turning within the cage.

Double Row, Tapered Roller

Double row, tapered roller bearings are precision fit during manufacture and components are not interchangeable. The cups, cones, and spacers are usually etched the same serial number and letter designator. If no letter designators are found, wire the components together to assure correct installation. Reusable bearing components should be installed in their original positions.

Heating Bearings

Bearings which require expansion for installation should be heated in oil not to exceed 250 degrees F (121 degrees C) When more than one part is heated to aide in assembly, they must be allowed to cool and then pressed together again. Parts often separate as they cool and contract.

Installation

Lubricate new or used bearings before installation. Bearings that are to be pre-loaded must have a film of oil over the entire assembly to obtain accurate preloading. When installing a bearing, spacer, or washer against a shoulder on a shaft, be sure the chamfered side is toward the shoulder.

When pressing bearings into a retainer or bore, uniformly apply pressure to the outer race. If the bearing is pressed on the shaft, uniformly apply pressure on the inner race.

Preload

Preload is an initial load placed on the bearing at the time of assembly. Whether a tapered roller bearing should have preload could depend on any of several conditions; rigidity of the housings and shaft, bearing spread, speed of operation, etc.

To determine whether a bearing requires preload or end clearance, consult the disassembly and assembly instructions pertaining to that bearing.

Care should be exercised in applying preload. Misapplication of preload to bearings requiring end clearance can result in bearing failure.

Sleeve Bearings

Do not install sleeve bearings with a hammer. Use a press and be sure to apply the pressure directly in line with the bore. If it is necessary to drive on a bearing, use a bearing driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part.

GASKETS

Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If it is necessary to make gaskets, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage.

When removed, always install new cylinder head and manifold gaskets using recommended gasket compound on head gaskets to allow uniform sealing.

BATTERIES

Clean batteries by scrubbing them with a solution of baking soda and water. Rinse with clear water. After cleaning, dry thoroughly and coat terminals and connections with an anti-corrosion compound or grease.

If the machine is to be stored or not used for an extended period of time, the batteries should be removed. Store the batteries in a warm, dry place, preferable on wooden shelves. Never store on concrete. A small charge should be introduced periodically to keep the specific gravity rating at recommended level.

HYDRAULIC SYSTEMS

WARNING
EXERCISE EXTREME CARE AROUND PRESSURIZED HYDRAULIC SYSTEMS. DO NOT WORK ON HYDRAULIC SYSTEM WHILE IT IS IN OPERATION OR UNTIL ALL PRESSURE IS RELEASED.

Cleanliness

Contaminants in a hydraulic system affect operation and will result in serious damage to the system components any debris in the hydraulic systems are a major cause of component failures.

Keep the System Clean.

When removing components of a hydraulic system cover all openings on both the component and the machine.

If evidence of foreign particles is found in the hydraulic system, flush the system. Disassemble and assemble hydraulic components on a clean surface.

Clean all metal parts in a non-flammable cleaning fluid. Then lubricate all components to aid in assembly.

Sealing Elements

Inspect all sealing elements (O-rings, gaskets, etc.) When disassembling and assembling the hydraulic system components. Installation of new elements is always recommended.

Hydraulic Lines

When installing metal tubes, tighten all bolts finger tight. Then, in order, tighten the bolts at the rigid end, the adjustable end, and the mounting brackets. After tubes are mounted, install the hoses. Connect both ends of the hose with all bolts finger tight. Position the hose so it does not rub the machine or another hose and has a minimum of bending and twisting. Tighten bolts in both couplings.

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.

FATIGUE OF WELDED STRUCTURES

Experience has shown that highly stressed welded structures, when repeatedly subjected to varying stresses caused by twisting, shock, bending, and intentional and/or unintentional overloads, often become subject to weld cracking which may be attributed to fatigue of the welded joint.

Equipment should be periodically inspected for evidence of weld fatigue. The frequency of these inspections should be commensurate with the age of the equipment, the severity of the application, and the experience of the operators and maintenance personnel.

The following are known as high stress areas applicable to cranes, and a visual inspection of these areas should be made part of an owner's planned preventative maintenance program.

- a) Extension Cylinder - wear pad retaining structures, cylinder attaching points, boom pivot shaft retaining structures.
- b) Boom Lift Cylinder - end connections.
- c) Outrigger Structures - near pivots, pads, arms, boxes and attachment structures.
- d) Turret structure - near pivots, slew bearing bolts, cylinder thrust points and cylinder eyes.
- e) Boom sections - near ends, pivots, and lower wear pads.
- f) Counterweight support structure.

g) Chassis mounting structure.

The above is provided only as a guide, and your inspection plan should not be limited to the areas listed. A thorough visual inspection of all weldments is good practice.

WELDED REPAIRS

Main Frame - Welding on the main frame should be carried out according to approved procedures, preceded and followed by appropriate heat treatments when applicable.

Other Structural - All welding is to be carried out according to approved procedures for additions and repairs. Any cracks should be fully ground out before re-welding using proper preheating procedures to avoid distortion, etc.

Refer to welding repair procedure as applicable to this machine.

WELDING REPAIR PROCEDURE

The materials used in the various structures of the CRANE are as follows;

Boom sides	50 W
Boom top	50 W
Boom Bottom	50 W
Turret	50 W

Welding material recommended for all of the above materials is all position low hydrogen rod.

CSA E-7018 for stick metal arc welding

For gas metal arc welding recommend using all position CA E-70S6 with CO₂ shielding gas.

Material should be 50 degrees F (10 degrees C) or above.

Welding on the boom should be carried out according to approved procedures, preceded and followed by appropriate heat treatments.

Other structurals, welding is to be carried out according for approved procedures for additions and repairs. Any cracks should be fully ground out before re-welding using proper preheating procedures to avoid distortion, etc. Use E7018 (E76018) low hydrogen electrodes in dry condition.

NOTE

Welding materials are to be always kept sealed or dry.

WARNING

WELDING IS TO BE DONE BY QUALIFIED PERSONNEL ONLY.

Refer to Canadian Standards Association section W59 for welding information.

LOCTITE

WARNING

LOCTITE TYPE ADHESIVES CONTAIN CHEMICALS THAT MAY BE HARMFUL IF MISUSED. READ AND FOLLOW THE INSTRUCTIONS ON THE CONTAINER.

Always follow the directions on the Loctite container as not all Loctite types are suitable for all applications.

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.

Torque values should correspond to the type of bolts, studs and nuts being used.

The torque tables (see Section 6 of this manual) are provided for reference when performing maintenance.

Use of proper torque values is extremely important. Improper torquing can seriously affect performance and reliability.

Identification of fastener grades is critical for replacement procedures. When fasteners are identified as being high strength (eg., grade 5, 8, etc.), the mechanic must be aware of the fact that appropriate torquing values should be referred and adhered to.

NOTE

Some special applications require variation from standard torque values. Reference should always be made to component overhaul procedures for recommendations.

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

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

When referring to the applicable torque charts, use values as close as possible to the torque values shown to allow for wrench calibration tolerance. An erratic or jerking motion in the wrench can easily result in excessive torque. ALWAYS use a slow wrench movement and STOP when the predetermined value has been reached.

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 be removed from service until

calibrated.

KNOW YOUR TORQUE WRENCH!

Flexible beam type wrenches, even though they might have a preset feature, must be pulled at right angles and the force must be applied at the exact centre of the handle. Force value readings must be made while the tool is in motion.

Rigid handle type torque wrenches are available with torque limiting devices that can be preset to required values and which eliminate dial readings.

NOTE

To convert pounds-foot of torque to kilograms-meter (kgm), multiply the pounds/foot quantity by 0.138255

To convert pounds-inch of torque to kilograms-centimeter (kgcm), multiply the pounds-inch quantity by 1.152.

When multipliers and/or special tools are used to reach hard to get at spots, ensure torque readings are precisely calculated.

HYDRAULIC SYSTEM

DESCRIPTION

The heart of the crane's hydraulic system is the motor driven pump. The pump obtains hydraulic oil from the reservoir and supplies sufficient pressure and volume to operate the various systems. The operator control valves direct oil to the crane functions, after which the oil is filtered and returned to the reservoir.

The greatest enemy of hydraulic systems is contamination, but even this can be controlled with reasonable effort by good housekeeping. Contaminants can enter the system by the addition of unfiltered hydraulic oils allowing moisture to get into the system. Replacement of components or lines that have not been stored properly, use of improper hydraulic oil, operating at excessively high temperature, or allowing pump cavitation by improper system warm-up, or with leaky suction lines.

Design and manufacturing tolerances of working parts in hydraulic systems are very close. Even small amounts of debris or foreign material in a system can cause wear or damage to pumps and generally faulty operation. Every precaution must be taken to ensure absolute cleanliness of the hydraulic oil. Filters provided in the return line should be checked and replaced at regular intervals. (Refer to section 4 Lubrication)

Examination of the filters for metal particles is a must to detect potential component deterioration. Laboratory analysis of oil samples can be very helpful in not only detecting and identifying contaminants but also to determine oil condition which could dictate oil replacement. Cloudy oils indicate high moisture content which promotes organic growth and subsequent oxidation or corrosion. Immediate change and thorough flushing of the system must be

accomplished when these conditions exist.

HYDRAULIC FLUID RECOMMENDATIONS

Oil in a hydraulic system serves as the power transmission medium. It is also the system's lubricant and coolant. Selection of the proper oil is a requirement for satisfactory system performance and life. Oil must be selected with care and with the assistance of a reputable supplier. Two important factors in selecting oil are:

1. **Anti-wear Additives** - The oil selected must contain the necessary additives to insure high anti-wear characteristics and excellent chemical stability.
2. **Viscosity** - The oil selected must have proper viscosity to maintain a lubricating film at system operating temperature.

The following table summarizes the oil types recommended for use in mobile hydraulic systems by viscosity. All must meet API service classifications.

NOTE

**DO NOT USE AUTOMOTIVE TRANSMISSION FLUIDS IN THE HYDRAULIC SYSTEM
USE OF SAME WILL VOID WARRANTY OF HYDRAULIC PUMPS AND MOTORS.**

Hydraulic System Operating Temperature Range (Min to Max)	SAE AND ISO Viscosity Designation
0°F to 210°F (-18°C-99°C)	10W to 30 (ISO 32)
50°F to 210°F (10°C-99°C)	20 to 20W (ISO 46)

Temperatures shown in the table are cold start minimum to maximum operating limits. Suitable start-up procedures must be followed to insure adequate lubrication during system warm up.

OIL RECOMMENDATIONS FOR ARCTIC CONDITIONS

Arctic conditions are considered those temperatures in the sub-zero range. These conditions represent a specialized field when extensive use is made of heating equipment before starting. Due to the variables involved in not only temperature by type of equipment available, the component factory should be consulted for specific recommendations.

CAUTION

**OPERATING TEMPERATURE MUST BE CLOSELY MONITORED WITH ALL LIGHT
WEIGHT OR DILUTED OILS AND NEVER BE ALLOWED TO EXCEED 130 DEGREES F
(54 DEGREES C)**

Hydraulic Start-Up

During cold start-up, high speed operation of system components must be avoided until the entire hydraulic system is warmed, to avoid pump cavitation and to provide adequate lubrication. Start-up of each operation after cold soak of more than a brief period must be considered in extremely cold conditions. eg) when outriggers have been positioned and operations are NOT performed for some time.

DRAINING AND FLUSHING HYDRAULIC SYSTEMS

NOTE

It may be necessary to add oil due to hydraulic line or component leakage, however, a complete drain and refill of reservoir should only be required upon completion of one thousand hours of machine operation, or if oil becomes cloudy or contaminated.

When it becomes necessary to change hydraulic oil, it is important that whoever is charged with the task knows the reason for the change. Just draining the hydraulic reservoir is not enough, even if it is only for viscosity reasons. It must be remembered that oil trapped in the system, especially when hydraulic cylinders are involved, accounts for a large percentage of the total capacity of the system. If a component has been changed because of a failure that might allow metal or abrasive particles to enter the system, all systems must be thoroughly checked, drained and flushed individually by removing lines and/or components that may have become contaminated.

Special cleaning oils containing compounds that remove gum and sludge, and also pick up loose rust, are available in a wide range of viscosity. These oils should be used while performing a thorough cleaning. They are usually recommended for a period up to 50 hours operation before changing to regular oils. When the cleaner is in the system, check, change and/or clean filters and strainers, frequently. When change is made to regular oil, flush all systems to prevent intermixing with cleaning oil.

NOTE

When hydraulic oils are changed, it will always be necessary to recheck reservoir oil level after brief operation and add oil to compensate for that which was pumped in the line and components.

Drain and refill hydraulic system as follows:

1. Place an oil channelling device under the drain located at the end of the oil reservoir. Remove drain plug ($\frac{3}{4}$ " SAE) allowing oil to flow out. After oil stops flowing from reservoir, allow a few additional minutes for side walls of tank to drain.

NOTE

The approximate capacity of the hydraulic reservoir is 200 US gallons. The approximate capacity of the total system is 230 US gallons. Use adequate size container or disposal equipment to collect the oil.

CAUTION

EXAMINE OIL FOR ANY EVIDENCE OF SYSTEM CONTAMINATION. DISCOVERY OF METAL PARTICLES REQUIRES THE REPLACEMENT OF THE DEFECTIVE COMPONENT AND A COMPLETE FLUSH AND REFILL OF THE HYDRAULIC SYSTEM. CLOUDY, MILKY OIL INDICATES WATER CONTAMINATION AND ALSO REQUIRES A FLUSH AND REFILL OF THE SYSTEM.

Hydraulic Oil Reservoir

1. If system does not require flushing, reinstall drain plug and refill reservoir with clean hydraulic oil specified in the Lubrication Chart in section 4 of this manual.
2. If system requires flushing, reinstall drain plug and fill hydraulic reservoir with a 50-50 mixture of diesel fuel and clean hydraulic oil.
3. Cycle all systems through all functions several times. Return machine to stowed position.

CAUTION

WHEN REMOVING ELEMENT, CHECK FOR METAL PARTICLES, IF PARTICLES ARE FOUND, THIS IS AN INDICATION OF POSSIBLE COMPONENT FAILURE. DETERMINE / REPAIR MALFUNCTION AND DRAIN, FLUSH AND REFILL SYSTEM WITH CLEAN OIL BEFORE REPLACING FILTER ELEMENT.

4. Discard filter element.
5. Install new filter element.
6. Tighten per instructions on filter.
7. Remove drain plug and drain flushing agent; reinstall drain plug and refill reservoir with clean hydraulic oil specified in Lubrication Chart of these manuals.
8. Reconnect cylinder return lines. Replenish reservoir oil level as necessary.
9. Follow basic procedure above for all remaining functions, one hydraulic cylinder at a time. When finished, all old oil will have been flushed from hydraulic system.

HYDRAULIC SYSTEM FILTER

The hydraulic system filter is installed in the top of the reservoir. Replacement of the original filter elements is recommended upon completion of 50 hours of system operation. Subsequent element replacement should be governed by the atmospheric conditions under which the machine is subjected to work in. In an average climate the element should be replaced after 200 hours of service. Should the machine be subjected to working in an unusually contaminated atmosphere, it is recommended that the elements be replaced more often.

Filter element is located in top of the reservoir. The hydraulic filter element is changed by removing top of filter. See Lubrication Section of Service and Parts Manual for filter replacement number.

HYDRAULIC TROUBLESHOOTING

(Some of this troubleshooting information is generic and may not apply to your equipment)

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid	Reservoir level low	Add hydraulic oil
	Intake filter or pipe plugged	Replace suction strainer and filter.
	Air leak in intake line preventing priming	Pour fluid on intake joints while listening to change in sound of operation. Tighten as required
	Pump internal coupling or shaft sheared or disengaged	Replace hydraulic pump
	Loss of pilot pressure	Check, adjust at pump
System not developing pressure	Pump not delivering fluid for any of above reasons	Check circulation by watching fluid in reservoir
	Relief valve setting low	Test with pressure gauge. Add relief valve
	Relief valve sticking open	Replace relief valve
	Leak in hydraulic control (cylinders or valves)	Test independently by system progressively blocking off the circuit
	Free circulation of fluid to reservoir	Ensure that control valve is not in open position or that fluid is not discharging to tank through an open line or improperly adjusted or non-functioning relief valve

HYDRAULIC SYSTEM TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Insufficient speed or power	Valve plate and cylinder block surface scored by abrasive in hydraulic fluid	Replace reducer
External leakage from motor	Worn seal or gaskets	Check hydraulic fluid output. Replace if necessary
Speed fluctuations with constant input flow	Irregular wear between valve plate and cylinder block	Replace if not operating Replace valve section
	Speed reducer failed	Replace valve
Slew does not turn	Control Valve	Replace valve if required
Slew very slow	Slew cylinder scored or motor, damaged	Repair or replace pump
Slew does not stop turning	Valve not returning to neutral	Replace valve
Boom does not extend/retract	Counterbalance valve	Main relief, circuit relief
	Control valve	Replace/repair cylinder
	Loss of load sense pressure if applicable	Replace/repair cylinder
Slow Boom extend/retract operation	Counterbalance valve	Replace/repair
	System pressure	Check for leakage at drain port. Replace hydraulic motor. Flush system with clean oil
	Cylinder internal leakage	
Lift or extend cylinder not holding	Lift cylinder internal leakage	Install new seal or gaskets
	Counterbalance valve	Replace hydraulic pump

Similar Problems may occur with other functions. Cause and Remedy will be similar to those listed above for motor driven and/or cylinder powered functions.

HYDRAULIC PUMPS

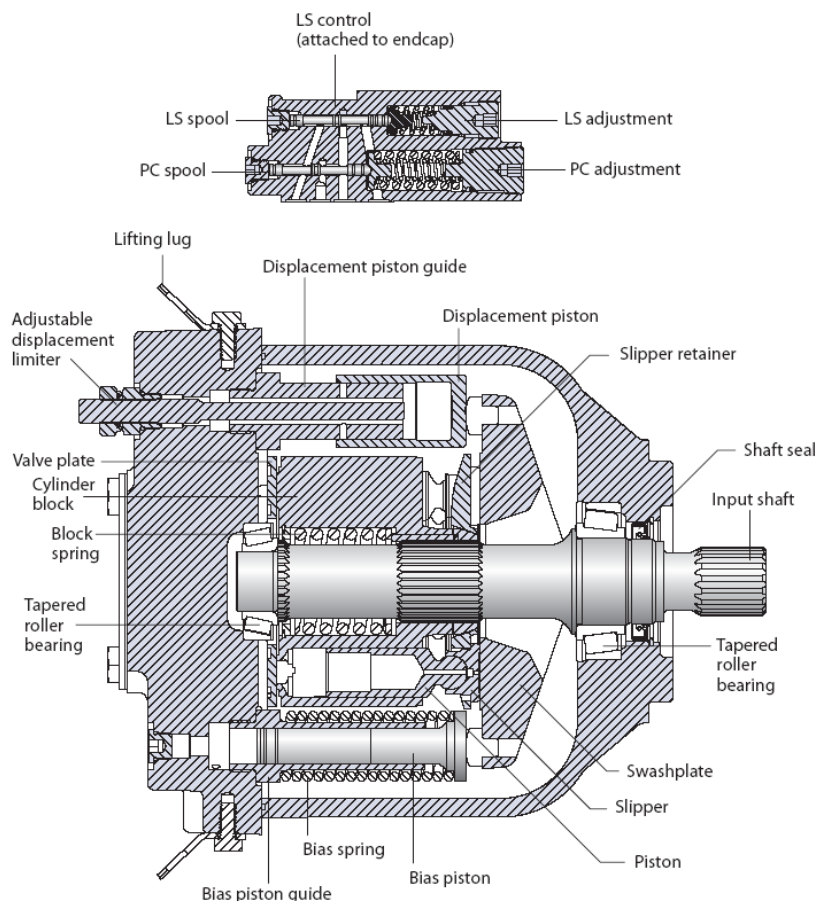
DESCRIPTION

An electric motor mounted on the crane turret or a remote power unit assembly supplies the required gallons-per-minute output for crane operations.

Refer to section 7 of service & parts manual for details or schematics. Repairs to pump should be made by a professional (variable displacement pump specialist when applicable).

THEORY OF OPERATION

The hydraulic pump has a dual servo piston design with a cradle- type swash plate set in polymer-coated journal bearings. The bias piston increases swash plate angle. The displacement piston decreases swash plate angle. At equal pressure, the larger diameter displacement piston overpowers the bias piston. Nine reciprocating pistons displace fluid from the pump inlet to the pump outlet as the cylinder block rotates on the pump input shaft. The block spring holds the piston slippers to the swash plate via the slipper retainer. The cylinder block rides on a bi-metal valve plate optimized for high volumetric efficiency and low noise. Tapered roller bearings support the input shaft and a lipseal protects against shaft leaks.



An adjustable two spool (LS) control senses the system pressure and load pressure (LS controls). The control directs system pressure to the displacement piston to control pump output flow.

The LS control matches system requirements for both pressure and flow in the circuit regardless of the working pressure. Used with a closed center control valve, the pump remains in low-pressure standby mode with zero flow until the control valve is opened. The LS setting determines standby pressure.

The LS control also performs as a PC control, decreasing pump flow when system pressure reaches the PC setting. The pressure compensating function has priority over the load sensing function.

MAINTENANCE

Inspection

Visually inspect pump for damage, corrosion, loose or missing parts, and evidence of leakage between housings and bearing carriers, and port end cover. Check that pump is properly mounted on pump drive and that all lines are attached securely.

Pump Removal

1. Put machine in service position. Clean pump around the inlet and outlet ports and hose connections.
2. Tag and disconnect the fittings that secure the inlet and outlet hoses in place.
3. Support the pump and remove the bolts securing the pump assembly to the electric motor.
4. Carefully draw the spline out and remove the pump.

CAUTION

SUPPORT THE PUMP IN A HORIZONTAL POSITION SO THAT THE SPLINE IS NOT DAMAGED.

Installation

For the installation of the hydraulic pump use the steps of the removal procedures in reverse. Refer to the flushing procedure after the pump has been installed.

NOTE

For detailed service information refer to the applicable service package in section 9 of this manual.

Functional Check

Perform a functional check of the pump as follows:

CAUTION

TO AVOID POSSIBLE DAMAGE TO A NEW OR REBUILT PUMP, BACK OFF MAIN RELIEF VALVE ADJUSTING SCREW BEFORE OPERATING PUMP. AFTER PUMP HAD RUN IN FOR ABOUT FIVE MINUTES AT MINIMUM PRESSURE (ALL CONTROLS IN NEUTRAL), ADJUST RELIEF VALVE PRESSURE TO PROPER SETTING. FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN ALMOST IMMEDIATE FAILURE OF PUMP, SHOULD RELIEF PRESSURE SETTING BE EXCESSIVE.

1. Start motor and allow to run with no load applied.
2. Using control lever, build up pressure intermittently for three (3) minutes.
3. Allow to run for approximately five (5) minutes.
4. Shut down and check pump for leakage.
5. Check pump delivery in accordance with the following:
 - a) Disconnect outlet (circuit supply) line from applicable pump.
 - b) Connect flow metre between pump outlet and circuit supply line, checking for correct oil flow and pressure.

HYDRAULIC PUMP TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid.	Coupling or shaft sheared or disengaged.	Check that pump drive is properly engaged. If drive shaft or coupling is damaged or sheared, remove and repair or replace as necessary.
	Low fluid in hydraulic reservoir.	Fill to correct level.
	Loss of load sense pressure (variable displacement only) Reservoir to pump supply line broken or restricted	Check/adjust pump valve setting Clean, repair, or replace line as necessary.
	Air entering at suction manifold. Pump not priming.	Check all for cracks for security manifold for cracks and proper attachment. Tighten, repair, or replace components as necessary.
	Internal contamination	Repair or replace pump. Drain, flush, and refill system with recommended oil.
Excessive pressure build up	System relief valve set too high	Use adequate pressure gauge and adjust system relief valve, as necessary at pump and at directional control valve.
	Restricted or damaged control valve supply line.	Clean, repair or replace line as necessary.
Pump noise. (Accompanied by oil foaming in reservoir)	Air entering pump inlet	Check all lines for security, manifold for cracks and proper attachment. Tighten, repair or replace components as necessary. Assure that oil level in reservoir is adequate. (Fill to HIGH mark on gauge).

CONTROL VALVES

DESCRIPTION

The valve banks controlling crane functions are installed on the side, inside the turret or in front of the operator's platform.

A radio or hard wire remote controls a series of levers which operate the respective valve sections. There are manual levers located on the control valve which may be used in emergency or in case of remote control power loss.

INSPECTION

Inspect control valves for visible damage, binding spools, and evidence of leakage. If excessive internal leakage is suspected during operation with spool in centre position, it is possible that the area between the spool and working section bore of the valve body is worn beyond serviceable limits. If this condition exists, the spool and section must be replaced as an assembly.



Internal Relief Valve Checks

The relief valves, incorporated in the control valve assemblies, are pilot or solenoid operated. The compression of the pilot spring within the relief valve body controls the relief opening of the pilot poppet valve. When the pilot poppet valve opens, hydraulic oil enters under pressure and opens the large poppet in the valve returning oil to tank thereby protecting the system components from pressures over and above their design ratings.

Valve Leakage Checks

Sever external leaks show up through dripping oil. If this is observed, the valve is leaking badly enough to take the machine out of service for immediate repairs. External leaks sometimes develop at fittings and seals. Spool seals are leak susceptible since they are subject to wear. Seals may be damaged by temperatures that are too high, debris, or paint accumulation on the spool. Damaged seals must be replaced.

Warped mounting surfaces can distort the assembly and cause leakage and extrusion. To check for valve distortion, loosen the mounting bolts slightly. If the leakage stops when the bolts have been backed off slightly, distortion was the problem. To correct this condition, shim the valve assembly and re-tighten the mounting bolts.

A component functioning at reduced efficiency may indicate the control valve for the component is leaking internally. Assuming preliminary check-out reveals adequate volume is being supplied to the affected valve bank, relief valves are properly adjusted and the component is not at fault, the next step would be to check the valve for scored or worn parts.

WARNING**SCORING IS A SIGN OF THE NUMBER ONE PROBLEM IN HYDRAULICS
CONTAMINATION.**

Scoring can be caused by external contamination by dust, or internal contamination by debris from deteriorating components or oxidized oil. Scored or severely worn valve components must be replaced.

Check the valve for rust or debris collecting on the linkages which can prevent free movement of the spool, and keep it out of true centre position.

Excessive system pressure can create both internal and external leaks in valves that are otherwise sound. Therefore, it is extremely important that relief valves be adjusted only by qualified personnel using the proper equipment.

Sticking Valve Spools

Some of the most common causes for stiff valve spool movement or jammed spool action are system overheating, excessive pressure, contaminated or deteriorated oil, or warped mountings. When deteriorated oil or contamination is the cause, flushing the system and replenishing with clean oil may solve the problem. If the spool bores are badly scored or galled, the valve must be removed for servicing. If the oil is scorched or deteriorated, similar treatment is required.

Warping also occurs when mounting plates are not level, or become distorted from machine damage. As mentioned previously, the valve can be shimmed level.

Oil breakdown will occur if the oil becomes contaminated with air, water or debris, or if the oil is exposed to excessively high temperatures or pressures. Even with normal usage, the additives that inhibit rust, oxidation, and foaming lose their effectiveness. Follow the recommended oil change intervals and procedures. They are intended to get the oil out of the system before it starts breaking down and before deterioration harms the system. Good oil is always a good investment. The money saved by switching from the recommended grade to a cheaper grade will probably be money spent repairing or replacing prematurely worn components, or cleaning sludge out of the system.

MAINTENANCE

Control Valves-Removal

1. Remove control levers.
2. Tag and disconnect hydraulic lines from valves; cap all lines and ports.
3. Support valve.
4. Remove hardware securing valve bank to mounting plate; remove valve bank.
5. Mark valve location in stack.
6. Remove tie bolts noting location of 'O' rings coils etc.

Control Valves - Installation

1. Reassemble valve bank in reverse order of disassembly. Torque tie bolts.
2. Position valve bank on mounting plate; secure with appropriate hardware.
3. Connect hydraulic lines to valve(s) assuring that lines are connected as marked prior to removal.

Functional Check

Perform a functional check of the applicable circuit(s) as follows:

1. Start motor and see that is at the recommended operating rpm.
2. Operate control lever(s) for applicable circuit(s): check for smooth operation for cylinders and motors. Check all lines and valve assembly/assemblies for leakage.

Main Relief and Circuit Relief Valve Adjustment

CAUTION
ALL RELIEF VALVES HAVE BEEN PROPERLY ADJUSTED AT THE FACTORY. DO NOT ADJUST ANY RELIEF VALVE UNLESS A PRELIMINARY PRESSURE CHECK REVEALS THAT THE PRESSURE SETTING DOES NOT AGREE WITH THOSE LISTED IN THE HYDRAULIC SCHEMATIC. ONLY QUALIFIED SERVICE PERSONNEL SHOULD ATTEMPT ADJUSTMENT OF THESE VALVES

1. Perform the following preparation procedures before initiating actual adjustment.
 - a) Check crane operation at high and low speed with no load.
 - b) Activate hydraulic systems and operate machine until hydraulic oil temperature reaches a minimum of 70 degrees F (21.1 degrees C).

CAUTION

WARM HYDRAULIC OIL BY NORMAL MACHINE OPERATION. DO NOT SUBJECT MACHINE TO UNDUE STRAIN FOR QUICKER RESULTS.

- c) Check control valve spools to assure that all spools have full travel (stroke) in either direction. However, some spools may be limited by adjustable spool limiters on valve.

CAUTION

NEVER ACTUATE VALVE SPOOLS RAPIDLY. ALWAYS USE SLOW EVEN STROKES FEATHERING CONTROLS.

NOTE

An accurate pressure gauge capable of reading at least 3000 psi should be used for this check.

2. Connect pressure gauge to the test tee at the main relief.
3. Remove adjustment screw, cover nut (if installed) from relief valve and loosen lock nut on applicable control valve.
4. Start HPU.
5. Apply a load to the cylinder(s), motor, etc., in the applicable circuit being checked, sufficient to activate the relief valve.
6. Move applicable control lever slowly to end of its travel, in the direction for which motion has been blocked. Note maximum reading on pressure gauge. The gauge will show a drop in pressure when the relief valve opens.

CAUTION

DO NOT HOLD PUMP ON RELIEF FOR MORE THAN ONE MINUTE AT A TIME. RELEASE CONTROL LEVER AFTER TAKING EACH READING AND WHILE MAKING NECESSARY ADJUSTMENTS

7. If pressure of circuits do not agree with the range specified in the list in the following chart, reset the relief valve(s). Refer to circuit adjustment in applicable Service manual.

Typical Valve Pressure Ranges

Valve/Circuit	Range (psi)
Main Relief Valve	2900
Boom lift	2700
Boom down	2600
Swing	2320
Hoist Up	2600
Hoist Down	2600
Pump PC Setting	2750

CAUTION

DO NOT OVER TIGHTEN ADJUSTMENT SCREW, AS POSSIBLE DAMAGE TO THE PILOT SPRING MAY RESULT.

- When proper pressure setting has been attained, tighten adjustment screw locknut and recheck pressure. It is possible that the setting may have been disturbed while tightening the locknut.

Holding Valves

Holding valves are installed in all hydraulic cylinders. These valves are designed to bear the load induced craning operations and therefore reducing the strain on the directional control valves. The holding valves are easily serviced by removing the valve cartridge and cleaning or replacing it.

Debris can cause holding valves to malfunction.

Check Valves

Check valves are designed to permit a flow of oil in one direction only. These valves can be located in the circuits where the direction of flow must be controlled.

If a piece of debris or rust has worked its way into the check valve, and lodges between the poppet and the seat, it would keep the valve open just enough to allow a return flow of oil.

The remedy is to clean the valve, but it is also a good idea to follow through by checking to make sure the hydraulic system filters are still serviceable.

For detailed service of valves refer to the applicable service package in section 9 of service & parts manual.

OVERLOAD

If overload occurs refer to Load Moment Indicator in Service Package Section and the electrical schematic for cylinder pressures and light sequence.

CONTROL VALVE TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Sticking Spool	Excessively high oil temperature	Eliminate any restriction in line or filtering system
	Debris in oil.	Change oil and flush system
	Connection fittings too tight.	Check torque. Recheck as necessary
	Valve warped from mounting	Loosen valve and check
	Excessively high pressure in valve. (Relief valve not working properly)	Check pressure at inlet and at working ports
	Handle or linkage binding	Free Linkage
	Return spring damaged	Replace faulty parts
	Spring or valve cap binding. Valve not thoroughly warmed up.	Loosen cap, re-centre and re-tighten. Allow time for system warm up
Leaking Seals	Paint on or under seal	Remove and clean as necessary
	Excessive back pressure	Open or enlarge line to reservoir
	debris under seal	Remove and clean, as necessary
	Scored spool	Replace valve section
	Loose seal plates	Clean and tighten plates
	Cut or scored seal	Replace faulty parts
Unable to move spool in or out	debris in Valve	Clean and flush out valve assembly
	Spool Cap full of oil	Replace seals
	Bind in linkage	Free linkage
	Spool & body scored	Replace section

TROUBLE	PROBABLE CAUSE	REMEDY
Load drops when spool moved from neutral	Debris in check valve	Disassemble and clean check valve
Poor hydraulic system performance or failure	Scored check valve poppet or seat	Replace poppet or lap poppet to seat
	Damaged pump	Check pressure or replace pump
	Debris in relief valve	Disassemble and clean relief valve
	Relief valve damaged	Replace relief valve
	Worn Cylinder(s) or motor(s)	Repair or replace damaged components
	Load too heavy	Reduce load (refer to load chart for rated capacities)
	Internal valve crack	Replace valve
	Spool not at full stroke	Check movement and linkage
	Oil low in reservoir	Add oil, Fill to FULL mark on glass.
	System filter clogged	Replace filter element
	Line restricted	Check line. Clean or repair as necessary

SWING DRIVE



DESCRIPTION

The turret swing system provides a 360 degree continuous rotation. Slew in either direction is controlled by a lever on the remote hand controls, or by the manual lever located on the inside of the turret

The swing circuit consists of the directional control valve with relief valve, drive motor, disc brakes and gear reducer. The system is supplied oil by the pump, the oil flows to the directional control valve. Two (2) 2320 psi circuit relief valves are located within this valve bank.

When the control lever is activated flow is directed through the directional valve and shuttle valve to release the brake to allow the hydraulic motor to drive the gear reducer and swing the turret and boom.

NOTE

For more detailed information see the applicable service packages.

MAINTENANCE

Hydraulic Motor Removal

1. Thoroughly clean off all outside debris around fittings on motor. (This step is taken to prevent entry of debris into the system.)
2. Tag and disconnect hydraulic hoses from motor assembly. Immediately cap all openings.
3. Remove bolts and washers securing motor to swing gear box, lift motor free of machine.

CAUTION

PULL STRAIGHT OUT ON MOTOR ASSEMBLY TO AVOID DAMAGING SPLINED SHAFT.

4. Clean and dry motor before proceeding with disassembly.

Hydraulic Motor Installation

Secure motor to the swing gear drive with bolts and washers, and connect hoses.

SWING DRIVE TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
No pressure	Check pump drive for loose coupling	Repair or replace coupling
Fluctuating pressure	Check hydraulic fluid level	Refill if needed
	Check for broken lines	Repair
	Broken pump-worn pump	Disassemble and repair pump
	Check if relief valve is stuck	Disassemble valve, clean and replace damaged parts.
Relief valve chatter	Damaged valve	Repair
	Debris between piston and seat in relief valve control head	Disassemble and clean
Noisy pump	Restricted intake.	Clean intake strainer; check intake piping for obstruction.
	Cavitation at pump inlet due to fluid viscosity being too high	Use a fluid with a lower viscosity
	Pump picking up air; a) Around shaft of head packing b) Loose or broken intake tube.	a) Replace packing, grease pump fitting. b) Repair or replace tube
	Worn pump	Disassemble pump, inspect internal parts for wear and replace
	Excessive pressure	Check relief valve setting for line restriction (clogged or under size line)
	Worn pump	Repair or replace pump
Slow operation of function	Extremely high fluid temperature causing pump to slip (temperatures increase as pump wears)	Use a higher viscosity index oil such as 10W40
	Pump cavitation	In cold weather, use 5W20 oil
	Plugged filter	Replace filter or clean

SWING DRIVE TROUBLESHOOTING Cont'd

TROUBLE	PROBABLE CAUSE	REMEDY
Slow operation of function	Relief setting too low	Set relief valve for proper psi Check spool travel adjustment
	Low Voltage at controller	Check Battery & Connection Check Alternator Voltage Output Check voltage at control valve coil. Voltage must be 6 volts one direction & 3 volts opposite direction
Motor will not turn	Shaft seized in housing due to excessive side load or misalignment (500 lbs. max.)	Check and replace housing assembly, set if damaged.
	Broken shaft from extreme side loads or misalignment	Correct and replace.
	Large contaminating particles in fluid	Flush all systems use better filtration.
Motor turns without turning	Broken Shaft	Replace shaft assembly. Check housing for wear and replace if necessary. Check for misalignment.

SWING BEARING



DESCRIPTION

The swing bearing mates the turret to the pedestal. The bearing outer race is bolted to the turret and the inner race is bolted to the pedestal.

MAINTENANCE

General

The swing bearing is the most critical maintenance point of the crane. It is here, at the centre line of rotation, that stresses of loads are concentrated. In addition, the bearing provides the only attachment between the turret and the carrier. Therefore, proper care of the bearing and periodic maintenance of the turntable to bearing bolts is a MUST to ensure safe operation.

Proper identification of bolt grade is important. When marked as a high strength (grade 8) bolt, the serviceman must be aware of the bolt classifications and that he/she is installing a high strength heat treated tempered component and the bolt must be installed to specifications. Special attention should be given to the existence of lubricant and plating that will cause variation from dry torque values. When a high strength bolt is removed from an assembly, it must be replaced with a bolt of the same classification.

Torquing Turntable Bolts

WARNING

FAILURE TO MAINTAIN PROPER TORQUE OF THE TURNTABLE BEARING BOLTS WILL RESULT IN DAMAGE TO CRANE AND POSSIBLE INJURY TO PERSONS.

Maintaining proper torque values for bolts is extremely important for structural strength, performance, and reliability of the crane. Variations in torque can cause distortion, binding, or complete separation of the turret from the carrier.

WARNING

IT IS REQUIRED THAT BEARING BOLTS BE INSPECTED FOR LACK OF TORQUE, AND RETORQUED IF NECESSARY, AFTER THE FIRST 300 HOURS OF CRANE OPERATION. THE BOLTS LOOSEN IN SERVICE DUE TO VIBRATION, SHOCK, AND TEMPERATURE CHANGES, THEREFORE, PERIODIC INSPECTION SHOULD BE PERFORMED EVERY 500 HOURS THEREAFTER.

KNOW YOUR TORQUE WRENCH!

Flexible beam type wrenches, even though they might have a preset feature, must be pulled at right angles and the force must be applied at the centre of the handle. Force value readings must be made while the tool is in motion. Rigid handle type, with torque limiting devices that can be preset to required values, eliminate dial readings and provide more reliable, less variable readings.

CAUTION

If multipliers and/or special tools are used to reach hard to get at areas, ensure torque readings are accurate.

Torque wrenches are precision tools and must be handled with the appropriate care. Have the torque wrench calibrated at regular intervals to ensure accurate readings. Always use slow, even movement and STOP when the predetermined value has been reached.

If the machine is suspected of being loaded in excess of the load chart limits, all turntable bolts must be inspected for looseness and retorqued to specifications.

Turntable bolts should be torqued diametrically opposed, working in sequence from one side of the bearing to the other.

Torque bolts to 50% and then to full final torque setting.

When using step wrenches, calculated wrench settings are valid only when the following conditions are met.

1. Torque wrenches must be those specified and forces must be applied at the handle grip. The use of handle extensions will change applied torque to the bolt.
2. All handles must be parallel to the step wrench during final tightening. Multiplier reaction bars may be mis-aligned no more than 30 degrees without causing serious error in torque.
3. Multiplier reaction bar handles must be propped or supported within the outer 1/4 of the handle length, or serious under or over tightening will occur.

The inner race of the bearing is secured to the pedestal by forty-eight (48) 1 1/4-7NC grade 8 bolts. The outer race of the bearing is secured to the turret by forty-eight (48) 1 1/4-7NC grade 8 bolts.

Torque Values

Torque the bolts according to the tables in section 6 of this manual. (1200 ft/lb)

Tools Required

Slew ring bolt socket (1 7/8" across flats, 1" drive socket), torque wrench and optional 4 to 1 multiplier.

Inner Race Torquing

1. Inner race (capscrew) bolts are to be torqued upon placing turret onto pedestal.
2. Torque the bolts at the diagonally opposed position then torque the remaining bolts in a diametrically opposed sequence.
3. First torque the bolts to half their rated value and then to a final torque.

Outer Race Torquing

1. Outer race bolts are attached to the turret frame.
2. From outside turret, torque the bolts in a diametrically opposed sequence and to the same values as the inner race bolts.

Removal of Swing Bearing

1. Attach adequate lifting device to boom to secure and remove outer ring bolts.
2. Remove hydraulic and electric lines and swivels at top of rotation bearing.
3. Remove boom and then remove turret from top of rotation bearing.
4. The rotational drive assembly will lift off with the turret assembly, as described earlier in this section.

CAUTION

ENSURE THE LIFTING DEVICE USED IS CAPABLE OF SUPPORTING THE WEIGHT OF THE BOOM & TURRET. ENSURE ALSO THAT THE COMPONENT DOES NOT TILT OR SLIDE DURING REMOVAL.

WARNING

ENSURE LIFTING DEVICE IS CAPABLE OF SUPPORTING THE ENTIRE COMPONENT ASSEMBLY. LIFTING EYES ARE PROVIDED. CRANE BOOM WITH HOISTS WEIGHS APPROXIMATELY 39,000 lbs.

5. Remove inner bearing race bolts & washers between bearing and pedestal.
6. Remove bearing from pedestal.

NOTE

If the same bearing is to be used again, mark the position on the carrier so that it can be re-installed at 180 degrees from the original location due to limited rotation.

Inspection

Disassemble bearing and check balls, plastic spacers and races for damage. Ensure that the bolt holes are dry and clean for proper re-torquing at installation.

Installation

CAUTION

ALL HIGH GRADE BOLTS THAT ARE REMOVED MUST HAVE NEW HIGH GRADE BOLTS FOR REASSEMBLY.

1. Using a suitable lifting device, set the rotational bearing in position on a stand. If the same bearing is used, align the position marks made during the removal.
2. Install new bolts and washers securing the bearing to the turret. Refer to TORQUING in section 6 of these manuals. Torque Bearing Bolts to 1,200 ft/lbs.

NOTE

Installation orientation of crane must be in the travel or stowed position.
--

3. Using an appropriate lifting device, align the turret over the bearing. Lower the turret into position on the bearing.
4. Install the bolts and washers. Refer to TORQUING SEQUENCE in this section.
5. Torque outer bolts as specified earlier in this section.
6. Connect hoses between turret and source.

Testing

Activate the controls and check for proper function.

NOTE

If the crane does not turn freely after bearing replacement, contact: Arva Industries Inc. (See front of this manual for complete contact information).
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SWING SYSTEM TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Boom will not swing in either direction	Damaged relief valve	Remove, clean, and repair valve
	Damaged rotation drive motor	Repair or replace drive motor
	Worn or damaged hydraulic pump	Repair/replace pump
Swing operation slow in either direction	Damaged relief valve	Adjust, repair or replace valve
	Improperly lubricated bearing	Lubricate bearing
	Improper size hose or fitting installed	Refer to parts section of manual
	Clogged hoses or fittings	Clean/replace hoses or fittings
	Damaged rotation swing gear	Repair or replace cylinder
	Worn damaged hydraulic pump	Repair or replace pump
Rotation operation slow in one direction	Machine not level	Level machine on stabilizers
	Damaged relief valve	Repair or replace valve
	Clogged or restricted hose	Clean or replace hose
	Improperly torqued rotational bearing	Re-torque bearing bolts
Boom swings slowly	Insufficient hydraulic volume	Check hydraulic pump
	Damaged relief valve	Repair or replace valve
	Low swing brake pressure	Check shuttle valve
	Drive Motor worn	Install seal kit or new motor
Rotation continues operation with control in neutral	Control valve spool sticking or valve otherwise damaged	Repair or replace valve
Rotation turning in wrong direction	Improper port connections	Reverse port connections
Rotation noisy	Gear reduction binding	Repair gear reduction
	Rotation bearing worn	Repair or replace

SWING SYSTEM TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Boom swing erratic in both directions.	Damaged relief valve	Replace relief valve
	Low engine rpm	Increase engine rpm
	Improper movement of control lever to the neutral position	Feather controls to neutral to maintain smooth operation
	Insufficient lubricant in rotational bearing.	Lubricate bearing
	Machine not level	Level machine on stabilizers
	Damaged rotation Bearing	Repair or replace
	Excessive overloading	Reduce load
	Restricted or partly clogged hydraulic hose or fitting.	Clean/replace hose or fitting
	Improperly torqued turntable bolts	Torque turntable bolts evenly
	Improperly torqued swing drive bolts	Torque swing drive bolts
Boom swing erratic in one direction	Malfunction of control valve	Remove and repair control valve
	Relief valve inoperative	Clean, readjust and/or replace relief valve
	Machine not level	Level machine on outriggers
	Rotational bearing binding due to repetitive limited swing	Rotate machine 360 degrees several time in both directions while greasing rotation bearing
	Restricted hose or fitting	Replace hose or fitting

GEAR REDUCER



DESCRIPTION

The gear reducer is bolted to the turret or the turntable. The gear reducer's pinion meshes with the teeth on the rotational bearing to cause the turret to rotate. Mark the eccentric ring so that the tooth mesh is correct on re-assembly.

The rotational drive motor is mounted to the gear reducer and power is transmitted through a splined shaft.

The gear reducer has a speed reduction ratio of 51.43:1.

NOTE

For more detailed information refer to the applicable service package.

Removal

1. Stabilize the crane with boom in crutch.
2. Tag, disconnect, and cap all hydraulic lines from the rotational drive. Mark the eccentric ring so that the tooth mesh is correct on re-assembly.
3. See SWING DRIVE section for removal of this unit.
4. Remove the bolts and washers securing the pinion guard and remove the guard.
5. The gear reducer must be supported before mounting bolts are removed. Use an adequate lifting device to lower the gear reducer to the ground after the bolts have been removed.

Installation

1. Attach the lifting device used in the removal procedure.
2. Carefully raise the gear reducer into place. While holding in place with lifting device, apply Loctite 271 to the threads of the mounting bolts and washers securing the gear reducer to the turret.
3. Torque the bolts to 110 lbs ft (149 Nm) and remove the lifting device.
4. Install the pinion guard and secure with the bolts and washers.
5. Reinstall the rotational drive motor if removed and connect the hydraulic lines as tagged during removal.
6. Refer to the LUBRICATION section for fluids and quantities.

Test

1. Test the swing of the turret in each direction. Stop and start swing several times.
2. Inspect the hydraulic lines and connections for leaks. Replace or repair if necessary.

Service Information

The reducer is filled with oil and may have a grease zerk for adding grease to output pinion bearing. When filling the reducer oil should be added until it appears around at the fill port on side of housing. See lubrication chart for greasing and oil check interval.

The output pinion seals used in the reducer are designed to hold the grease in while keeping the debris out. An external grease fitting is installed to the grease pinion bearing if output pinion is located at the top of reducer and the drive motor at the bottom.

SWIVEL

DESCRIPTION

The swivel installation consists of a hydraulic swivel directly mounted to the bottom of the turret. Solid connections cannot be used to transfer current or hydraulic oil between the turret and carrier due to continuous 360 degree swing. These swivels accomplish the task safely, cleanly and efficiently.

The hydraulic swivel has a spool section fastened to a mounting plate which is bolted to the turret base plate. In the top of the mounting plate there are ports for crane functions. A set of matching ports are found on the barrel of the swivel which is restrained from turning by two chains attached directly to the frame. Hydraulic lines from the various control valves are lead to the ports in the swivel barrel. Through channels in the swivel, fluid is directed to the appropriate ports in the mounting plate and then routed through hydraulic lines to the crane functions.

Each port on the hydraulic swivel is stamped with an identification number or letter. The function of each port is described in the list below.

Port Number	Function
1	1 1/2" Return Line
2	1 1/4" Pressure Line
3	3/4" Drain Line
4	3/8" Load Sense Line

THEORY OF OPERATION

The hydraulic swivel allows oil to flow from the power unit to the control valves then to the various functions on the crane. All oil is routed into the barrel portion of the swivel where, through a series of internal passages, oil is transferred to a channel in the spool position of the swivel. These channels correspond with ports in the top of the mounting plate from which hydraulic lines lead to the various functions.

The channels on the outside of the spool are separated by a set of teflon and o-ring seals that prevent hydraulic fluid from leaking into adjacent circuits within the swivel.

Through the use of the hydraulic swivel, a complete 360 degree rotation of the turret is possible.

An electrical collector ring assembly is bolted either to the bottom or top of the hydraulic swivel. Electrical power is conducted to feed power through the centre of the hydraulic swivel for lights, electrical controls or power unit power.

MAINTENANCE**Removal****WARNING**

BE SURE THAT THE BOOM ASSEMBLY IS ADEQUATELY SUPPORTED AND ALL HYDRAULIC PRESSURE IS RELIEVED.

1. Turn the crane off and relieve hydraulic pressure by toggling the BOOM, TELESCOPE, and HOIST levers.
2. Disconnect, tag and cap all hydraulic lines out of the top swivel mounting plate and plug the ports.
3. Disconnect and tag all electrical wires at the connection box on the crane and remove collector ring assembly.
4. Pull the electrical harness down through the centre of the hydraulic swivel and set aside.
5. Disconnect, tag, and cap all hydraulic swivel lines to the barrel section of the swivel. Plug the ports to prevent debris from entering the swivel.
6. Support the swivel from two lifting lugs within the turret with a suitable lifting device. The swivel weighs approximately 225 pounds (102 kg).
7. Remove bolts which restrain the swivel from rotating.
8. Remove the four (4) bolts and nuts from the swivel mounting to the turret.
9. Lower the swivel down through the hole in the turret base plate.

Installation

1. Using the lifting device from the removal procedure, raise the lower swivel in turret up to the hole in the turret base support plate.
2. Connect all the hydraulic lines as tagged at removal.
3. Position the swivel according to the mounting holes and secure it to the turret base plate. Attach the restraining lugs to the swivel that keep the swivel from rotating.
4. Remove lifting device.
5. Connect the hydraulic lines, as tagged, to the barrel of the swivel.
6. Feed electrical harness through the centre of the hydraulic swivel.
7. Reconnect the electrical wires at the boom connection box.
8. Activate all systems, cycle all functions, and observe for proper operation. Check hydraulic connections for leaks.

CAUTION

HIGH PRESSURE HYDRAULIC SPRAY FROM RUPTURED LINES CAN CAUSE SERIOUS CUTS AND INFECTION.
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Disassembly

1. Clean the swivel thoroughly with all the ports plugged to prevent foreign material from entering the channels.
2. Place the swivel on a clean work surface.
3. Remove the port plugs.
4. Remove the retaining ring from the end of the swivel opposite the mounting surface.
5. Carefully slide the barrel over the swivel spool.
6. The teflon and o-ring seal are now exposed and can be removed from the seal grooves in the outside of the spool.
7. The appropriate ARVA seal kit will provide all the components required to refurbish the seal in the swivel (refer to the parts manual for seal kit number).
8. When replacing seals, never over expand or stretch the seals. The minimum amount of expansion required to position the seal is recommended.
9. After replacing the seals in the proper fashion, lubricate each seal with a thin film of hydraulic oil and carefully slide the barrel over the spool section.
10. Replace the retaining ring and reinstall the port plugs.

NOTE

Contamination is the major cause of hydraulic system failure. Prevent foreign material from entering the system by proper prevention.
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HOIST

DESCRIPTION

The hoists are variable speed, planetary driven hoist with a dual brake system. A control lever on the control regulates the direction of the hoisting operation. Hydraulic fluid is directed to the hoist when the control lever is pushed for which ever direction you wish the hoist to move.

The hoist is bolted to the crane boom or turret as required.

HOIST SPECIFICATIONS

Main Hoist: (Hook speed 2 part reeved)	26 fpm
Line Pull, Single Line	15,000 lbs
Cable (420 ft 7/8" Dyform 18)	45.4 tons breaking strength
Whip Hoists:	140 fpm
Line Pull, Single Line	10,000 lbs
Cable (320 ft 3/4" 19 x 7 non-rotating)	32.8 tons breaking strength

NOTE

For more detailed information, refer to the applicable service package. Refer to WINCH in parts manual.

Removal (Applicable for main and auxiliary hoists)

1. Remove hook block attached to the wire rope and rewind the rope fully back to the hoist.
2. Attach a suitable lifting device to the hoist.
3. Tag and disconnect the hydraulic lines at the hoist. Cap or plug lines and ports.
4. Disconnect the speed sensor unit at the hoist if applicable.
5. Remove the bolts and washers that secure the hoist.
6. Lift the hoist straight up and move it to a suitable working area.

Hoist Installation

1. Ensure the hoist mounting area is clean and clear of debris and debris.
2. With the appropriate lifting device, position the hoist in place on the respective mounting plate.

3. To properly align the hoist with the boom:
 - i) Locate a line that is parallel to the drum axis when looking down from the top of the hoist.
 - ii) Locate the centre of the top of the boom base section at either end and mark the centre point.
 - iii) String chalk line over the two boom centre points and pull it tight so that it extends over the hoist axis line.
 - iv) Measure the angle between the chalk line and drum axis with a protractor. Position hoist so that the angle is 90 degrees, with a tolerance of no more than $\frac{1}{2}$ a degree (elongate mounting holes if necessary).
4. Torque the hoist fasteners to recommended values (see General Maintenance section).
5. Remove the lifting device.
6. Service the hoist as per the applicable service package.
7. Reconnect the hydraulic lines and electrical wiring.
8. Re-route the wire rope and install the hook block.

Functional Check

1. Attach a test weight to the hook. Raise and lower the load several times.
2. Check the hoist for smooth operation of the hoist motor and brake system.
3. Ensure the hydraulic connections are secure and free of leaks.

NOTE

Refer to the applicable service package for lubrication of hoist.

BOOM

DESCRIPTION

The boom assembly is a one piece fixed length construction.

The boom assembly supports other equipment such as the, lights, load sensor devices and anti two-block mechanism.

The boom assembly's lift is provided by the lift cylinders which are described in this section of the manual.

MAINTENANCE

Removal

(This is the procedure to remove the entire boom assembly in one piece).

1. Ensure the crane is stabilized.
2. Put the boom in the horizontal rest position
3. Remove the hook block and anti-two block weight that is around the wire rope.
4. Rewind all the wire rope on the hoist drum.
5. Shut crane off.
6. Disconnect electrical cables between the boom and turntable.
7. Support the sheave end of the fly section with rigging appropriate for the weight of the boom. See drawing on page 5.41 for lifting locations for boom or turret with boom. Raise the fly slightly to relieve the pressure on the lift cylinders.

WARNING

ENSURE BLOCKING AND LIFTING DEVICES ARE CAPABLE OF SUPPORTING THE BOOM ASSEMBLY
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8. Block the lift cylinders to prevent them from falling and then remove the rod end pins.
9. Support the pivot end of the base section with rigging appropriate for the weight of the boom assembly. Raise the pivot end slightly to free up the pivot shaft.
10. Tag and disconnect all hydraulic lines to the boom and extension cylinder and winch. Cap hose ends and plug any ports to prevent debris from entering the system.

WARNING

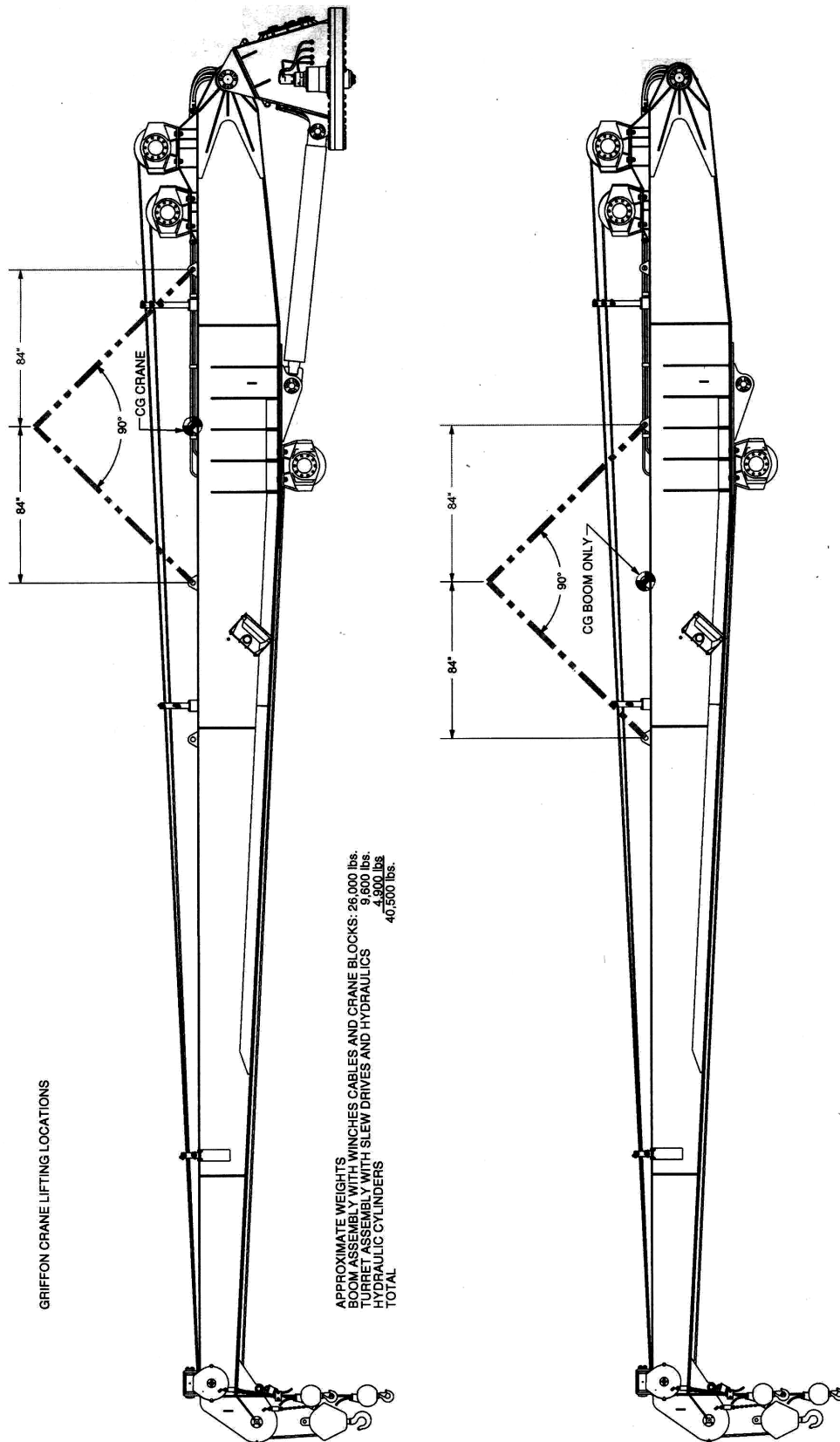
CONTAMINATION IS A MAJOR CAUSE OF HYDRAULIC SYSTEM FAILURE. PREVENT FOREIGN MATERIAL FROM ENTERING THE LINES AND COMPONENTS.

11. Remove pivot shaft(s) at the base section of the boom.
12. Using a suitable lifting device, separate the boom assembly from the turntable and lower the boom to a convenient work area.

Installation

1. Attach the lifting device to the boom assembly so that safe lifting can be performed.
2. Lift the boom into position slowly.
3. Align the pivot bearings in the base section of the boom with those in the turntable.
4. Lubricate and install the pivot shaft(s). Install the retaining pin and bolt to secure the shaft(s).
5. Support and extend the lift cylinders to align the rod end with the lift brackets on the bottom of the base section of the boom.
6. Lubricate and install the rod end pins of the lift cylinders and secure them with the retaining pins and bolts.
7. Reconnect the electrical cable, anti two-block system and hydraulic lines as tagged prior to removal.
8. Remove lifting device from boom after ensuring that the boom will not drop suddenly.
9. Start the crane and lift the boom slightly so that any blocks used may be removed.
10. Cycle the lift and extension cylinders to remove air in the system and check for leaks at connections.
11. Reinstall wire rope and hook block.

Lifting Locations



LIFT CIRCUIT



DESCRIPTION

The boom lift circuit consists of two lift cylinders with holding valves. The holding valves are mounted on the front of the lift cylinders.

Moving the boom lift lever causes a spool in the control valve to shift and direct fluid through passages to the lift cylinders.

The holding valve on the front of the lift cylinder function is to stop the cylinder from retracting & lowering the boom when levers are not operating.

When booming up, oil unseats the check valve inside the holding valve allowing oil flow to the piston side of the cylinder. Pressure is applied to the piston which causes the cylinder to extend, raising the boom.

When booming down, oil enters the retract port of the holding valve and flows to the rod side of the cylinder. When pilot pressure reaches a pre-determined value, the check valve unseats and oil flows from the piston side of the cylinder to the reservoir.

When holding the boom, oil is trapped in the cylinder cavities by the holding valves.

MAINTENANCE

Lift Cylinder Removal

1. Elevate the boom to provide clearance for removal of the lift cylinders if necessary.

WARNING

ENSURE THE LIFTING AND SUPPORTING DEVICES ARE ADEQUATE

2. Ensure the boom is fully supported for removal of the lift cylinders.
3. Attach a lifting device capable of lifting the cylinders.
4. Remove the bolts, washers, and pins that retain the cylinder pins.
5. Block the cylinder up and pry out the rod ends.
6. Retract the cylinders fully.
7. Tag and disconnect hoses from the cylinders. Cap hose ends and plug valve ports.
8. Take up any slack in the cylinder lifting device, then remove the cap and the cylinder pins.
9. Lift the cylinders clear of the crane being careful not to damage the attached tubing

Installation

1. Attach an adequate lifting device to the lift cylinder and move the cylinder into position in the turret.
2. Install the cap end cylinder pin and secure it in place with the pins and bolts.
3. Align the lift cylinder rod end with the attachment point on the boom and install the cylinder pins, securing it with the pin and bolt.
4. Connect the hydraulic lines to the lift cylinders making sure they are arranged as they were before disassembly.
5. Remove the lifting and supporting devices from the cylinders and boom. Start the crane and activate the hydraulic system to check for leaks and proper operation.

ELEVATION SYSTEMS TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Boom will not raise	Excessive load	Reduce load as required
	Improperly adjusted control valve linkage	Adjust linkage to obtain full travel
	Worn or damaged pump section	Repair or replace pump section
	Broken pump shaft	Replace shaft and seals
	Broken pump drive coupling	Replace drive coupling
	Broken control valve spool	Replace control valve
	Low hydraulic oil	Replenish oil to proper level
	Relief valve damaged	Repair or replace valve
Boom will not lower	Improperly adjusted control valve linkage	Adjust linkage to obtain full spool travel
	Worn or damaged hydraulic pump section	Repair or replace pump section
	Broken pump shaft	Replace shaft and seals
	Broken pump coupling	Replace drive coupling
	Broken control valve spool	Replace control valve

ELEVATION SYSTEMS TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Boom raises erratically	Low hydraulic oil level	Replenish hydraulic oil to proper level
	Low engine rpm	Increase engine rpm to recommended setting
	Main relief valve defective	Replace relief valve
	Air in hydraulic cylinder	Cycle (elevate and lower) boom
	Bent cross shaft	Replace cross shaft
Boom lowers slowly	Low hydraulic oil level	Replenish hydraulic oil to proper level.
	Low engine rpm	Increase engine rpm to recommended setting
	Relief Valve inoperative	Repair or replace relief valve
	Air in hydraulic cylinder	Repair or replace relief valve
	Control valve linkage out of adjustment	Cycle (elevate and lower) boom
	Air in holding valve	Adjust linkage to obtain full spool travel
	Holding valve damaged	Bleed holding valve
	Improperly adjusted holding valve	Repair or replace valve
		Adjust holding valve
Boom lowers erratically	Damaged hydraulic pump section	Repair or replace pump section
	Low hydraulic oil	Replenish oil to proper level
	Low engine rpm	Increase and maintain engine rpm
Boom raises slowly	Damaged relief valve	Repair or replace valve
	Extremely cold hydraulic oil	Operate to bring oil to proper temperature
	Control valve linkage out of adjustment	Adjust linkage to obtain full spool travel

ELEVATION SYSTEMS TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Boom raises slowly (cont'd)	Operating two functions in same bank assembly	Feather controls to obtain designed speed of functions.
	Restricted return hose.	Replace return hose
Boom lowers slowly	Piston seal leaking	Replace all cylinder seals
	Scored cylinder barrel	Hone or replace barrel
	Worn hydraulic pump section	Repair or replace pump section
	Low hydraulic oil level	Replenish oil level
	Low engine rpm	Increase rpm
	Damaged relief valve	Repair or replace valve
	Operating two functions in same valve bank	Feather controls to obtain desired speed of functions
	Extremely cold hydraulic oil	Operate unit to raise oil to operating temperature
	Control Valve linkage out of adjustment.	Adjust linkage to obtain full spool travel
	Restricted return hose	Replace return hose
	Improper adjustment of holding valve	Adjust valve
	Low hydraulic oil	Replenish oil to proper level
	Relief valve damaged	Repair or replace valve

BOOM DRIFTS TROUBLESHOOTING

Lift Cylinder Drift Checks

If the boom has a tendency to drift down when elevated, the following procedure should be followed to locate the malfunction.

1. Check for holding valve leakage as follows:
 - a) Elevate boom approximately eight inches from horizontal.
 - b) Disconnect hydraulic line from inlet side of elevation control valve and check for leaks. If valve leaks, reconnect line, lower boom and shut down operation.
 - c) Remove valve, inspect for scoring, wear and foreign material. Clean and repair or replace as necessary.
2. If boom drifts down consistently only at one specific elevation, this indicates that a short scored area exists in a cylinder barrel. Proceed as follows:
 - a) Elevate boom approximately eight inches from horizontal.
 - b) Inspect cylinder for evidence for scoring or any other defect, which could cause the drift problem.
 - c) Repair or replace as necessary.
3. If boom drifts down at all angles, proceed as follows:
 - a) Elevate boom approximately eight inches from horizontal.
 - b) Shut down operations and disconnect top interconnecting line from lift cylinder. If oil is evident a cylinder has worn seals or is scored. Remove and repair cylinders or seals.

ELECTRIC SYSTEM

The electrical control system is 24 volt DC. The main power source is 460 volt AC commercial power.

Electric power is connected to soft start motor controller which is connected to the electro/hydraulic power unit.

The electric motor start box also contains a 480 to 220 VAC transformer for boom lights and a 220 to 24 VDC transformer unit which is used for crane controls.

All fuses are numbered relative to the respective position and circuits serviced. Refer to electrical schematic in section 7 for further details.

MAINTENANCE

Electrical system maintenance includes replacement of damaged components. When replacing wiring ensure that wires are replaced with wire of equivalent size and rating.

Observe standard wiring practice when wiring replacement is necessary.

Switches

Check operation of all electrical switches. Tighten switch attaching hardware and electrical connections as necessary. Replace damaged switches.

Indicating Instruments & Lights

Check all indicating instruments and lights for proper operation. Tighten all loose connections and replace damaged instruments and lights.

Electrical Box

The electrical box located on one side of the HPU reservoir, contains the main circuitry for controlling the crane. There is a start/stop switch located on the front of the electrical box that is used to control power supply to the crane. It starts the hydraulic pump motor and transformer for 24V DC control power.

The Electrical Disconnect box is located within the confines of the ships electrical service platform.

WARNING
DO NOT USE BREAKERS WITH A RATING DIFFERENT FROM THOSE INDICATED ON THE LABEL.

Troubleshooting

Most problems associated within the electrical system can be traced by use of a multi-metre. Problems are normally due to poor ground, bad connection, short to ground etc. When disconnecting wires, always mark wires so they return to the original position.

WARNING

When necessary to perform electrical maintenance on live circuits, remove all rings and watches before performing maintenance as serious burns result from accidental grounding.

Ensure power is disconnected before performing maintenance on an un-fused electrical circuit. Ensure Standard Lock Out procedures are used to prevent other personnel from connecting power sources or engaging controls when performing maintenance.

WIRE ROPE & SHEAVES

DESCRIPTION

Wire rope is a precisely designed “machine” made up of many moving parts, each of which must be free at all times to move independently of all others. Were it not for this movement between wires and strands, we would have a rod or bar too stiff to operate over sheaves and drums.

This machine, treated with the respect it deserves during usage and with proper maintenance, can last for thousands of working hours. Improper handling, usage and/or maintenance can ruin it in a few hours.

While most wire ropes are manufactured from the finest grades of steel, nicks and scratches on the surface of the individual wires and/or kinking or severe bending will greatly reduce service life. This can happen with improper storage, transport, uncoiling or other non-operational handling. As with all machinery, a “break-in” period is advisable. Several slow operating cycles with moderate loads will give the rope an opportunity to seat itself to the form of the sheaves and enable the individual strands to become firmly aligned in place.

WIRE ROPE SPECIFICATION

Main Hoist Cable: (420 ft 7/8” Dyform 18)	45.4 tons breaking strength
Whip Hoists Cables: (320 ft 3/4” 19 x 7 non-rotating)	32.8 tons breaking strength

MAINTENANCE

Kinking is generally caused by allowing a loop to form in a slack line and then pulling the loop down to a tight permanent set, resulting in localized wear. Overloading, results in a complete fracture of the rope or crushing and distortion on the drums and sheaves. This is caused simply by working the rope with a load too near its breaking strength.

Dragging of the rope over a bank or some other obstruction which will score it causes localized wear.

Improper seizing permits strands to become loose, unbalancing the rope and throwing all of the load onto a few strands.

Improper spooling results in crushed and distorted ropes.

Whipping a line can result in many wires being broken off. This is caused by jerking the line or running it loose.

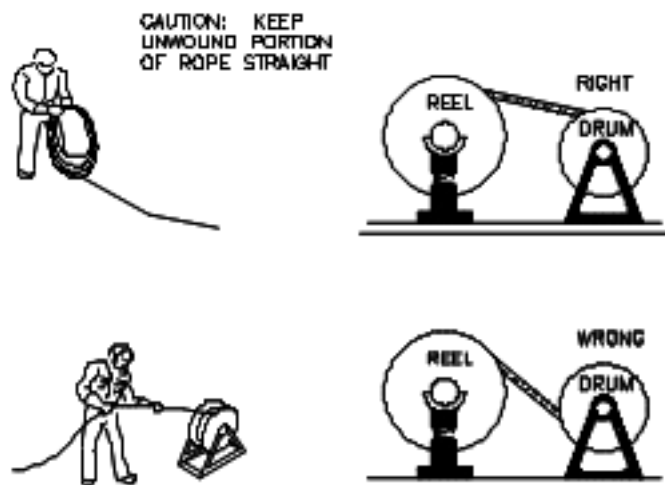
WARNING

NEVER HANDLE WIRE ROPE WITH BARE HANDS AS ALMOST INVISIBLE NICKS CAN CAUSE SEVERE AND PAINFUL CUTS.

ALL FUNCTIONAL WIRE ROPE SHOULD BE VISUALLY INSPECTED EVERY DAY, PRIOR TO PUTTING THE CRANE INTO SERVICE.

NOTE

When wire rope is replaced for any reason, consideration should be given to the conditions under which it will be used. Regular (right) lay rope should always be used to maintain level wrap on the winch.

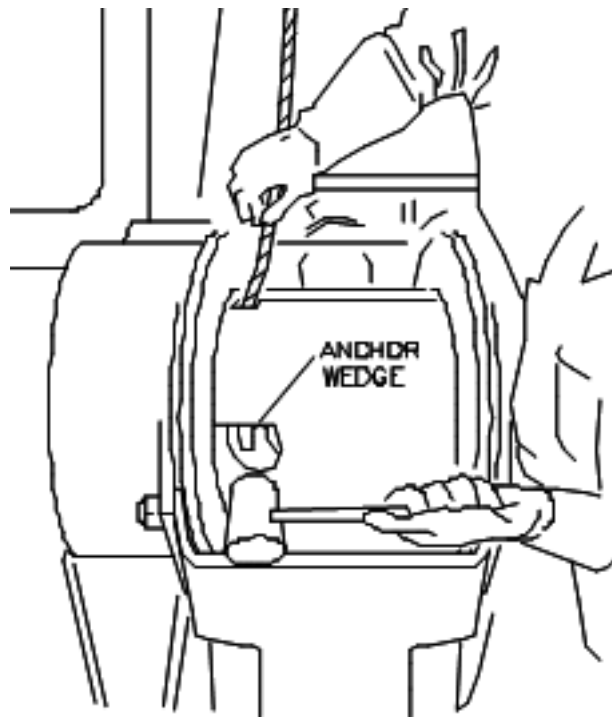


The serviceability of wire rope cannot be over-emphasized, it assures the safety of personnel and machine operation; it is also a preventative measure in safeguarding the load.

A thorough inspection of all functional wire rope should be made at least once a month and a running record of the rope condition kept on file.

Any deterioration, resulting in an appreciable loss of the rated rope strength, should be carefully examined and its serviceability evaluated as to the potential of a possible safety hazard. The following conditions should justify speculation of wire safety and consideration for replacement.

1. Corrosion.
2. More than one broken wire in any one strand.
3. More than one broken wire near attachment fitting.
4. Excessive wear and/or broken wires in rope sections under sheaves where rope travel is limited.



5. Evidence of noticeable reduction in original rope diameter after allowance for normal stretch and diameter reduction of a newly rigged rope has been made.
6. Excessive abrasion, scrubbing and peeling of outside wires; pitting, birdcaging (deformation), or other mechanical damage resulting in physical changes to the rope structure.

INSPECTION

Sheaves, guards, guides, drums, flanges, etc., and other surfaces that come in contact with the rope should be inspected for any defective areas that could cause possible damage to the rope.

NOTE

It is recommended that the coil or reel be rotated as rope is unwound.

UNWINDING

Extreme care should be taken when unwinding rope from either a coil or a reel. By rotating the coil or reel, the possibility of the rope twisting or kinking is lessened.

CAUTION

REGARDLESS OF THE METHOD USED, KEEP UNWOUND PORTION OF ROPE STRAIGHT DURING UNWINDING.

CUTTING

Proper seizing and cutting operations are not difficult to perform, and they insure that the wire rope will later do its job. When wire rope is carelessly or inadequately seized, especially in anticipation of cutting, ends become distorted and flattened and the strands and the life of the rope is significantly shortened.

The three preferred and most common methods of cutting wire rope are shearing, abrasive cutting or flame cutting. The following procedures are recommended regardless of the method being used.

1. Preformed wire rope: Clamp rope on each side of cut mark and proceed with cutting.
7. Non-preformed wire rope, less than 7/16 inch diameter; Place two clams on each side of cut mark and proceed with cutting.
8. Non-preformed wire rope, 7/8 inch diameter or greater: Place three clamps on each side of cut mark and proceed with cutting.

NOTE

END OF ROPE SHOULD BE EVEN WITH BOTTOM OF ANCHOR WEDGE.
--

9. Position anchor wedge in drum slot; pull firmly on free end of cable to secure wedge.

NOTE

IF WEDGE DOES NOT SEAT SECURELY IN SLOT, CAREFULLY TAP TOP OF WEDGE WITH Mallet.

10. Place a block of wood against the storage reel flange to serve as a brake to achieve a taut wrap, and wind rope, using power.
11. Install becket.

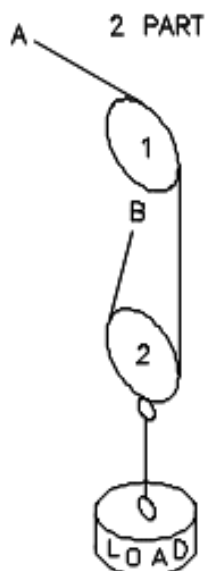
CABLE REEVING INSTRUCTIONS (if applicable)

Multiple part lines allow the operator to raise a greater load than permitted with the use of a single part line. Illustrated reeving shows 2-part line in relation to the number of sheaves in the boom nose and hook block.

CAUTION

WHEN REEVING WITH LESS THAN TOTAL NUMBER OF SHEAVES IN BOOM NOSE AND/OR HOOK BLOCK, REEVE CABLE OVER AND/OR UNDER CENTERMOST SHEAVES OF BOOM NOSE AND/OR HOOK BLOCK ASSEMBLIES TO EQUALLY DISTRIBUTE CABLE LOAD.

1. Two-Part Line:
 - a) From point 'A', reeve cable over sheave '1'.
 - b) From sheave '1', route cable under sheave '2' and secure becket.



LUBRICATION

Wire ropes are thoroughly saturated with lubricants during manufacture. Fibre centres are soaked with it. Lubricant is applied around every wire of the strand and around each strand in the rope.

Several types of lubricant are used in ropes. One is petroleum, a clear, thin, penetrating lubricant. Another is wire rope compound, a heavy bodied grease used primarily to protect rope. Other special types developed by individual cable manufacturers are available under their trade names.

Wire rope lubrication is vital in the protection of the rope and in reducing wear.

When wire rope is in use, the internal wire surfaces rub against each other and the outer wires wear against sheaves and drums. Lubrication reduces wear both on the outside and inside of the rope.

There is no set timetable governing the lubrication of wire rope. Lubrication intervals should be established around the working conditions to which the rope is subjected. **Assure that the lubricant used has the following characteristics.**

- Free from acid or alkaline content.
- Sufficient adhesive strength to remain on rope.
- High film strength properties.
- Oxidation resistant.
- Ability to saturate between wires and strands.
- Insoluble under methods of application.

Wire rope should be thoroughly cleaned prior to lubricating. Wire brushes, scrapers or compressed air, are the most efficient means. Assure that all old lubricant and any foreign matter is removed from the rope. There is no preferred wire rope lubrication method.

Lubrication in the field presents special problems. In the manufacturing process, the lubricant is applied hot to their separate wires and strands as they are formed into rope.

In the field, a lighter lubricant is required: one which will penetrate into the rope. It can be sprayed, brushed, poured on or applied in a bath when conditions permit.

Two important points of field lubrication are:

1. Clean the rope as thoroughly as possible before applying the lubricant.
2. Give the lubricant as much opportunity as possible to soak in.

The frequency of application depends on the nature of the operation and can be determined by inspection.

SECTION 6

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1. PREVENTATIVE MAINTENANCE

1.1. GENERAL

The actual operating environment of the machine governs the maintenance schedule. The suggested check lists following indicate the areas of the machine to be checked and the intervals at which they should be checked.

NOTE:

The following schedule check sheets are based on average operating conditions. The type of work being done, size of loads, and weather conditions are all factors which must be considered when establishing a maintenance schedule for the machine. The suggested schedule basis is given for hours of operation and calendar year.

Any changes in the established maintenance schedules should be preceded by a complete re-analysis of the machine's operation. Carefully study previous maintenance sheets and records before making changes in, or extending, the check intervals.

The lubrication chart in SECTION 4 provides the general locations of the individual points, time intervals for fluid changes and lists the type of lubricant which should be used for each component.

1.2. USING THE SUGGESTED SCHEDULE CHECK SHEETS

The maintenance schedule check sheets are designed as a preventative maintenance guide, until adequate experience is obtained to establish a schedule to meet a specific operating environment.

The check sheets can be reproduced by any printer to obtain additional copies. Maintenance personnel making each check should then indicate on the sheet that the required check has been completed, and the machine will be ready for additional service until the next check is due. Completed check sheets should be retained as a permanent part of the machine's maintenance records for future use.

NOTE:

The inspection frequency times do not need to be accomplished at the exact hour frequency shown. A convenient shutdown near the indicated time interval is satisfactory.

Some parts are not included in these suggested schedule check sheets, review service package section of these manuals for any items not reflected in these check sheets.

2. ' A' MAINTENANCE CHECKS - 10 HOURS OR DAILY SERVICE

Maintenance Person _____

Date Performed _____

Machine Model No. _____

Machine Serial No. _____

CHKD	MAINTENANCE POINTS	PERFORMED BY
_____	Check Hydraulic Lines for Leakage	_____
_____	Check Unit for Obvious Structural Damage	_____
_____	Check Hydraulic Oil Level	_____
_____	Lubricate Wear Pads (If Applicable)	_____
_____	Lubricate Swing Gear Teeth	_____

COMMENTS _____

3. `B' MAINTENANCE CHECKS - 50 HOURS OR WEEKLY SERVICE

Maintenance Person_____

Date Performed_____

Machine Model No._____

Machine Serial No._____

CHKD	MAINTENANCE POINTS	PERFORMED BY
_____	Repeat `A' Maintenance Checks	_____
_____	Lubricate – Control Levers (If Applicable)	_____
_____	Lubricate – Boom Lift Cylinder Rod Pin	_____
_____	Lubricate – Slew Ring Bearing	_____

COMMENTS_____

4. 'C' MAINTENANCE CHECKS - 100 HOURS OR MONTHLY SERVICE

Maintenance Person _____

Date Performed _____

Machine Model No. _____

Machine Serial No. _____

CHKD	MAINTENANCE POINTS	PERFORMED BY
_____	Repeat 'A' & 'B' Maintenance Checks	_____
_____	Lubricate – Boom Slider Wear Pads (If Applicable)	_____
_____	Lubricate – Boom Extend Cylinder Trunnions (If Applicable)	_____
_____	Lubricate – Boom Pivot Pin	_____
_____	Check Condition of Hoses & Tubing	_____
_____	Check Torque– Swing Bearing Bolts (bolts to be torqued to 1,200 ft/lbs)	_____

COMMENTS _____

5. 'D' MAINTENANCE CHECKS - 500 HOURS OR QUARTERLY SERVICE

Maintenance Person _____

Date Performed_____

Machine Model No. _____

Machine Serial No. _____

CHKDMAINTENANCE POINTSPERFORMED BY

Repeat 'A', 'B', and 'C' Maintenance Checks

_____ Check Boom Wear Pads (If Applicable) _____

COMMENTS _____

6. `E' MAINTENANCE CHECKS - 1,000 HOURS OR SEMI-ANNUAL SERVICE

Maintenance Person _____

Date Performed _____

Machine Model No. _____

Machine Serial No. _____

CHKD	MAINTENANCE POINTS	PERFORMED BY
_____	Repeat `A', `B', `C' and `D' Maintenance Checks	_____
_____	Check Condition of Hoses and Tubing	_____
_____	Check Torques - Slew Ring Bolt (Torque to 1,200 ft/lbs)	_____
_____	Visually Check Slew Ring Bolts	_____
_____	Visually Check Slew Ring Seals	_____

COMMENTS _____

7. 'F' MAINTENANCE CHECKS - 4,000 HOURS OR 2 YEARS SERVICE

Maintenance Person _____

Date Performed_____

Machine Model No. _____

Machine Serial No. _____

CHKD	MAINTENANCE POINTS	PERFORMED BY

Repeat 'A', 'B', 'C', 'D' and 'E' Maintenance Checks

Replace – Seals in Control Valve

Replace – Boom Wear Pads (If Applicable)

COMMENTS _____

8. `G' MAINTENANCE CHECKS - 10,000 HOURS OR 5 YEARS SERVICE

Maintenance Person_____

Date Performed_____

Machine Model No._____

Machine Serial No._____

CHKD	MAINTENANCE POINTS	PERFORMED BY
_____	Repeat `A', `B', `C', `D', `E' & `F' Maintenance Checks	_____
_____	Replace – Boom Wear Pads (If Applicable)	_____
_____	Replace - Seals in Boom Extension Cylinders (If Applicable)	_____
_____	Replace - Seals in Boom Lift Cylinders	_____

COMMENTS_____

9. PROCEDURES FOR RE-LUBRICATION

(Refer to Lubrication Chart for Correct Fluids and Time Intervals)

1. LIFT CYLINDER PIN - Apply grease gun to fitting on each end of cylinders. Grease until lubricant extrudes out of bushings.
2. PIVOT PIN - Apply grease gun to fitting on pivot housing at base of boom.
3. SLEW BEARING - Refer to detailed lubrication instructions found in SERVICE PACKAGE SECTION of this manual.
4. SLEW GEARBOX - Refer to detailed lubrication instructions found in slew gear box manual.
5. SLEW GEAR TEETH - Apply lubricant as instructed in slew bearing manual in SERVICE PACKAGE SECTION of this manual.

10. TIMES AND FLUID QUANTITIES

Time to grease all points and check fluid levels for items 1 through 4 is estimated at 15 minutes. Fluid (grease) quantity is estimated at 1/4 lb (100g).

Time to grease the gear teeth item 5, is ¼ hour.
Material used is estimated at ¼ lb (100 g)

Time to change fluid in slew gear box depends on temperature and degree of need for change (contamination would require tear down). Refer to gear box manuals for fluid quantities.

11. CLEANLINESS

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

Whenever hydraulic hoses and tubing are disconnected, inspect all passages and holes to ensure that they are free from debris. Check replacement parts when they are being installed to ensure that they are clean.

12.INSPECTIONS

12.1.REMOVAL AND INSTALLATION

When performing maintenance, do not attempt to manually lift heavy parts when hoisting equipment should be used. Never locate or leave heavy parts in an unstable position. When lifting a portion of a machine or a complete machine, ensure the machine is blocked securely and the weight is supported by blocks rather than by lifting equipment.

When using hoisting equipment, following the hoist manufacturer's recommendations, use lifting devices that will allow you to achieve the proper balance, of the assemblies being lifted and to ensure safe handling.

Unless otherwise specified, all removals requiring hoisting equipment should be accomplished using an adjustable lifting attachment. All supporting members (chains and cables) should be parallel to each other and as near perpendicular as possible to the top of the object being lifted.

CAUTION

THE CAPACITY OF AN EYE BOLT DIMINISHES AS THE ANGLE BETWEEN THE SUPPORTING MEMBERS AND THE OBJECT BECOMES LESS THAN 90 DEGREES. EYE BOLTS AND BRACKETS SHOULD NEVER BE BENT AND SHOULD ONLY HAVE STRESS IN TENSION.

Some removals require the use of lifting fixtures to obtain proper balance. The weights of some components are given in the specification section of this manual.

If a part resists removal, check to be certain all nuts and bolts have been removed and that an adjacent part is not interfering.

12.2.DISASSEMBLY AND ASSEMBLY

When assembling or disassembling a component or system, complete each step in turn. Do not partially assembly one part and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see that nothing has been overlooked. Recheck the various adjustments by operating the machine before returning it to the job.

12.3.PRESSING PARTS

When pressing one part into another, use an anti-seize compound or a molybdenum disulphides based compound to lubricate the mating surfaces.

Assemble tapered parts dry. Before assembling parts with tapered splines, be sure the splines are clean, dry and free from burrs. Position the parts together by hand to mesh the splines before applying pressure.

Parts which are fitted together with tapered splines are always very tight. If they are not tight inspect the tapered splines and discard the part if the spines are worn.

12.4.LOCKS

Lock washers, flat metal locks, or cotter pins are used to lock nuts and bolts.

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

Always use new locking devices on components which have moving parts.

When installing lock washers on housings made of aluminium, use a flat washer between the lock washer and the housing.

12.5.WIRES AND CABLES

Batteries should always be disconnected with the BATTERY DISCONNECT SWITCH prior to working on the electrical system.

When removing or disconnecting a group of wires or cable, tag each one to ensure proper identification during assembly.

12.6.SHIMS

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

12.7.BEARINGS

12.7.1.Anti-friction Bearings

When an anti-friction bearing is removed, cover it to keep out dirt and abrasives. Wash bearings in non-flammable cleaning solution and allow them to drain dry. The bearing may be dried with compressed air, BUT do not spin the bearing.

Discard the bearings if the races and balls or rollers are pitted, scored or burned. If the bearing is serviceable, coat it with oil and wrap it in clean waxed paper. Do not unwrap new bearings until time of installation.

The life of an anti-friction bearing will be shortened if not properly lubricated. Dirt in an anti-friction bearing can cause the bearing to lock resulting in the shaft turning in the inner race or the outer race turning within the cage.

12.7.2.Double Row, Tapered Roller

Double row, tapered roller bearings are precision fit during manufacture and components are not interchangeable. The cups, cones, and spacers are usually etched the same serial number and letter designator. If no letter designators are found, wire the components together to assure correct installation. Reusable bearing components should be installed in their original positions.

12.7.3.Heating Bearings

Bearings which require expansion for installation should be heated in oil not to exceed 250 degrees F (121 xC) When more than one part is heated to aide in assembly, they must be allowed to cool and then pressed together again. Parts often separate as they cool and contract.

12.7.4.Installation

Lubricate new or used bearings before installation. Bearings that are to be pre-loaded must have a film of oil over the entire assembly to obtain accurate pre-loading. When installing a bearing, spacer, or washer against a shoulder on a shaft, be sure the chamfered side is toward the shoulder.

When pressing bearings into a retainer or bore, uniformly apply pressure to the outer race. If the bearing is pressed on the shaft, uniformly apply pressure on the inner race.

12.7.5.Pre-load

Pre-load is an initial load placed on the bearing at the time of assembly. Whether a tapered roller bearing should have pre-load could depend on any of several conditions; rigidity of the housings and shaft, bearing spread, speed of operation, etc.

To determine whether a bearing requires pre-load or end clearance, consult the disassembly and assembly instructions pertaining to that bearing.

Care should be exercised in applying pre-load. Misapplication of pre-load to bearings requiring end clearance can result in bearing failure.

12.7.6.Sleeve Bearings

Do not install sleeve bearings with a hammer. Use a press and be sure to apply the pressure directly in line with the bore. If it is necessary to drive on a bearing, use a bearing driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part.

12.8.GASKETS

Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If is necessary to make gaskets, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage.

When removed, always install new cylinder head and manifold gaskets using recommended gasket compound on head gaskets to allow uniform sealing.

12.9.BATTERIES

Clean batteries by scrubbing them with a solution of baking soda and water. Rinse with clear water. After cleaning, dry thoroughly and coat terminals and connections with an anti-corrosion compound or grease.

If the machine is to be stored or not used for an extended period of time, the batteries should be removed. Store the batteries in a warm, dry place, preferable on wooden shelves. Never store on concrete. A small charge should be introduced periodically to keep the specific gravity rating at recommended level.

12.10.HYDRAULIC SYSTEMS

WARNING

EXERCISE EXTREME CARE AROUND PRESSURIZED HYDRAULIC SYSTEMS.
Do not work on hydraulic system while it is in operation or until all pressure is released.

12.10.1.Cleanliness

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.

Keep the System Clean.

When removing components of a hydraulic system, cover all openings on both the component and the machine.

If evidence of foreign particles is found in the hydraulic system, flush the system.

Disassemble and assemble hydraulic components on a clean surface.

Clean all metal parts in a non-flammable cleaning fluid. Then lubricate all components to aide in assembly.

12.10.2.Sealing Elements

Inspect all sealing elements (O-rings, gaskets, etc.) When disassembling and assembling the hydraulic system components. Installation of new elements is always recommended.

12.10.3.Hydraulic Lines

When installing metal tubes, tighten all bolts finger tight. Then, in order, tighten the bolts at the rigid end, the adjustable end, and the mounting brackets. After tubes are mounted, install the hoses. Connect both ends of the hose with all bolts finger tight. Position the hose so it does not rub the machine or another hose and has a minimum of bending and twisting. Tighten bolts in both couplings.

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.

13.FATIGUE OF WELDED STRUCTURES

Experience has shown that highly stressed welded structures, when repeatedly subjected to varying stresses caused by twisting, shock, bending, and intentional and/or unintentional overloads, often become subject to weld cracking which may be attributed to fatigue of the welded joint.

Equipment should be periodically inspected for evidence of weld fatigue. The frequency of these inspections should be commensurate with the age of the equipment, the severity of the application, and the experience of the operators and maintenance personnel.

The following are known as high stress areas, and a visual inspection of these areas should be made part of an owner's planned preventative maintenance program.

- A) Cylinder - wear pad retaining structures, cylinder attach points, carriage roller shafts.
- B) Lift Cylinder - end connections.
- c) Outrigger Structures - near pivots, pads, arms, boxes and attachment structures.
- d) Turret structure - near pivots, slew bearing bolts, cylinder thrust points and cylinder eyes.
- e) Boom sections - near ends, pivots, and lower wear pads.
- f) Counterweight support structure.
- g) Chassis mounting structure.

The above is provided only as a guide, and your inspection plan should not be limited to the areas listed. A thorough visual inspection of all weldments is good practice.

14.WELDING REPAIRS

Main Frame - Welding on the main frame should be carried out according to approved procedures, preceded and followed by appropriate heat treatments when applicable.

Other Structural - All welding is to be carried out according to approved procedures for additions and repairs. Any cracks should be fully ground out before re-welding using proper preheating procedures to avoid distortion, etc.

Refer to welding repair procedure as applicable to this machine.

15..WELDING REPAIR PROCEDURE

ARVA MODEL AT3035 Crane

The materials used in the various structures of the machine are as follows;

Boom & Frame	100,000 psi yield (T-1)
Outrigger	70,000 psi yield
Cab	50,000 psi yield
Hoods & Housings	44,000 psi
Tanks & Other Frame	44,000 psi

Welding material recommended for all of the above materials with exception of T-1, is all position low hydrogen rod.

CSA E-7018 for stick metal arc welding
Use CSA E-11018 stick for Boom & Frame

For gas metal arc welding recommend using all position CA E-70S6 with CO2 shielding gas.

Material should be 50 degrees F (10 degrees C) or above.

NOTE: Welding materials are to be always kept sealed or dry.

WARNING
WELDING IS TO BE DONE BY QUALIFIED PERSONNEL ONLY.

Refer to Canadian Standards Association section W59 for welding information.

16.LOCTITE

WARNING
LOCTITE TYPE ADHESIVES CONTAIN CHEMICALS THAT MAY BE HARMFUL IF MISUSED. READ AND FOLLOW THE INSTRUCTIONS ON THE CONTAINER.

Always follow the directions on the Loctite container as not all Loctite types are suitable for all applications.

17.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.

Torque values should correspond to the type of bolts, studs and nuts being used.

The torque tables (see following) are provided for reference when performing maintenance.

Use of proper torque values is extremely important. Improper torque can seriously affect performance and reliability.

Identification of fastener grades is critical for replacement procedures. When fasteners are identified as being high strength (eg., grade 5, 8, etc.), the mechanic must be aware of the fact that appropriate torque values should be referred and adhered to.

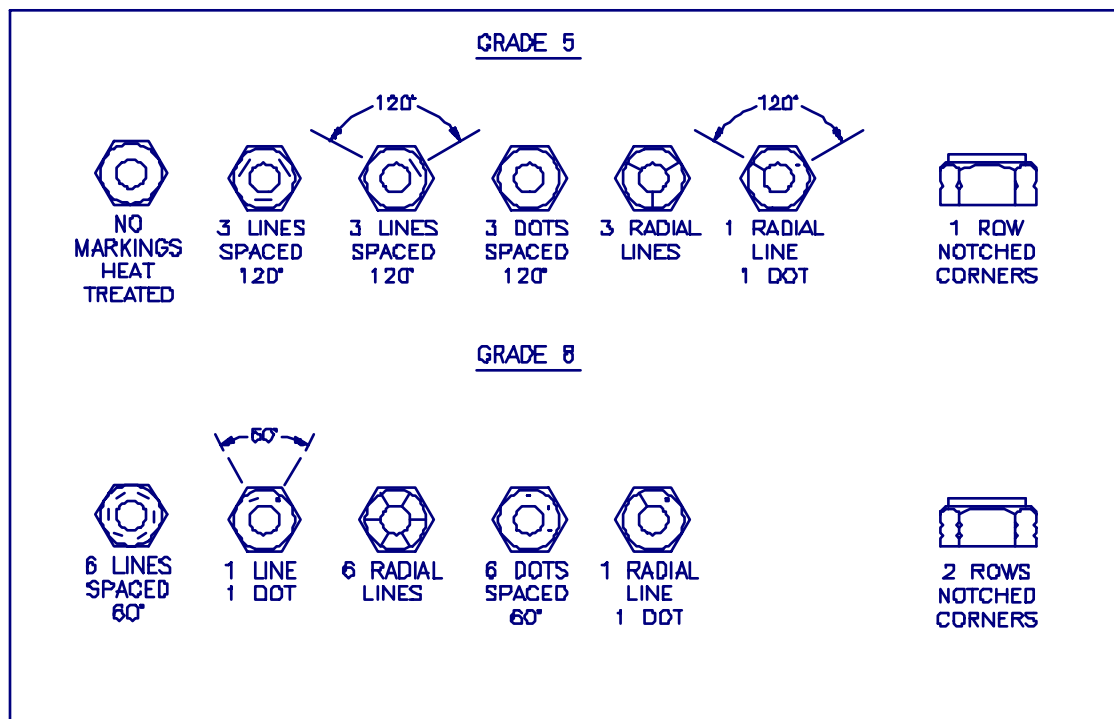
Special attention should be given to the existence of lubricant, plating or other factors that might require variation from standard torque values.

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




When referring to the applicable torque charts, use values as close as possible to the torque values shown to allow for wrench calibration tolerance. An erratic or jerking motion in the wrench can easily result in excessive torque. ALWAYS use a slow wrench movement and STOP when the predetermined value has been reached.

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 over-stressed or damaged, it should be removed from service until calibrated.

18.NUT IDENTIFICATION














19.METRIC TORQUE VALUES

	M5	M6	M7	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27
	TORQUE (FOOT-POUNDS)												
	4	7	11	18	32	58	94	144	190	260	368	470	707
	6	10	16	25	47	83	133	196	269	366	520	664	996
	7	11	20	29	58	100	159	235	323	440	628	794	1205












Torque values as shown are for nut-bolt combinations that have not been plated and have not had special lubricants applied to them and/or for those using flat or split ring types of washers. (Discount residual lubricant that was applied at the time of manufacture.)

20.S.A.E. TORQUE VALUES (LUBRICATED)

	S.A.E. 2 A.S.T.M. A 307 STEEL	64,000 PSI	LOW CARBON STEEL	17	27	40	59	84	135	182	270	593		951
	S.A.E. 3 STEEL	100,000 PSI	MEDIUM CARBON STEEL	27	42	62	93	131	211	335	496	1090		1748
	S.A.E. 5 A.S.T.M. A 449 STEEL	105,000 PSI	MEDIUM CARBON STEEL OR LOW ALLOY HEAT TREATED	28	45	68	99	135	225	340	524	987		1573
	A.S.T.M. 354 BB STEEL													
	A.S.T.M. A 325					100		200	355	525	790	1495		2600
	A.S.T.M. A 354 BC STEEL	125,000 PSI	LOW ALLOY OR MED. CAR QUINCHD TMPRD	31	49	73	107	150	242	384	580	1253		2010
	S.A.E. 6 STEEL	133,000 PSI	MED. CARB. STEEL QUINCHD TMPRD	39	62	95	135	188	315	495	743	1634		2620
	S.A.E. 7 STEEL		MED. CARB. ALLOY, QCHD TMPRD RL THR'D											
	S.A.E. 8 STEEL	150,000 PSI	MED. CARB. ALLOY QUINCHD TMPRD	41	68	104	149	203	333	532	804	1768	2367	2835
	SOC. HEAD CAPSCREW ALSO N.A.S. AIRCRAFT STD.	160,000 PSI	HIGH CARB. ALLOY QUINCHD TMPRD	45	73	109	158	216	356	566	868	1908		3052
	N.A.S. 144 AIRCRAFT STD. MS20000 MIL. STD.													

Torque values as shown are for nut-bolt combinations that have been plated or have had lubrication applied. (Maximum torque values are listed).

21.S.A.E. TORQUE VALUES (DRY)

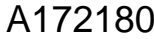
Fine or Course Thread Fastener	Grade Designation	Tensile Strength Minimum	Material	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/4	1-3/8	1-1/2
				TORQUE (FOOT-POUNDS)										
	S.A.E. 2 A.S.T.M. A 307 STEEL	64,000 PSI	LOW CARBON STEEL	19	30	45	66	93	150	202	300	659		1057
	S.A.E. 3 STEEL	100,000 PSI	MEDIUM CARBON STEEL	30	47	69	103	145	234	372	551	1211		1943
	S.A.E. 5 A.S.T.M. A 449 STEEL	105,000 PSI	MEDIUM CARBON STEEL OR LOW ALLOY HEAT TREATED	31	50	75	110	150	250	378	583	1097		1748
	A.S.T.M. 354 BB STEEL													
	A.S.T.M. A 325					100		200	355	525	790	1495		2600
	A.S.T.M. A 354 BC STEEL	125,000 PSI	LOW ALLOY OR MED. CAR QUNCHED TEMPERED	34	54	81	119	167	269	427	644	1392		2234
	S.A.E. 6 STEEL	133,000 PSI	MED. CARB. STEEL QUNCHED TEMPERED	43	69	106	150	209	350	550	825	1815		2913
	S.A.E. 7 STEEL		MED. CARB. ALLOY, QUNCHED TEMPERED REL. THREADED											
	S.A.E. 8 STEEL	150,000 PSI	MED. CARB. ALLOY, QUNCHED TEMPERED	46	75	115	165	225	370	591	893	1964	2633	3150
	SQC. HEAD CAPSCREW ALSO N.A.S. AIRCRAFT STD.	160,00 PSI	HIGH CARB. ALLOY QUNCHED TEMPERED	50	81	121	176	240	395	629	964	2120		3402
	N.A.S. 144 AIRCRAFT STD. MS20000 MIL. STD.													

Torque values as shown are for nut-bolt combinations that have not been plated and have not had special lubricants applied to them and/or for those using flat or split ring types of washers. (Discount residual lubricant that was applied at the time of manufacture)

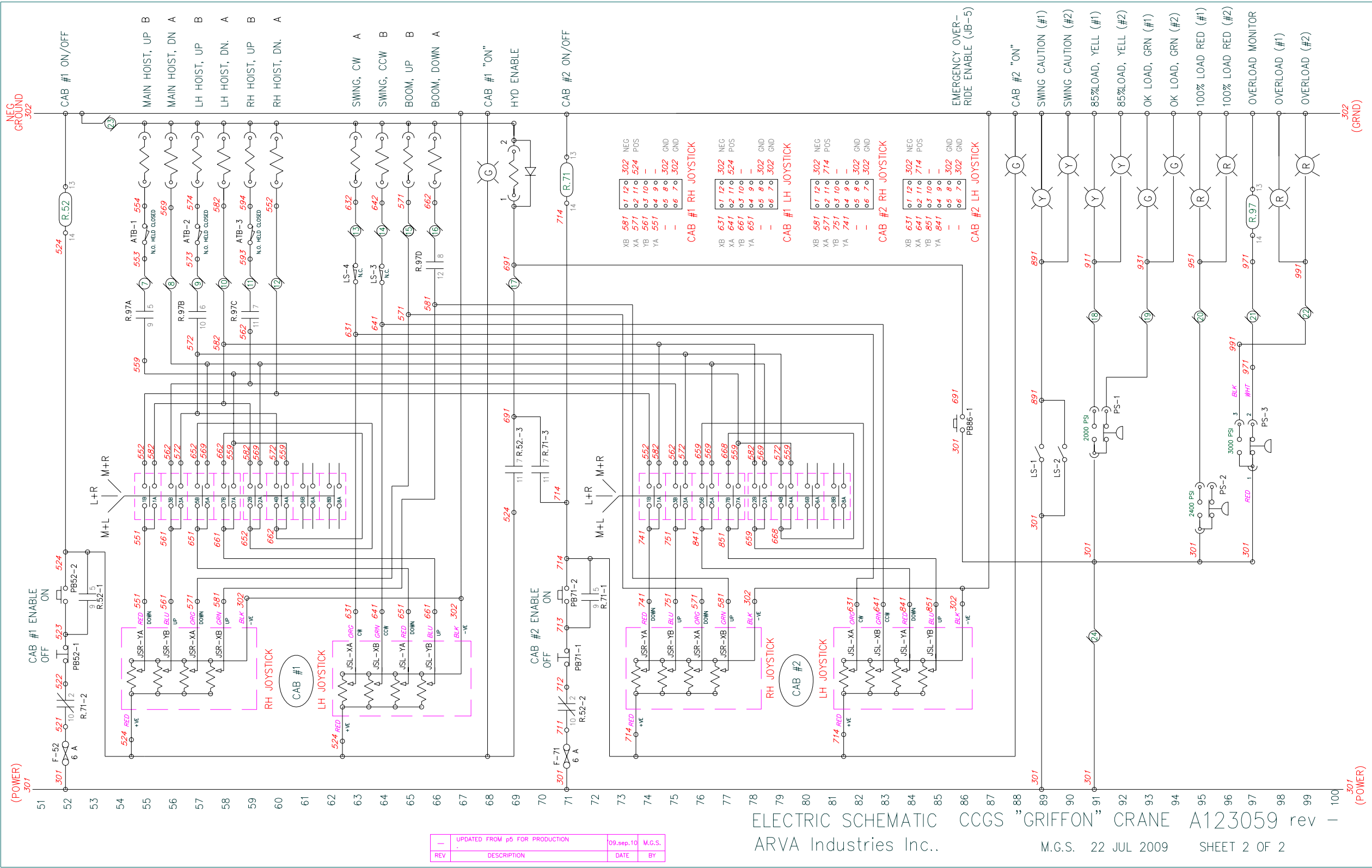
SECTION 7

Electrical Schematic	A123059
Hydraulic Schematic	A115122

SECTION 7
ELECTRICAL SCHEMATIC A123059 (SHEET 1 OF 2)

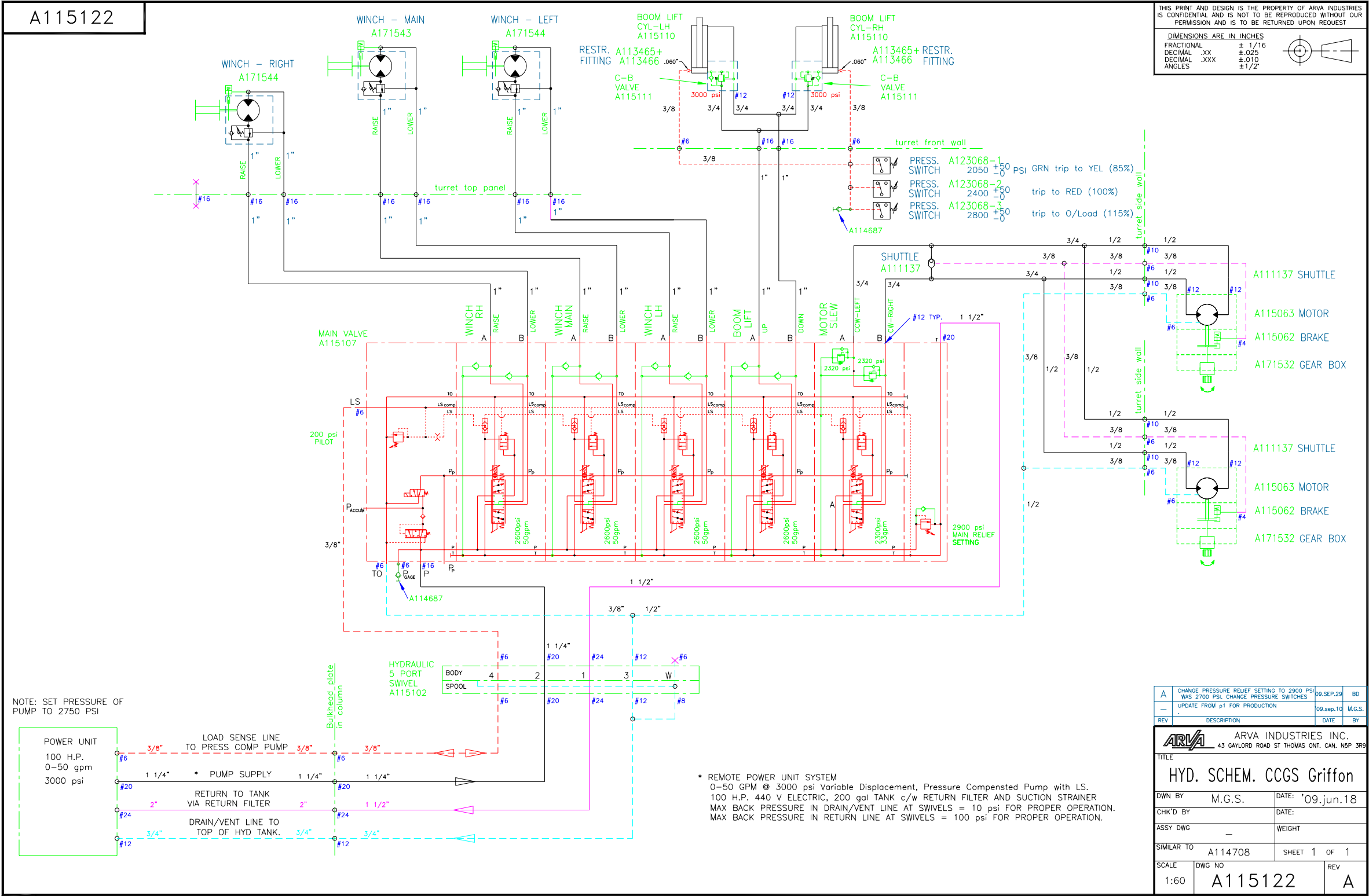


SECTION 7
ELECTRICAL SCHEMATIC A123059 (SHEET 2 OF 2)



SECTION 7

HYDRAULIC SCHEMATIC A115122 (SHEET 1 OF 1)



SECTION 8

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1. Give Model and Serial Number of your machine. This information is found on the machine serial plate.
2. Give complete information on the Part(s) requested including the part number, description, and quantity.
3. Give complete `Ship-to= address and specify exact method of shipment wanted, giving a billing address if different from ship to address.
4. Specify the urgency of the parts order by designating the priority (emergency or stock), include preference for shipper if applicable.

NOTE: When placing telephone order, please record with whom you spoke and date, so that follow-up telephone conversations are processed without confusion.

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e-mail: sales@arvaindustries.com
web site: www.arvaindustries.com

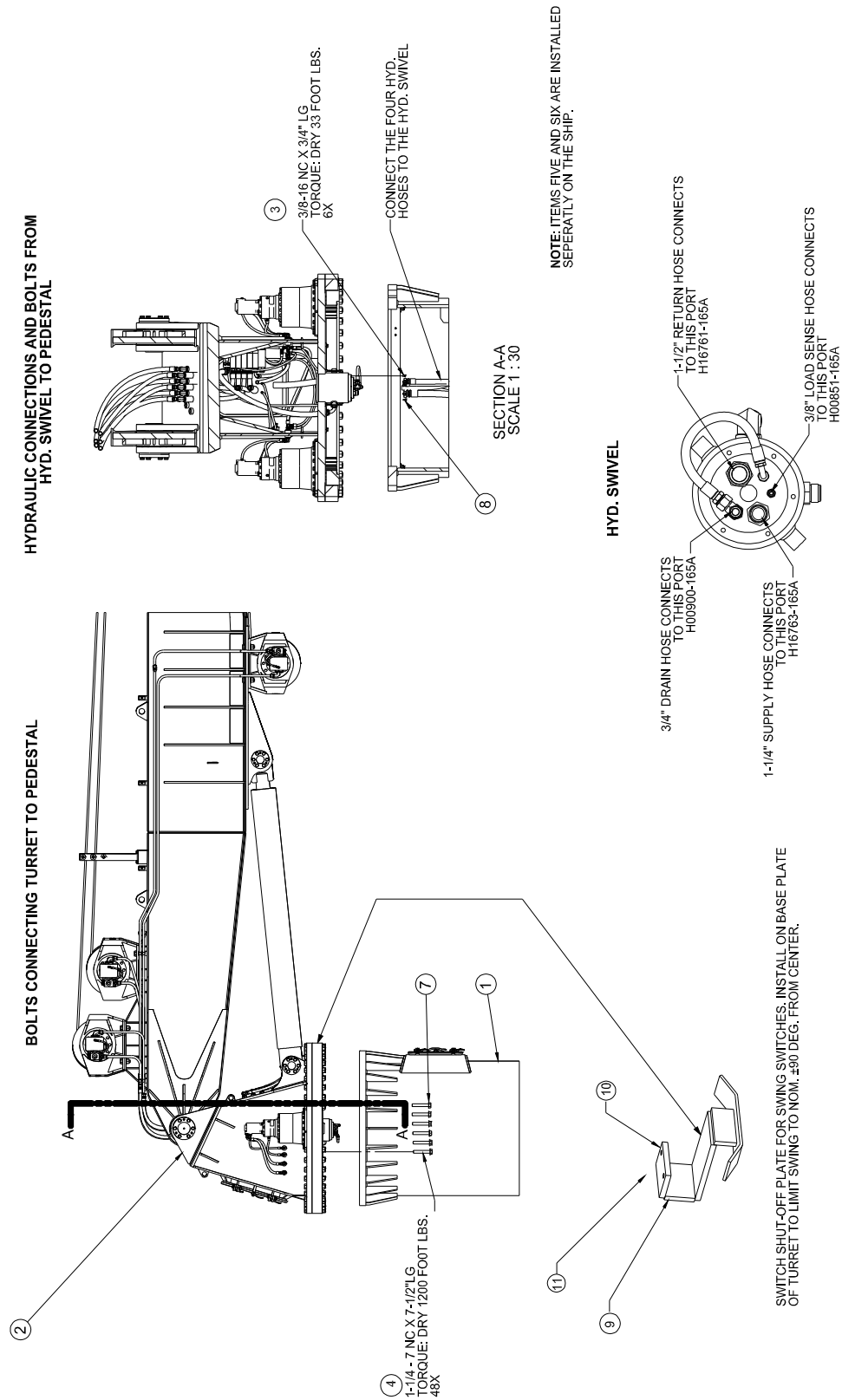


FIGURE G

MARINE CRANE ARVA16520M

Figure G

A171535

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A171602	REF	Pedestal Assembly	Ref Fig 1-3
2	A171641	1	Boom & Turret Installation	Ref Fig 1
3	A100204H	6	Bolt, 3/8-16Nc X 3/4" Gr 5 (Hex)	
4	A101066	48	Bolt, 1-1/4-7Nc X 7-1/2" Gr 8 (Hex)Plated	
5	A115103	1	Power Unit, Hydraulic W/100Hp Motor, Reservoir & Switch	
6	A115104	1	Panel, Control Motor	
7	A103030	6	Washer, 1-1/4"Sae (Flat Hard)	
8	A103022H	6	Washer, 3/8" (Flat Hard Gr8)	
9	A172106	2	Switch Shut-Off Weldment	
10	A102613H	4	Nut, 1/2-13Nc Gr5 (Jam)	
11	A102246	4	Screw, 1/2-13Nc X 2" (Set)	
12	A123058	1	Electrical Installation	Ref Fig 2
13	A172043	1	Paint And Decal Installation	Ref Fig 3

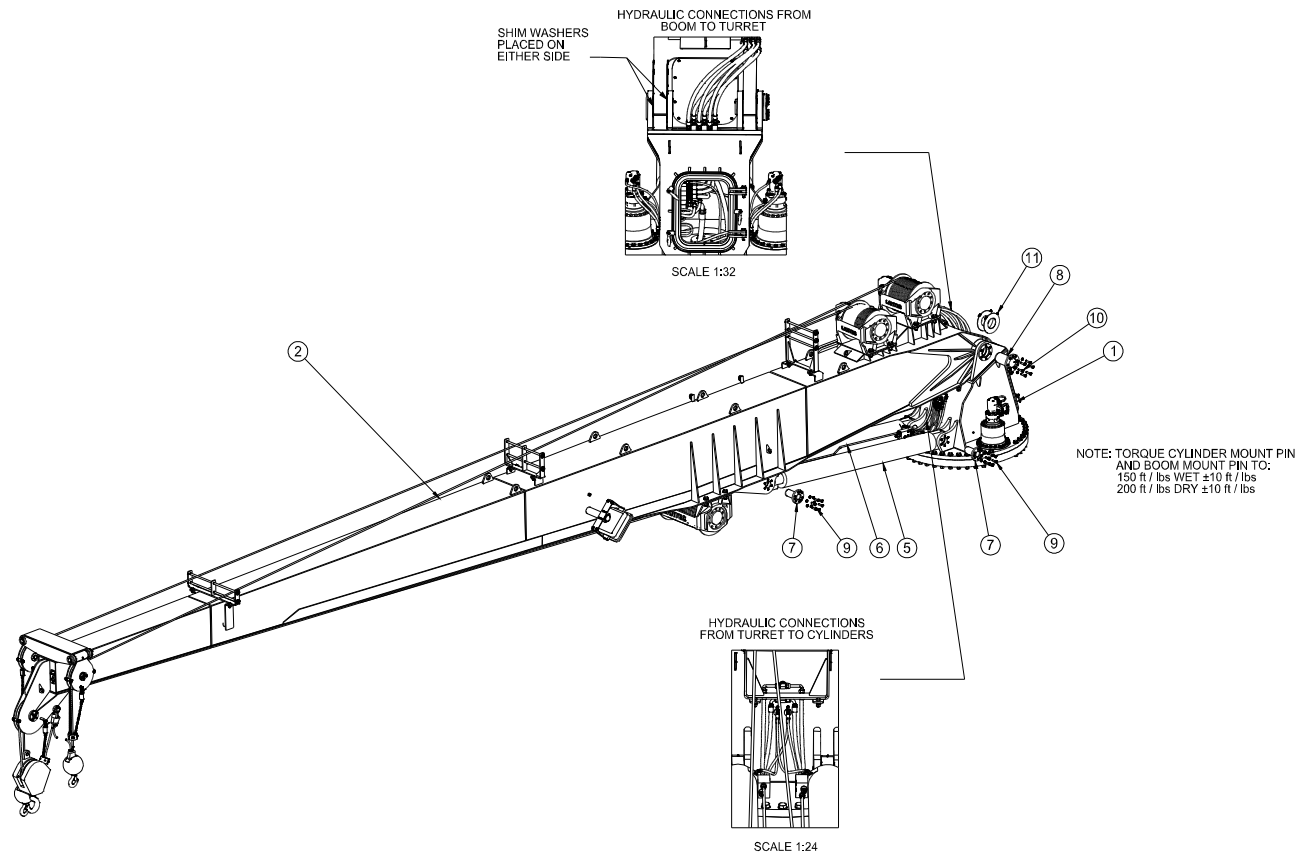


FIGURE 1

BOOM & TURRET INSTALLATION

Figure 1		A171641		Drawing Rev A	
ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE	
1	A171637	1	Turret Assembly	Ref Fig 1-1	
2	A171640	1	Boom Assembly	Ref Fig 1-2	
3	A172002	1	Winch Installation	Ref Fig 1-4	
4	A172031	1	Atb Installation	Ref Fig 1-7	
5	A115168	1	Hydraulic Cylinder Installation Lh	Ref Fig 1-8	
6	A115167	1	Hydraulic Cylinder Installation Rh	Ref Fig 1-9	
7	A171656	4	Cylinder Mount Pin Weldment		
8	A171659	2	Boom Mount Pin Weldment		
9	A100737	24	Bolt, 3/4-10Nc X 2-3/4" Gr 8 (Hex)		
10	A103207H	36	Washer-Lock, 3/4"		
11	A100745	12	Bolt, 3/4-10Nc X 3-1/4" Gr 8 (Hex)		
12	A173365	4	Shim, Washer, SS		

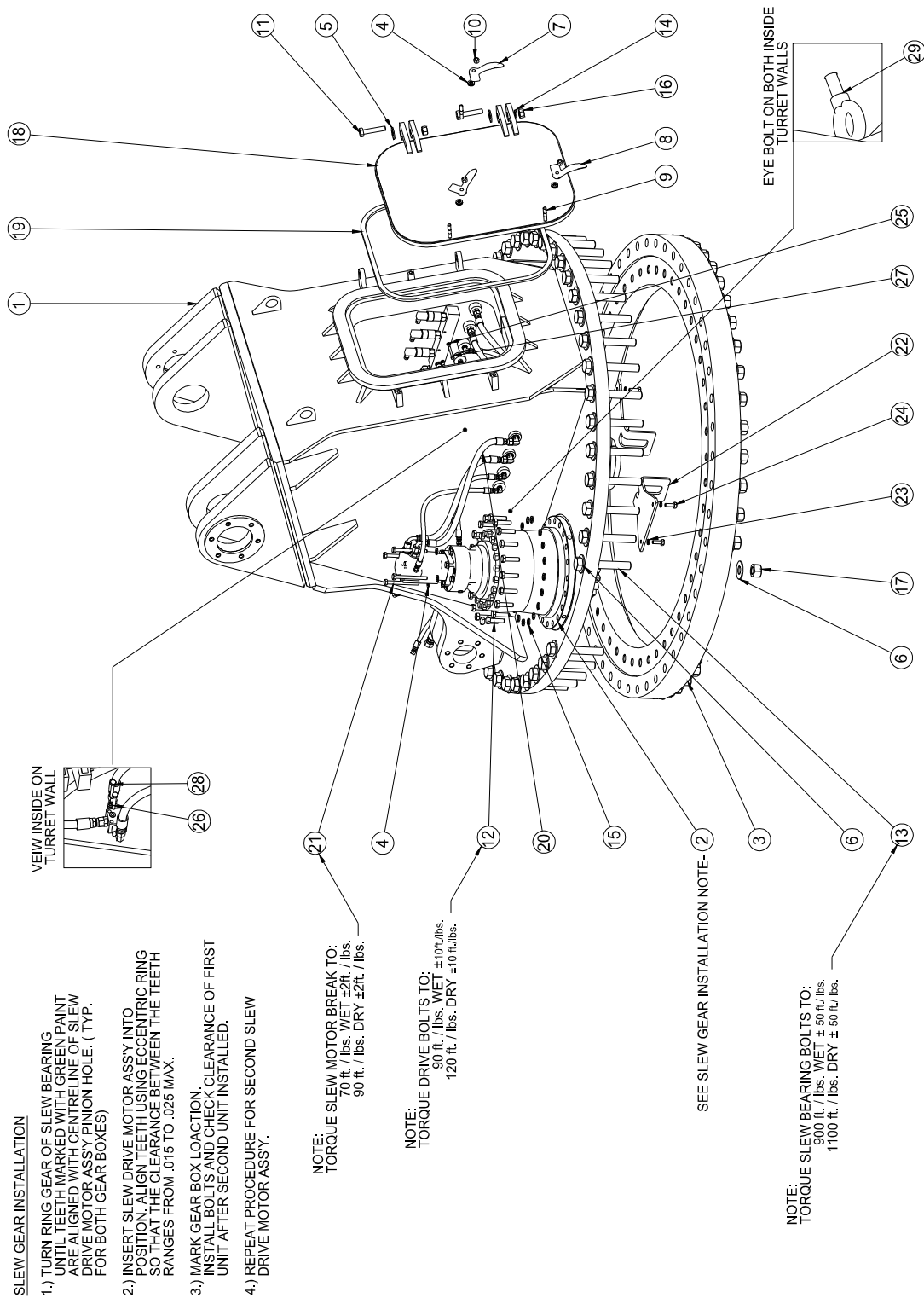
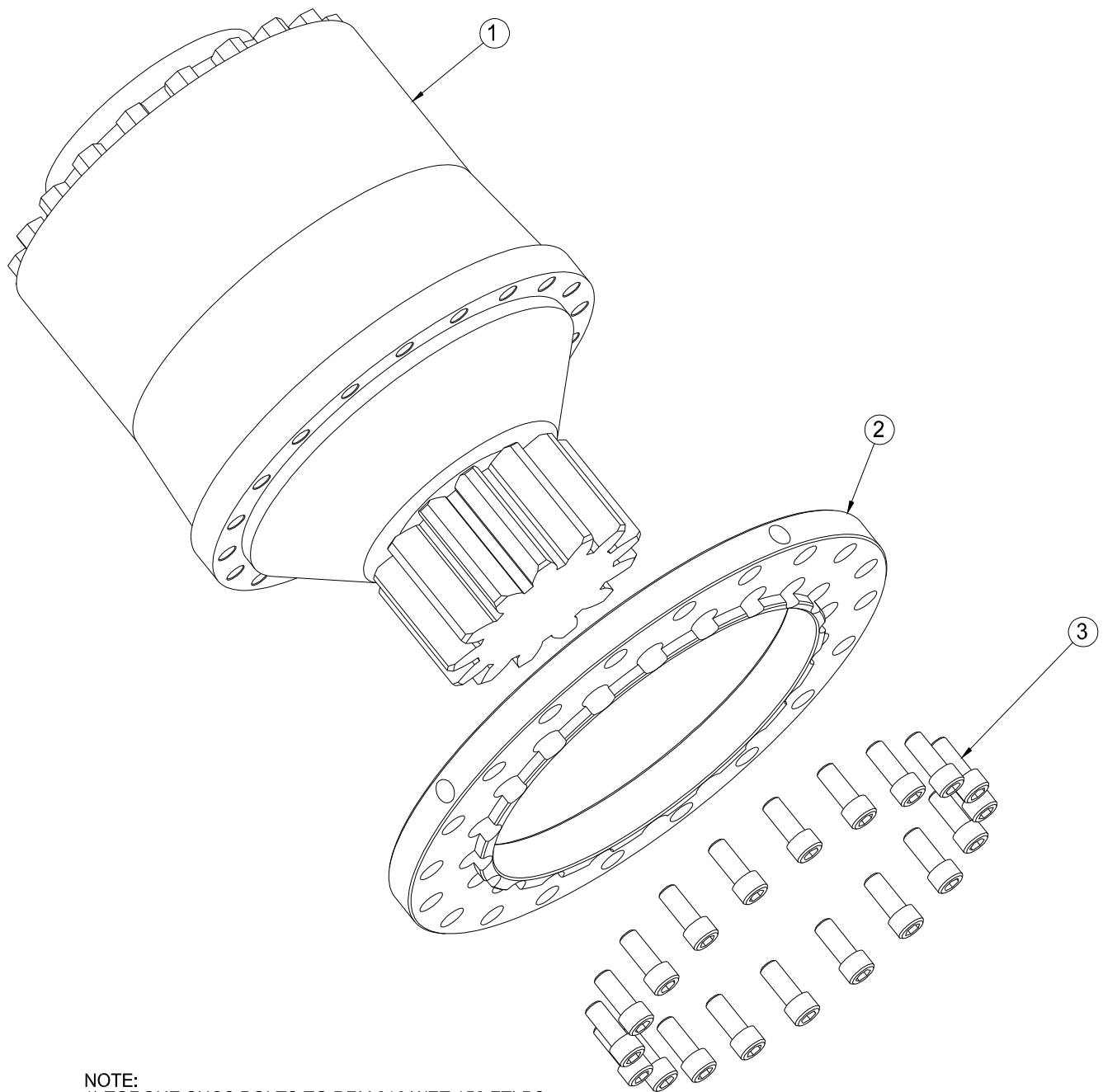


FIGURE 1-1

TURRET ASSEMBLY

Figure 1-1 A171637 Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A171636	1	Turret Machining	
2	A171634	2	Slew Motor Drive Assembly	Ref Fig 1-1a
3	A171531	1	Slew Ring	
4	A103024	9	Washer, 1/2" Hard (Flat)	
5	A103027	2	Washer, 3/4" Gr8 (Flat Hard)	
6	A103030	84	Washer, 1-1/4"Sae (Flat Hard)	
7	A171603	1	Latch, Heavy Duty, 1/4 Turn, Rh	
8	A171622	2	Latch, Heavy Duty, 1/4 Turn, Lh	
9	FS00083	3	Stud, 1/2" X 2-3/4 Nc/Nf	
10	A102713H	3	Nut-Nylock, 1/2-13Nc Gr8	
11	A100753	2	Bolt, 3/4-10Nc X 3-3/4" Gr 8 (Hex)	
12	A100633	40	Bolt, 5/8-11Nc X 2-1/2" Gr 8 (Hex)	
13	A101065	42	Bolt, 1-1/4-7Nc X 8-1/2" Gr 8 (Hex) Plated	
14	A103207H	2	Washer-Lock, 3/4"	
15	A103206	40	Washer-Lock, 5/8" (High Alloy)	
16	A102525	2	Nut, 3/4-10Nc (Hex) Gr8	
17	A102554	42	Nut, 1-1/4-7Nc (Hex) Gr8	
18	A171669	1	Turret Door Weldment	
19	A172030	1	Turret Hatch Door Seal, Neoprene- Stckr Tite	
20	A115118	1	Turret Hydraulic Installation	Ref Fig 1-1b
21	A100477H	8	Bolt, 1/2-13Nc X 5-1/2" Gr 8 (Hex)	
22	A172057	2	Plate, Hyd. Swivel Bracket	
23	A103204	4	Washer-Lock, 1/2" (High Alloy)	
24	A100417H	4	Bolt, 1/2-13Nc X 1-1/2" Gr 8 (Hex)	
25	A103201H	2	Washer-Lock, 5/16"	
26	A103200H	2	Washer-Lock, 1/4" (Plated)	
27	A100132H	2	Bolt, 5/16-18Nc X 2-1/2" Gr 5 (Hex)	
28	A100020H	2	Bolt, 1/4-20Nc X 1-3/4" Gr 5 (Hex)	
29	A102092	2	Bolt, 1/2-13Nc X 1-1/2" (Eye)	



NOTE:
1) TORQUE SHCS BOLTS TO DRY 216 WET 150 FTLBS.

FIGURE 1-1a

SLEW MOTOR DRIVE ASSEMBLY

Figure 1-1a

A171634

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171532	1	Gear Box, Eskridge
2	A171620	1	Eccentric Ring
3	A101534	20	Bolt, 5/8-11Nc X 1-1/2" (Soc)

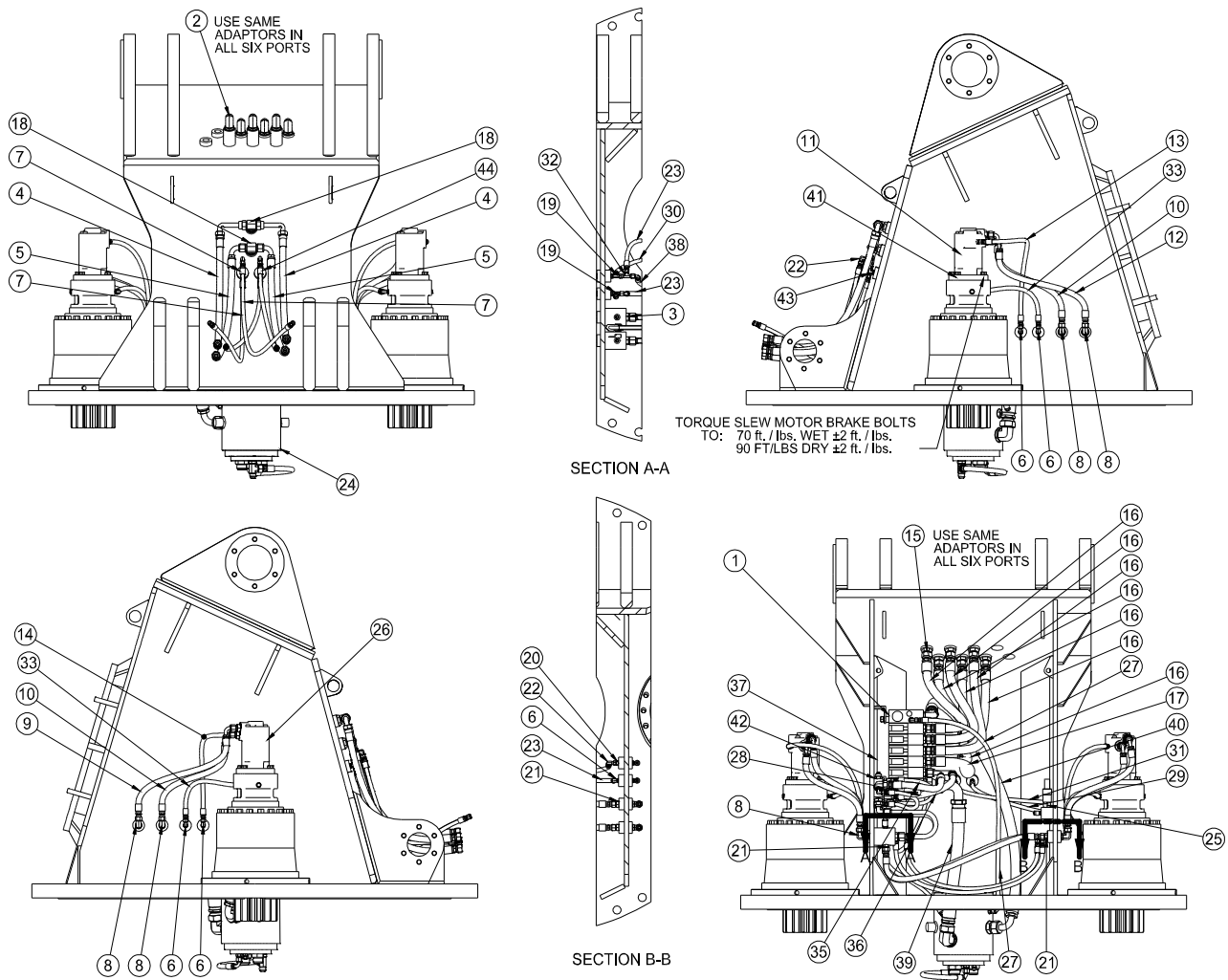


FIGURE 1-1b

TURRET HYDRAULIC INSTALLATION

Figure 1-1b

A115118

Drawing Rev D

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	A115157	1	Control Valve Assembly, Griffon	1-1ba
2	A13230	6	Adapt-90, 16Sae-16Jicm	
3	A13850	2	Adapt, 12Sae - 12Jicm	
4	H00906-36A	2	Hose Assembly 3/4	
5	H00902-31A	2	Hose Assembly 3/4	
6	A13253	9	Adapt-90, 6Sae - 6Jicm	
7	H00851-32A	2	Hose Assembly 3/8	
8	A111245	4	Adapt-90, 10Sae - 10Jicm	
9	H00888-29A	1	Hose Assembly 1/2	
10	H00888-25A	2	Hose Assembly 1/2	
11	A115160	1	Swivel Drive Motor/Brake Lh Assembly	1-1bb
12	H00888-30A	1	Hose Assembly 1/2	
13	H00851-29A	1	Hose Assembly 3/8	
14	H00851-23A	1	Hose Assembly 3/8	
15	A13231	8	Adapt, 16Sae - 16Jicm	
16	H15679-29A	7	Hose Assembly 1	
17	H15679-32A	1	Hose Assembly 1	
18	A113658	2	Branch Tee, 16Sae-12Jic-12Jic	
19	A13858	2	Adapt-Tee, 6Sae - 6Jicm (Run)	
20	A13240	3	Adapt, 6Sae - 6Jicm	
21	A17641	4	Adapt, 10Sae - 10Jicm	1-1bc
22	A13241	1	Adapt-90, 6Jicf/S - 6Jicm	
23	H00853-38A	2	Hose Assembly 3/8	
24	A115161	1	Hydraulic Swivel Assembly	
25	A115163	1	Manifold Assembly, 2 Port, 3 Hole	
26	A115159	1	Swivel Drive Motor/Brake Rh Assembly	
27	H00853-45	1	Hose Assembly 3/8	
28	H00851-14A	2	Hose Assembly 3/8	
29	H00851-33A	1	Hose Assembly 3/8	
30	H00853-22A	1	Hose Assembly 3/8	
31	H00851-36A	1	Hose Assembly 3/8	1-1bd
32	A13893	1	Adapt-Tee, 6Jicf/S - 6Jicm (Run)	
33	H00851-25	2	Hose Assembly 3/8	
34	H16768-36A	2	Hose Assembly 1/2	
35	H00902-29A	1	Hose Assembly 3/4	
36	H00906-29A	1	Hose Assembly 3/4	
37	H00851-22A	1	Hose Assembly 3/8	
38	H00853-40A	1	Hose Assembly 3/8	
39	H16766-27A	1	Hose Assembly 1-1/2	
40	H16736-54A	1	Hose-Assembly 1-1/4	
41	A103024	8	Washer, 1/2" Hard (Flat)	1-1be
42	A100477H	8	Bolt, 1/2-13Nc X 5-1/2" Gr 8 (Hex)	
43	A115763	1	Assembly, Dual Counterbalance Valve	
44	A13242	2	Adapt-Tee, 6Sae - 6Jicm (Branch)	
45	H00851-28	2	Hose Assembly 3/8	

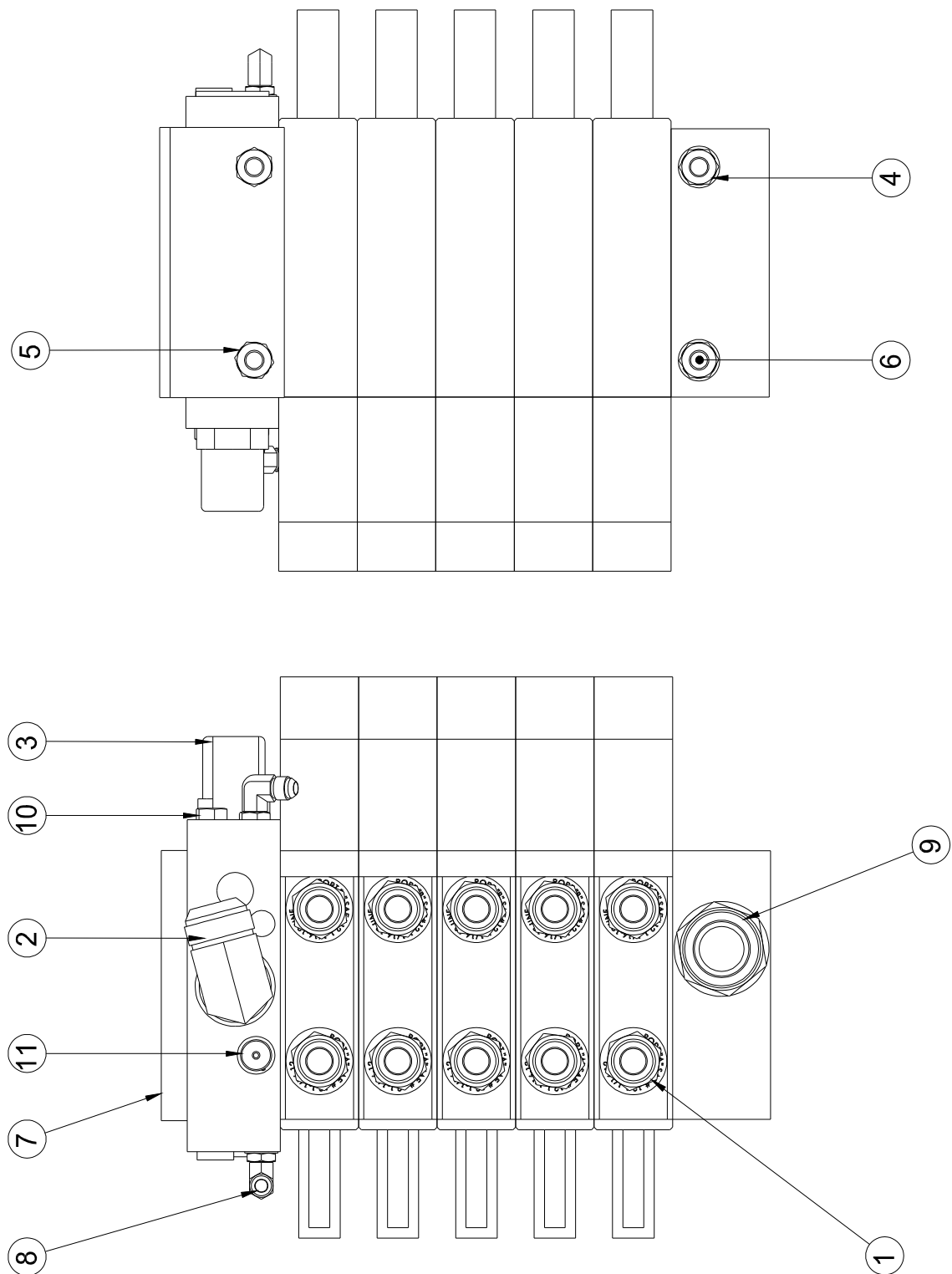


FIGURE 1-1ba

CONTROL VALVE ASSEMBLY

Figure 1-1ba

A115157

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A13850	10	Adapt, 12Sae - 12Jicm
2	A112589	1	Adapt-90, 16Sae - 20Jicm
3	A115107	1	Valve, Pvg100-Pwm Coils
4	A109083	4	Nut, M12 X 1.75 (Hex) (Fac)
5	A103204	4	Washer-Lock, 1/2" (High Alloy)
6	RM01217-32	4	Rod-Threaded
7	A171962	1	Bracket, Valve Top
8	A13253	2	Adapt-90, 6Sae - 6Jicm
9	A115028	1	Adapter, 20 Sae - 24 Jic Str
10	H00107	1	Plug, 6 Sae Hex Head
11	A114687	1	Test-Port, 6 Sae

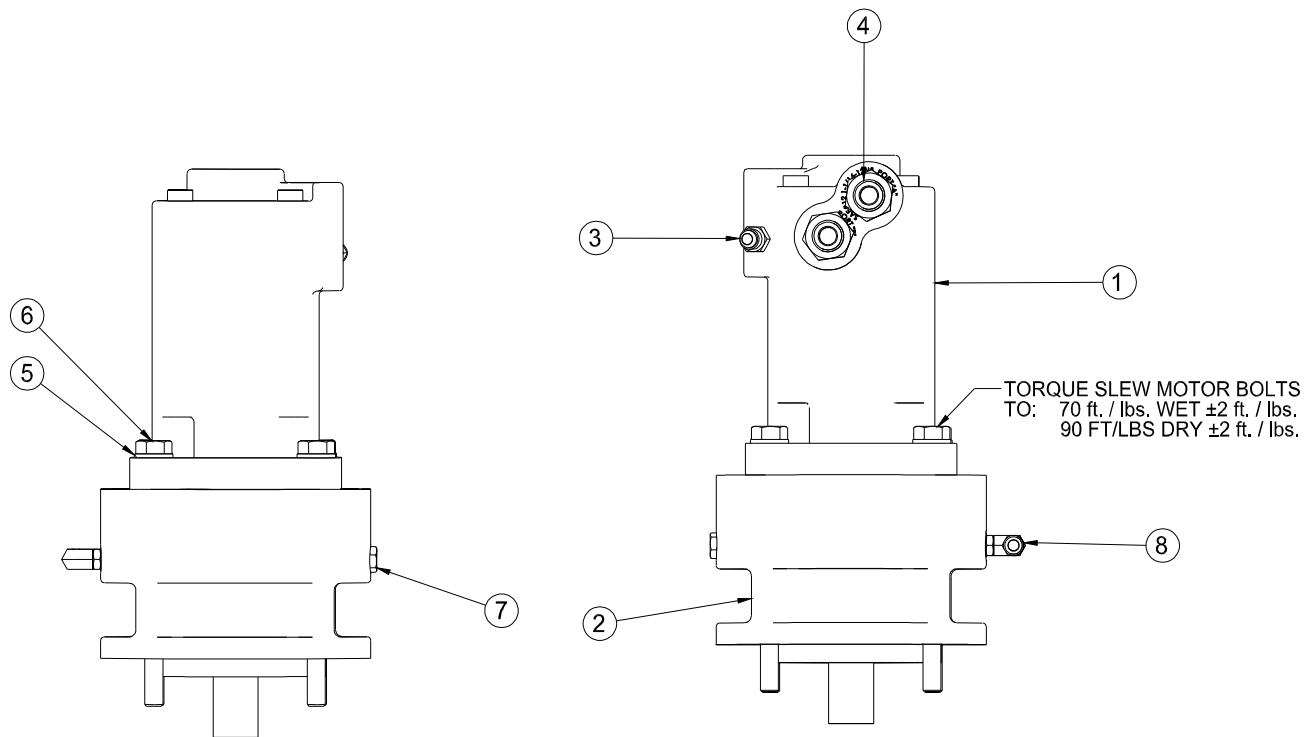


FIGURE 1-1bb

SWIVEL DRIVE MOTOR/BRAKE LH ASSEMBLY

Figure 1-1bb

A115160

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	H00422	2	Adapt, 12Sae-10Jicm	
2	A115768	1	Swivel Drive Motor	
3	A115766	1	Swivel Drive Motor Brake	
4	A13240	1	Adapt, 6Sae - 6Jicm	
5	A103024	4	Washer, 1/2" Hard (Flat)	
6	A100489H	4	Bolt, 1/2-13Nc X 7" Gr 8 (Hex)	
7	A111301	1	Plug, 1/4 Sae Hex Head	
8	H00333	1	Adapt-90, 4Sae-6Jicm	

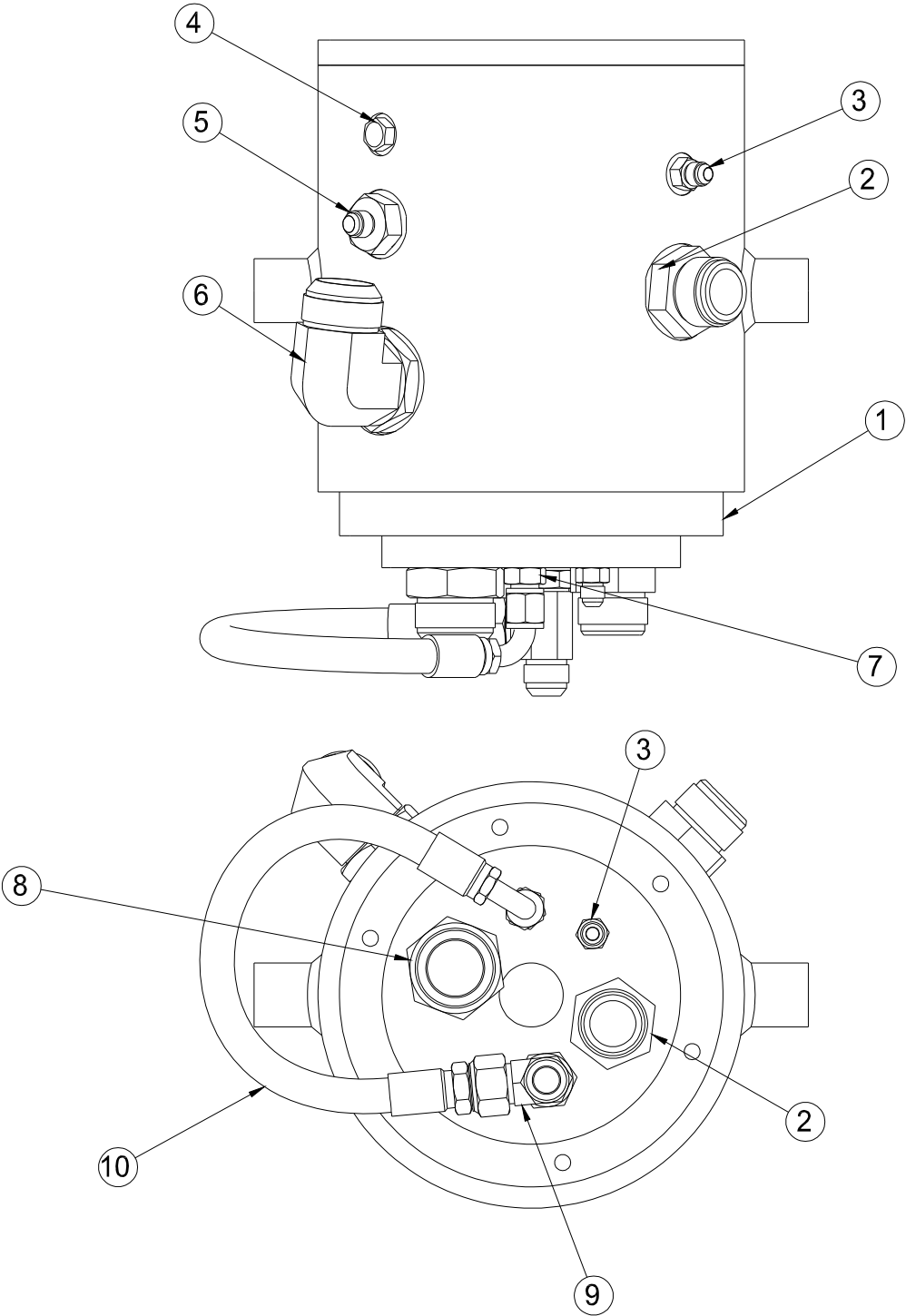


FIGURE 1-1bc

HYDRAULIC SWIVEL ASSEMBLY

Figure 1-1bc

A115161

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115102	1	Swivel, Hydraulic 5 Port
2	A17639	2	Adapt, 20Sae - 20Jicm
3	A13240	2	Adapt, 6Sae - 6Jicm
4	H00107	1	Plug, 6 Sae Hex Head
5	A111017	1	Adapt, 12Sae - 6Jicm
6	A111628	1	Adapt-90, 24Sae - 24Jicm
7	A13886	1	Adapt, 8Sae - 8Jicm
8	H00530	1	Adapt, 24Sae - 24Jicm
9	A13920	1	Adapt-Tee, 12Sae - 12Jicm (Run)
10	H00883-18	1	Hose Assembly 1/2"

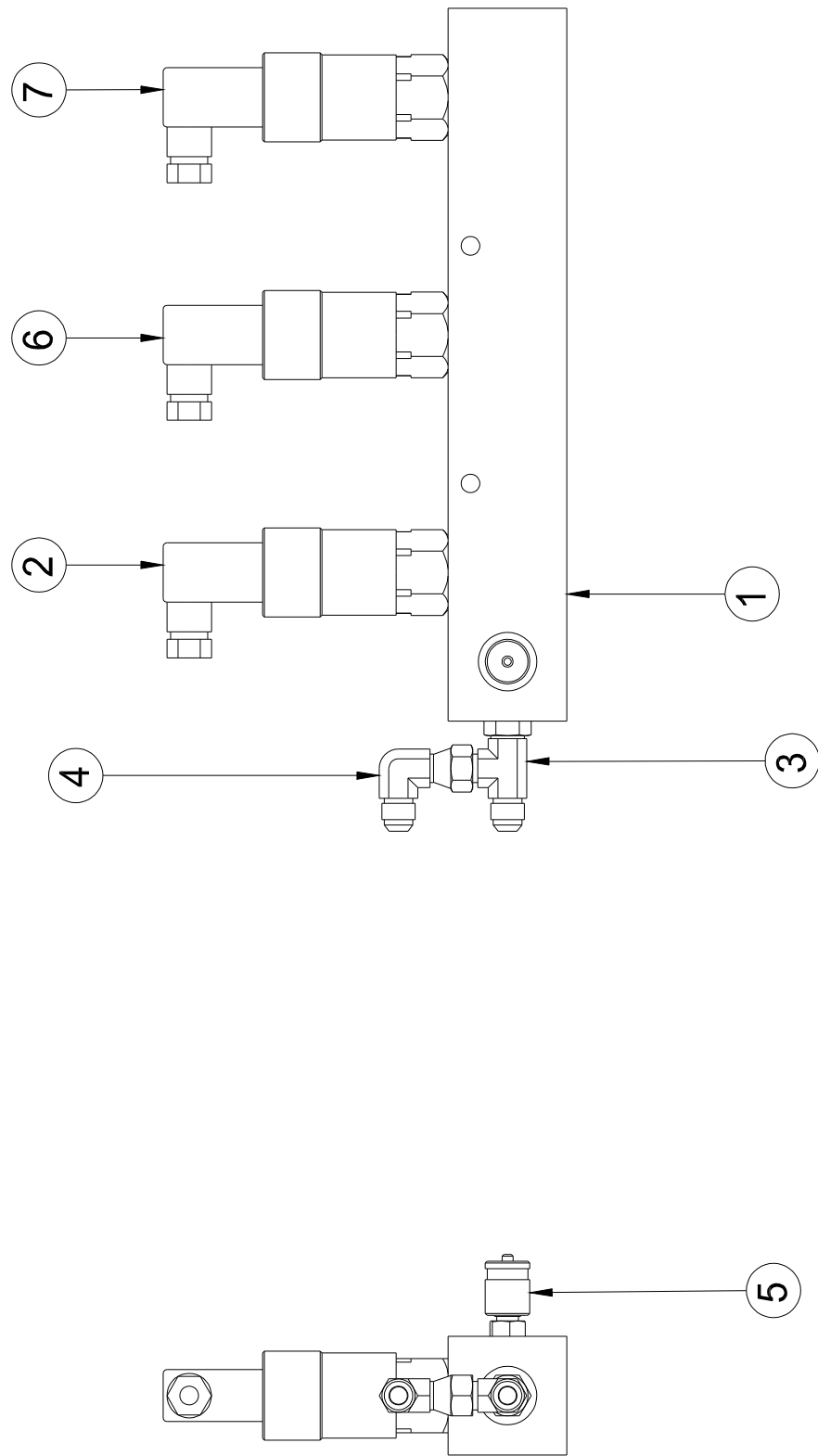


FIGURE 1-1bd

MANIFOLD ASSEMBLY, 2 PORT, 3 HOLE**Figure 1-1bd****A115163****Drawing Rev B**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115136	1	Manifold, 2 Port, 3 Hole
2	A123068-1	1	Pressure Switch - 2050 +50/-0 Psi
3	A13858	1	Adapt, 6Sae - 6Jicm
4	A13241	1	Adapt-90, 6Jic - 6Jicfs
5	A114687	1	Connector, Test Port 6 Sae
6	A123068-2	1	Pressure Switch - 2400 +50/-0 Psi
7	A123068-3	1	Pressure Switch - 2800 +50/-0 Psi

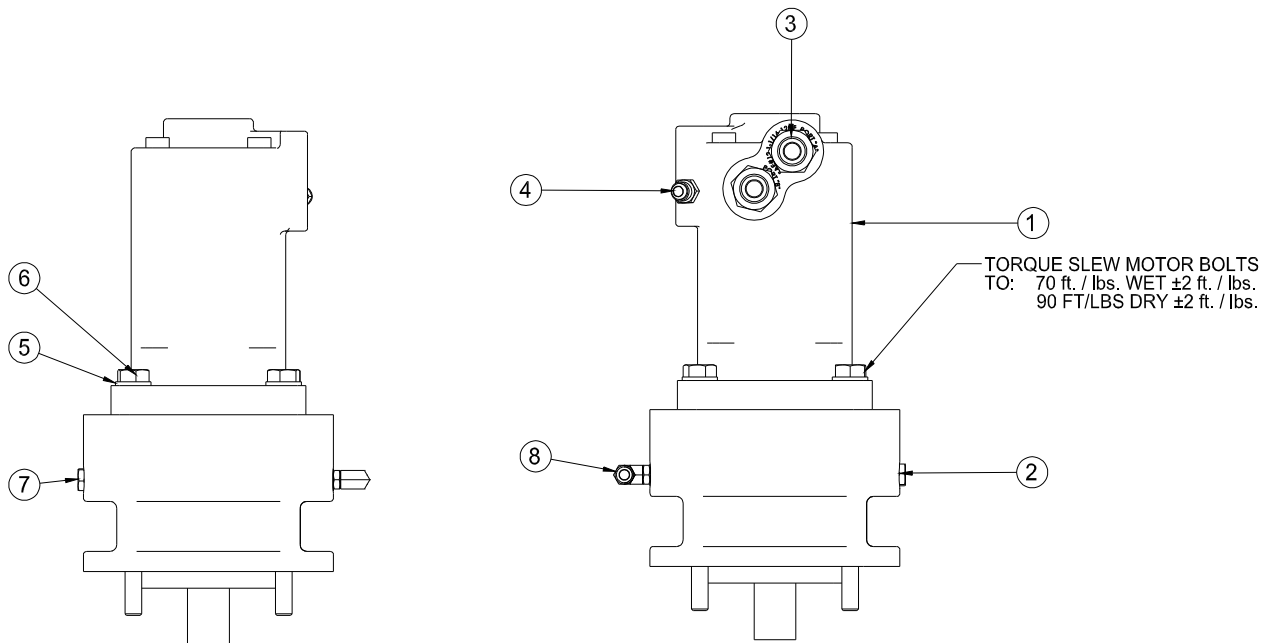


FIGURE 1-1be

SWIVEL DRIVE MOTOR/BRAKE RH ASSEMBLY

Figure 1-1be

A115159

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	H00422	2	Adapt, 12Sae-10Jicm	
2	A115768	1	Swivel Drive Motor	
3	A115766	1	Swivel Drive Motor Brake	
4	A13240	1	Adapt, 6Sae - 6Jicm	
5	A103024	4	Washer, 1/2" Hard (Flat)	
6	A100489H	4	Bolt, 1/2-13Nc X 7" Gr 8 (Hex)	
7	A111301	1	Plug, 1/4 Sae Hex Head	
8	H00333	1	Adapt-90, 4Sae-6Jicm	

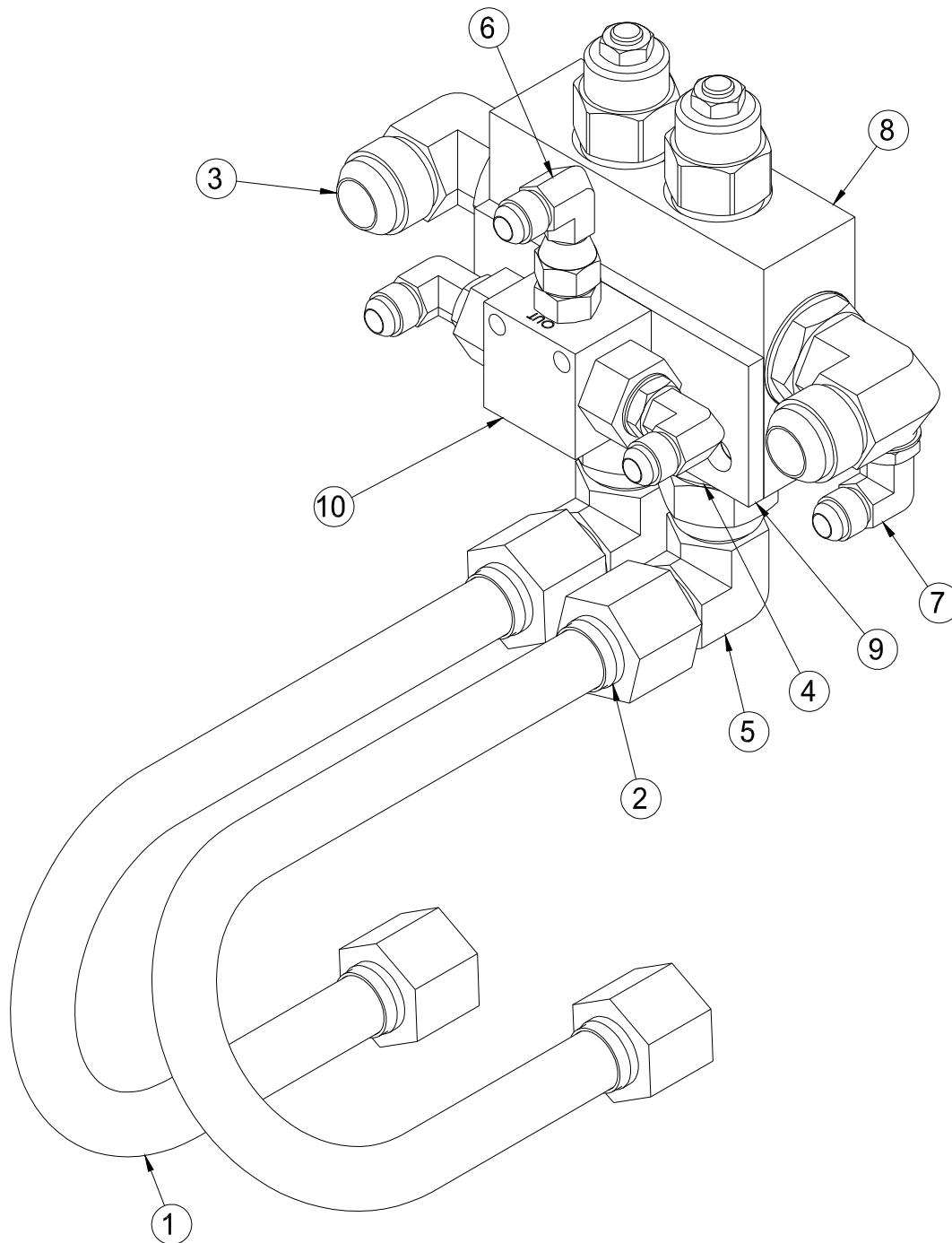


FIGURE 1-1bf

ASSEMBLY, DUAL COUNTERBALANCE VALVE

Figure 1-1bf

A115763

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	A115764	1	Assembly, Tube, 3/4", Stainless	
2	A115765	1	Assembly, Tube, 3/4", Stainless	
3	A13866-SS	2	Adapt-90, 12Sae-12Jicm Stainless	
4	A13850	2	Adapt, 12Sae - 12Jicm	
5	A13862	2	Adapt-90, 12Jicf/S - 12Jicm	
6	A13241	1	Adapt-90, 6Jicf/S - 6Jicm	
7	A13253	1	Adapt-90, 6Sae - 6Jicm	
8	A115350	1	Valve, Counterbalance	
9	A176385	1	Plate, Valve Mount	
10	A115158	1	Shuttle Valve Assembly	

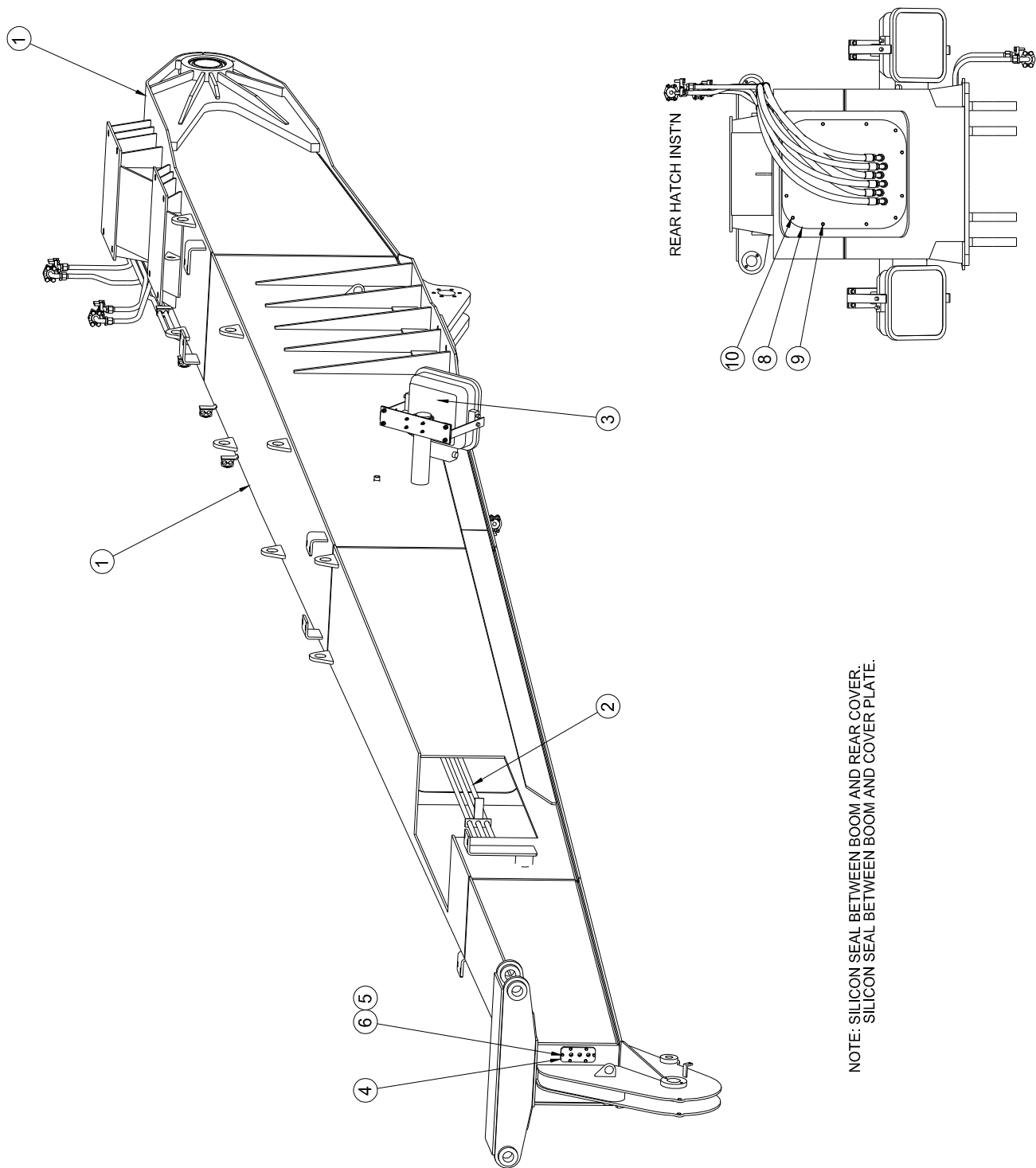


FIGURE 1-2

BOOM ASSEMBLY

Figure 1-2 **A171640** **Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172026	1	Boom Final (Bracket) Weldment	
2	A123072	1	A2B Conduit Installation	Ref Fig 1-2a
3	A123080	1	Lighting Conduit Installation	Ref Fig 1-2b
4	A172033	1	Plate, Cover	
5	A103201H	6	Washer-Lock, 5/16"	
6	A100112H	6	Bolt, 5/16-18Nc X 1-1/4" Gr 5 (Hex)	
7	A115162	1	Boom Hydraulics Installation	Ref Fig 1-2c
8	A171803	1	Cover	
9	A103202H	12	Washer-Lock, 3/8"	
10	A100208H	12	Bolt, 3/8-16Nc X 1" Gr 5 (Hex)	

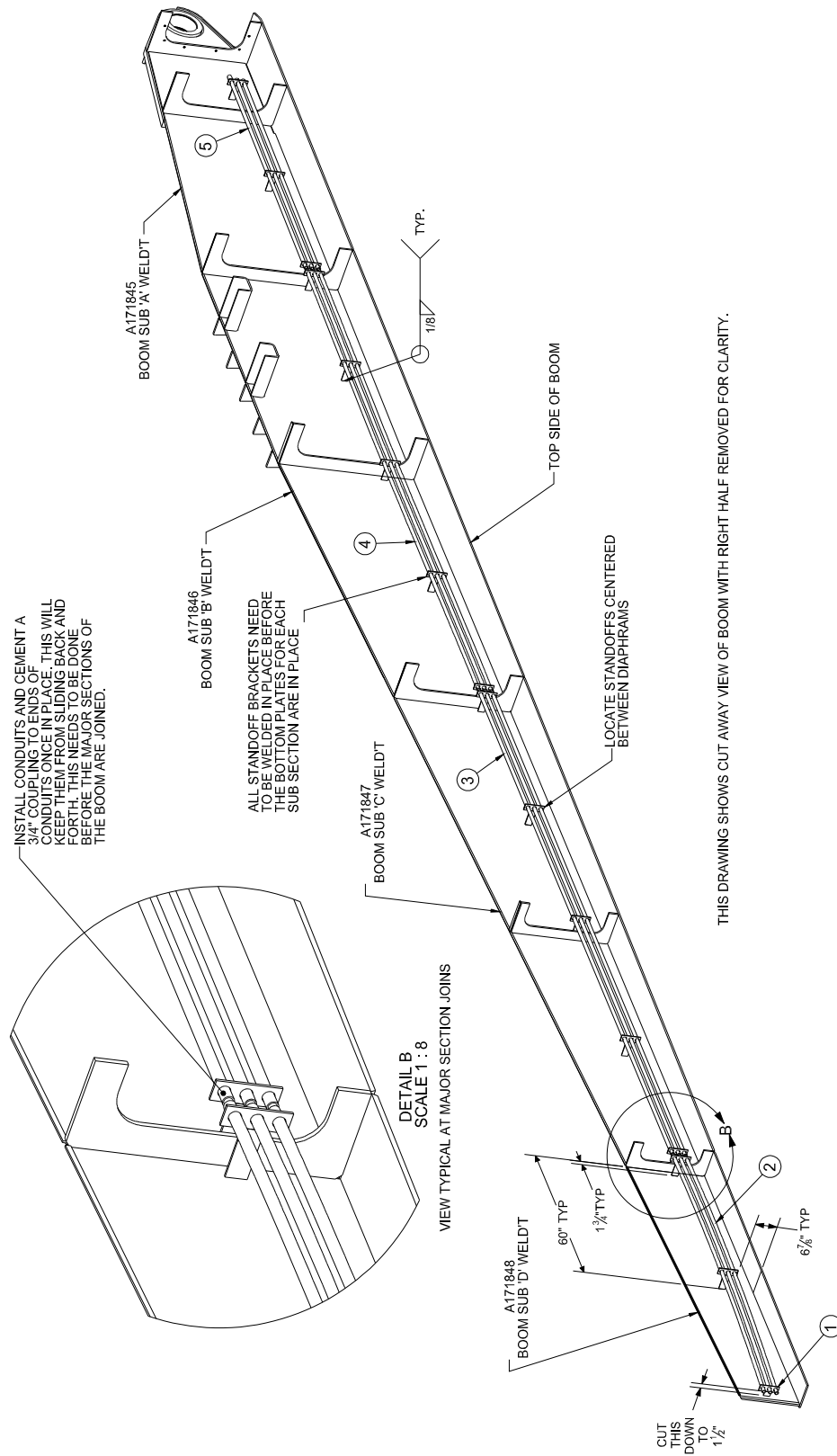


FIGURE 1-2a

A2B CONDUIT INSTALLATION**Figure 1-2a****A123072****Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171967	16	Conduit Standoff Weldment
2	RM00540-117	3	Pipe, Conduit, 3/4"
3	RM00540-238	3	Pipe, Conduit, 3/4"
4	RM00540-215	3	Pipe, Conduit, 3/4"
5	RM00540-96	3	Pipe, Conduit, 3/4"
6	A123074	30	Coupling, Pvc, 3/4"

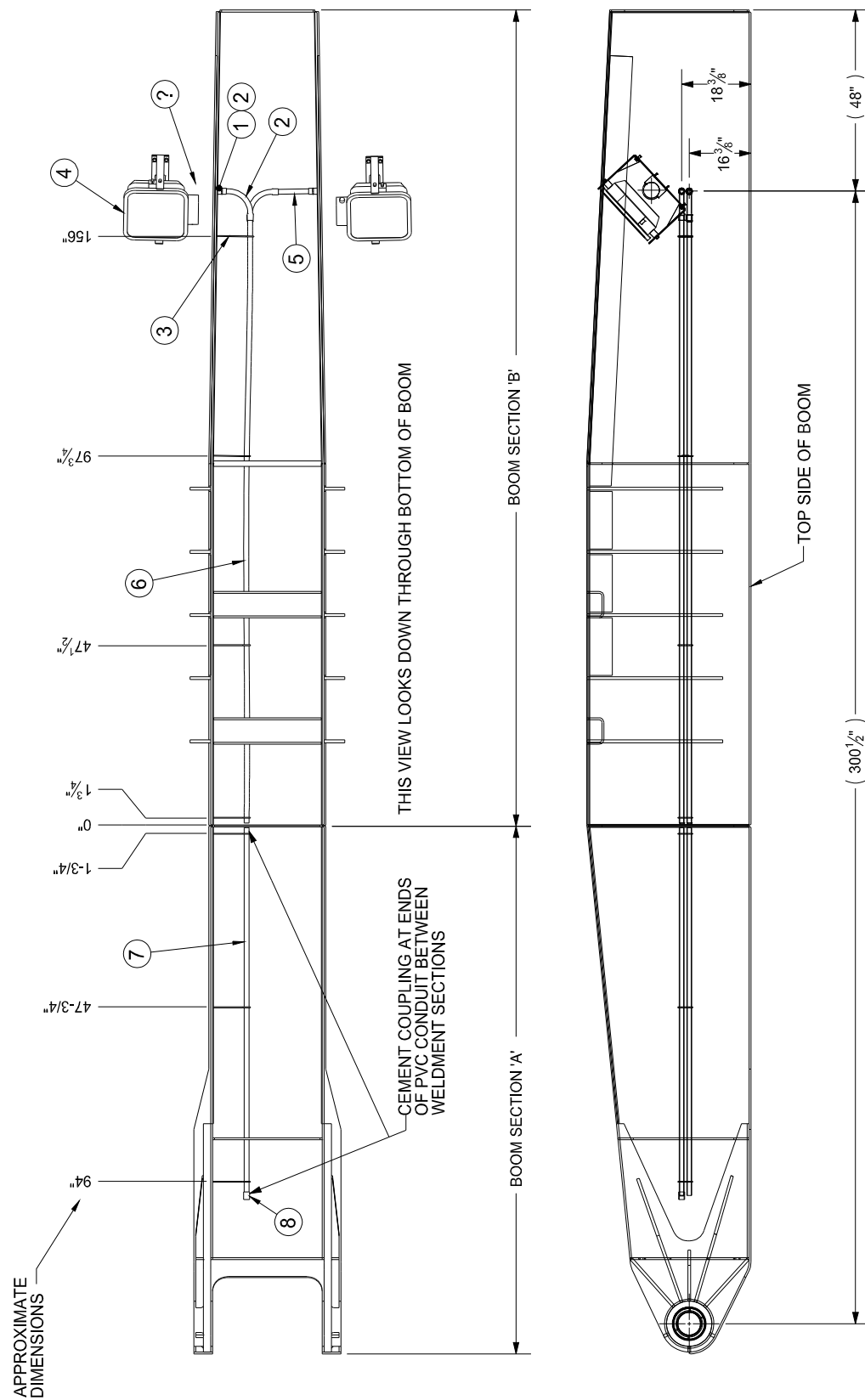


FIGURE 1-2b

LIGHTING CONDUIT INSTALLATION

Figure 1-2b

A123080

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123075	2	Pvc, Conduit Female Adaptor 1"
2	A123079	2	Pvc, Conduit Elbow 90 Deg Bell End 1"
3	A171976	7	Conduit Standoff Weldment
4	A171974	2	Light/Bracket Assembly
5	RM00541-11	1	Pvc Conduit 1"
6	RM00541-160	2	Pvc Conduit 1"
7	RM00541-96	2	Pvc Conduit 1"
8	A123084	6	Coupling, Pvc, 1"

Ref Fig 1-2ba

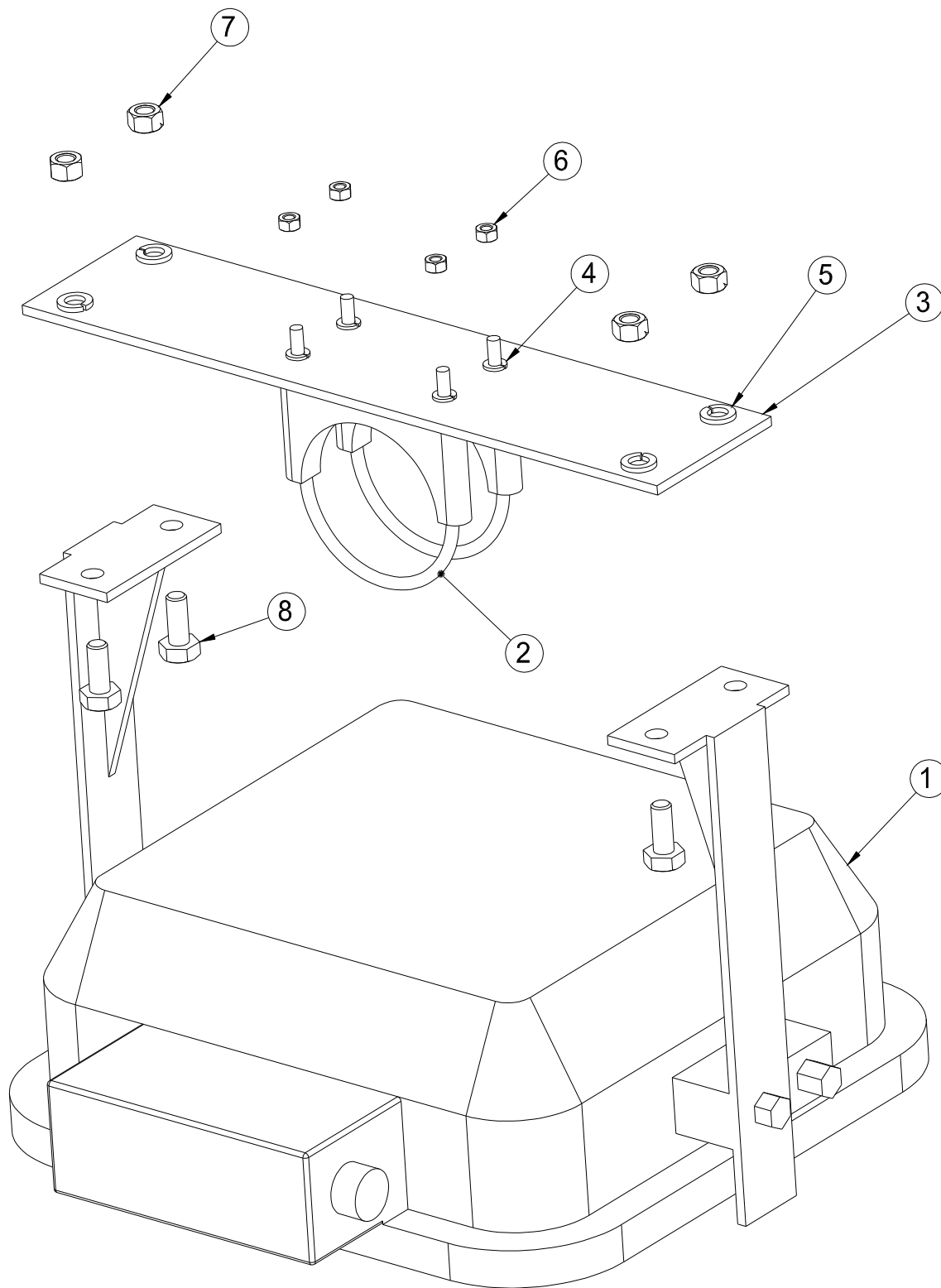


FIGURE 1-2ba

LIGHT/BRACKET ASSEMBLY

Figure 1-2ba

A171974

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123056	1	Fixture, Light, 400W Metal Halide 277 Vac Max.
2	A153615	2	Clamp, Saddle, 4"
3	A171972	1	Light Bracket Base
4	A103201H	4	Washer-Lock, 5/16"
5	A103204	4	Washer-Lock, 1/2" (High Alloy)
6	A102740H	4	Nut-Nylock, 5/16-18Nc Gr5
7	A102756	4	Nut-Nylock, 1/2-13Nc Gr5
8	A100413H	4	Bolt, 1/2-13 Nc X 1-1/4" Gr 8 (Hex)

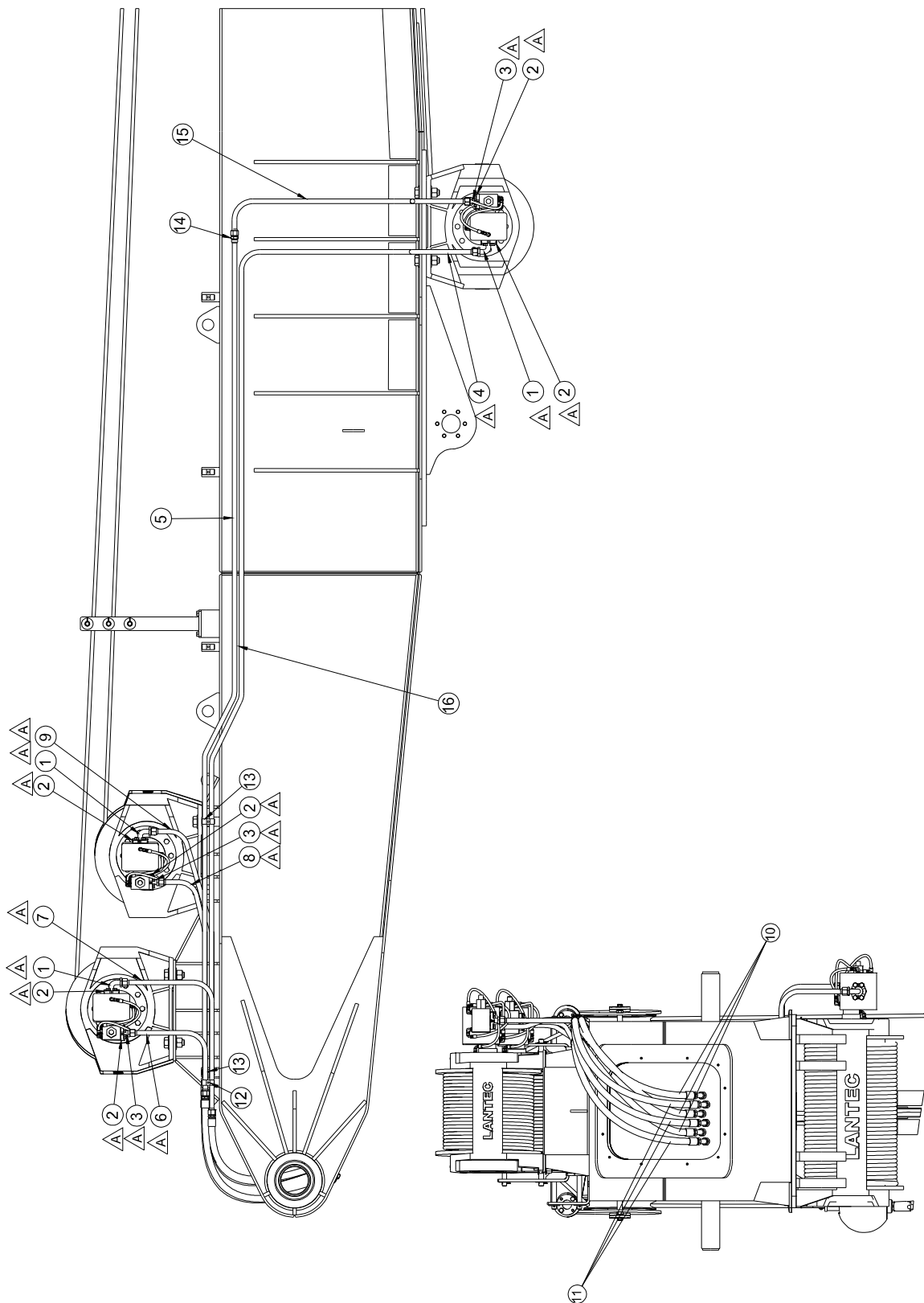


FIGURE 1-2c

BOOM HYDRAULICS INSTALLATION

Figure 1-2c

A115162

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115175	3	Adapter, 1 1/2 Sae Flange - 1" Jic 90
2	A14995	6	Split Flange Kit 1-1/2" Sae Code 61
3	A115176	3	Adapter, 1 1/2 Sae Flange - 1" Jic Str.
4	A115153	1	Tube Assembly 1"
5	A115154	1	Tube Assembly 1"
6	A115149	1	Tube Assembly 1"
7	A115150	1	Tube Assembly 1"
8	A115151	1	Tube Assembly 1"
9	A115152	1	Tube Assembly 1"
10	H16764-43	3	Hose Assembly 1"
11	H16764-50	1	Hose Assembly 1"
12	A172027	Ref	Stauff Clamp Bracket Weldment #1
13	A172028	Ref	Stauff Clamp Bracket Weldment #2
14	A13887	1	Adapt, 16Jic - 16Jic
15	A115192	1	Tube Assembly 1"
16	H00653	Ref	Clamp Stauff 1" Double

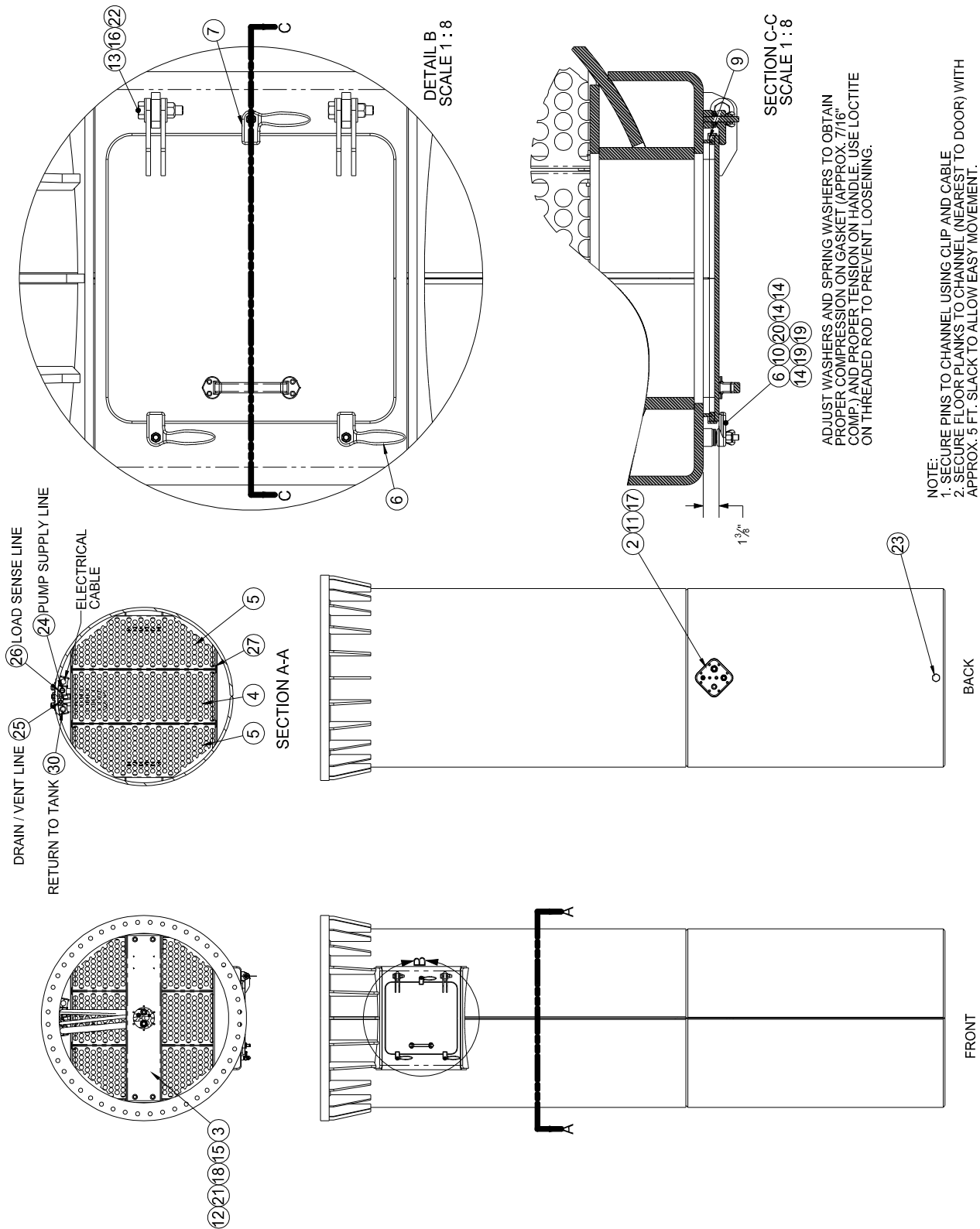
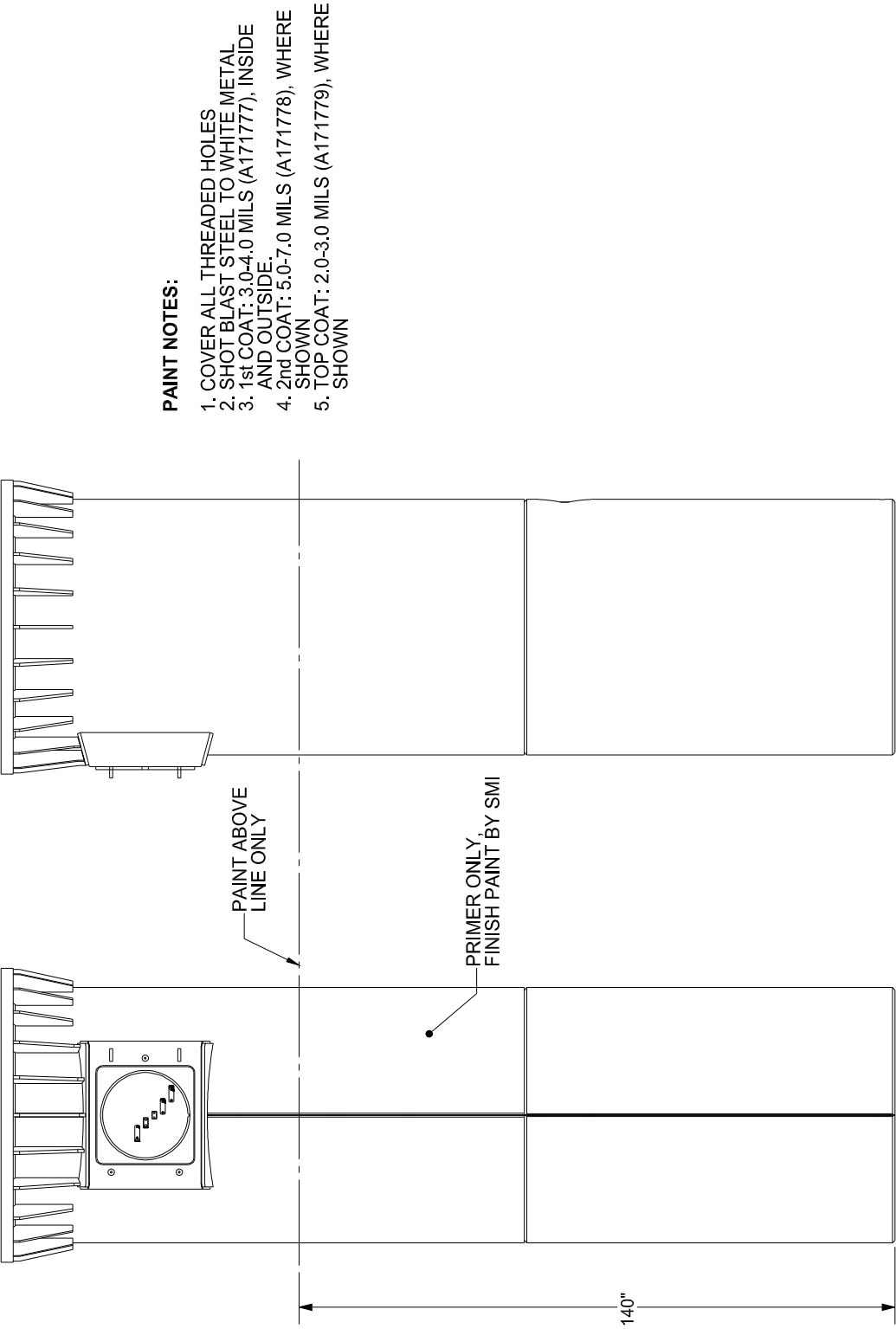


FIGURE 1-3

PEDESTAL ASSEMBLY

Figure 1-3 A171602 Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171866	1	Pedestal Paint Specification
2	A171878	1	Pedestal Bulkhead Assembly
3	A172176	1	Swivel Support Channel Assembly
4	A171775	1	Plank, Perf-O Grip, Middle
5	A171776	2	Plank, Perf-O Grip, Side
6	A171622	2	Latch, Heavy Duty, 1/4 Turn, Lh
7	A171603	1	Latch, Heavy Duty, 1/4 Turn, Rh
8	A171845	1	Door, Pedestal, Weldment
9	RM02687	92	Neoprene
10	RM01214-SS	9	Rod, 1/2-13Nc (Threaded)
11	A100208H	8	Bolt, 3/8-16Nc X 1" Gr 5 (Hex)
12	A100625	4	Bolt, 5/8-11Nc X 2" Gr 8 (Hex)
13	A100745	2	Bolt, 3/4-10Nc X 3-1/4" Gr 8 (Hex)
14	A103024	9	Washer, 1/2" Hard (Flat), Also A103004
15	A103026	4	Washer, 5/8" (Flat Hard)
16	A103027	4	Washer, 3/4" Gr8 (Flat Hard)
17	A103202H	8	Washer-Lock, 3/8"
18	A103206	4	Washer-Lock, 5/8" (High Alloy)
19	FS00224	6	Washer, Belleville (Disc Spring), 1/2"
20	A102713H	3	Nut-Nylock, 1/2-13Nc Gr8
21	A102721	4	Nut-Nylock, 5/8-11Nc Gr8
22	FS00020	2	Nut-Lock, 3/4-10 Nc Crown Stover C
23	A112128	1	Plug, 2 Nptm Hex Soc Hd Flush (Steel)
24	H16763-165A	1	Hose Assembly, 1-1/4"
25	H00900-165A	1	Hose Assembly 3/4"
26	H00851-165A	1	Hose Assembly 3/8"
27	A109605	4	Pin-Lock, 3/8 X 2-1/2"
28	A16569	10	Crimp Clip, 1/8"
29	RM00400	240	Cable, 1/8" (Aircraft)
30	H16767-165A	1	Hose Assembly 1-1/2"



PAINT NOTES:

1. COVER ALL THREADED HOLES
2. SHOT BLAST STEEL TO WHITE METAL
3. 1st COAT: 3.0-4.0 MILS (A171777), INSIDE AND OUTSIDE.
4. 2nd COAT: 5.0-7.0 MILS (A171778), WHERE SHOWN
5. TOP COAT: 2.0-3.0 MILS (A171779), WHERE SHOWN

SERIAL NUMBER - 1801-A171534

FIGURE 1-3a

PEDESTAL PAINT SPECIFICATION

Figure 1-3a

A171866

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171578	1	Pedestal Secondary Weldment
2	A171777	6	Primer, Zinc Rich, Moisture Cure Urethane
3	A171778	3	Paint, Mid Coat Polymide-Epoxy Intergard 345
4	A171779	2	Paint, Enamel, Acrylic Urethane, Gloss,
5	A168025	1	Decal, Serial Plate
6	A102195	4	Screw, #8 X 1/2" (Drive)

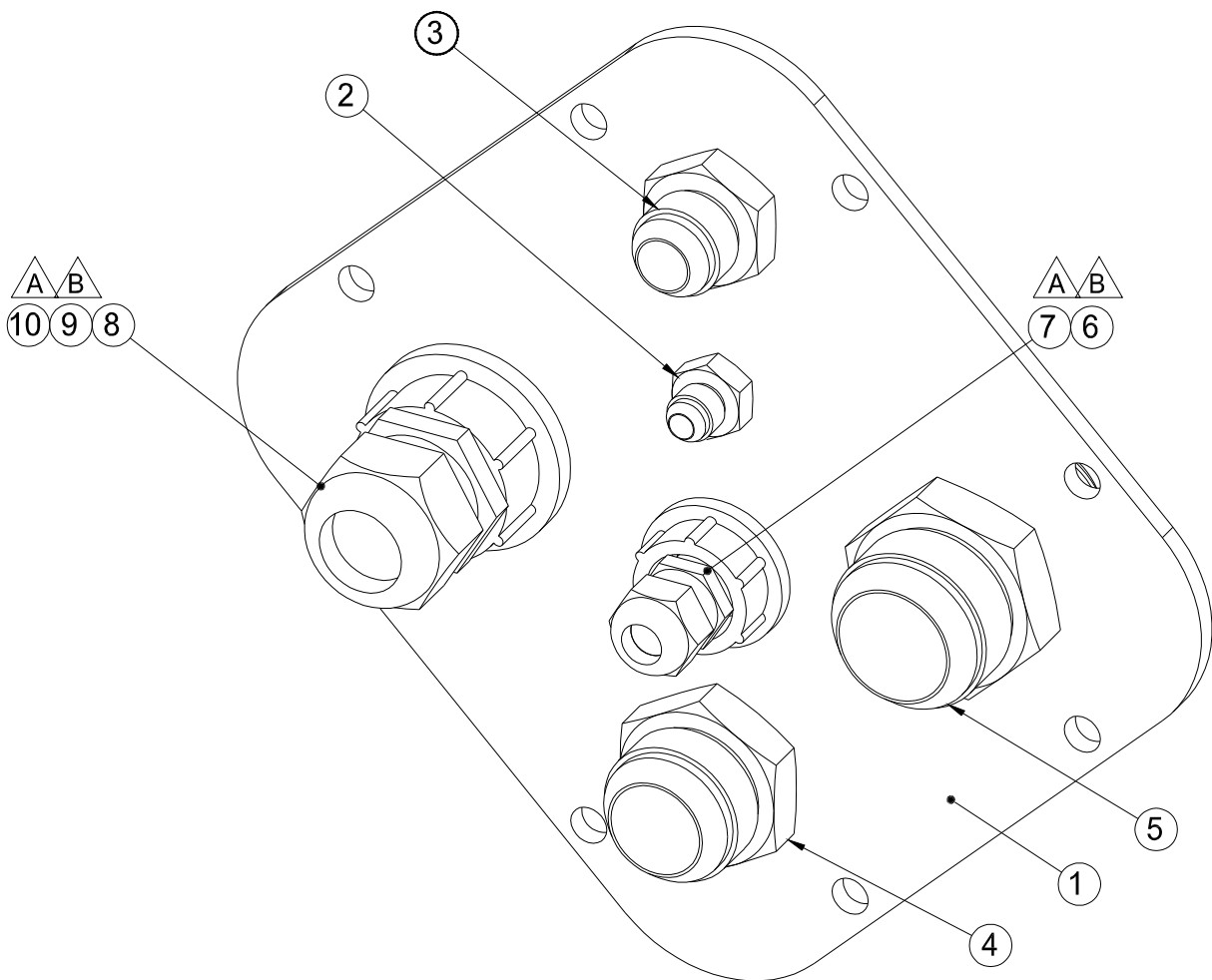


FIGURE 1-3b

PEDESTAL BULKHEAD ASSEMBLY

Figure 1-3b

A171878

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171773	1	Plate, Bulkhead
2	A13903	1	Adapt, 6Jicm - 6Jicm (Bulkhead C/W Nut)
3	A13902	1	Adapt, 12Jic - 12Jic (Bulkhead)
4	A115130	1	Adapt, 20Jicm - 20Jicm (Bulkhead)
5	A115131	1	Adapt, 24Jicm - 24Jicm (Bulkhead)
6	A122675	1	Conduit Hub. 3/4"
7	A120593	1	Connector, 3/4" Npt P/L
8	A122465	1	Strain Relief, Nylon, 1" Npt
9	A122074	1	Conduit, 1-1/4" Bulkhead Steel
10	A121598	1	Bushing, Reducer, 1-1/4" - 1" Conduit

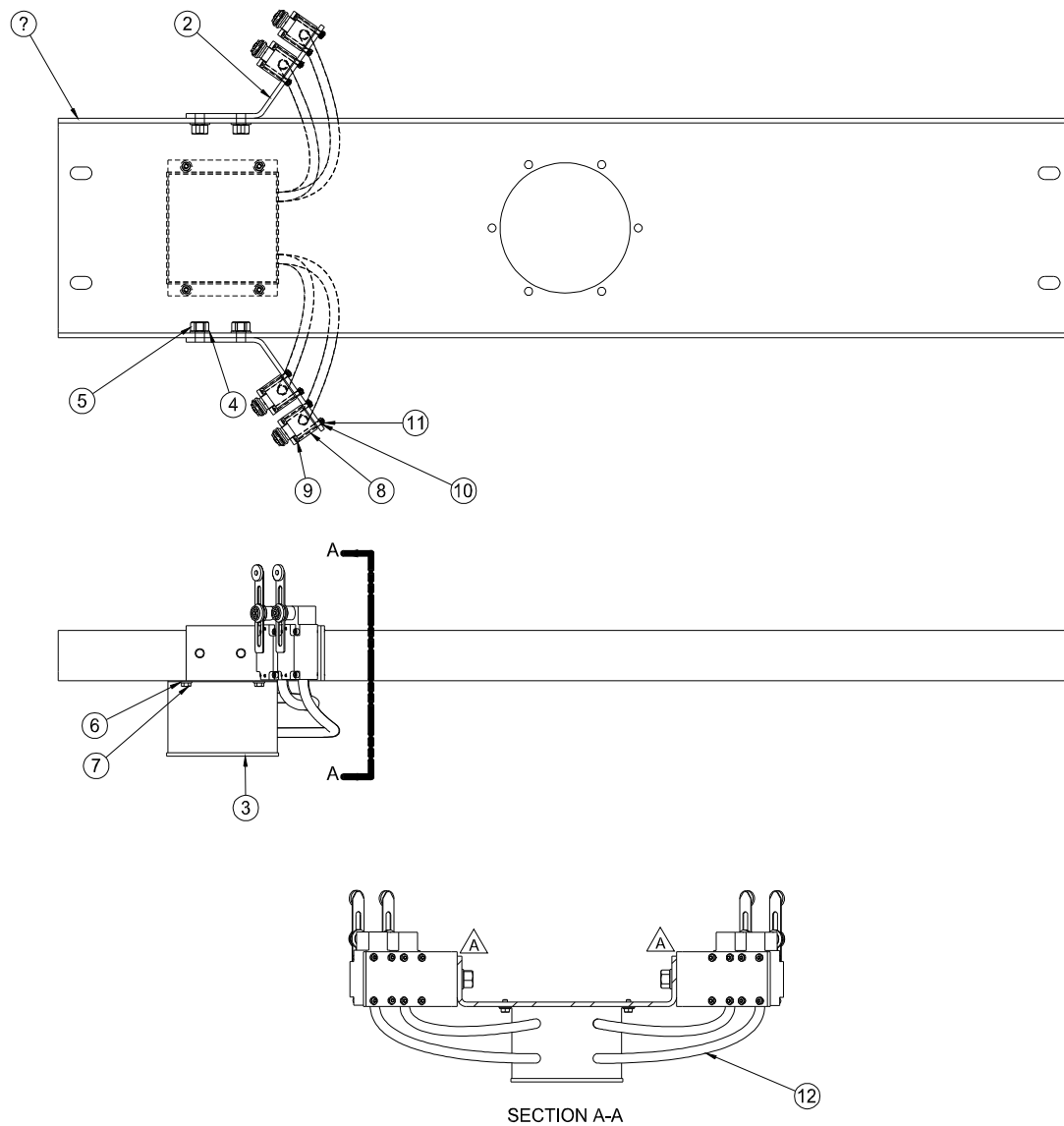


FIGURE 1-3c

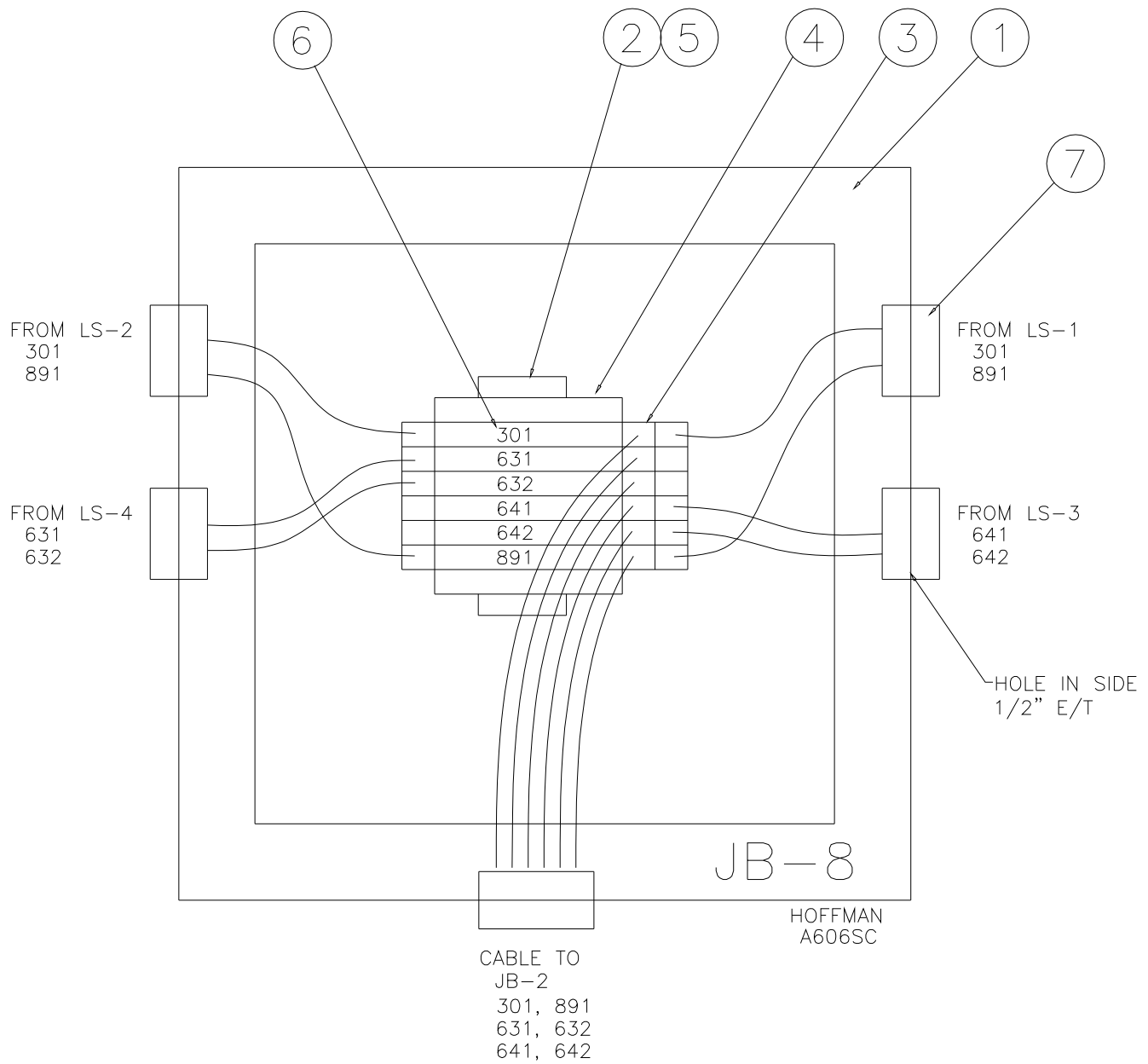
SWIVEL SUPPORT CHANNEL ASSEMBLY

Figure 1-3c

A172176

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	A171774	1	Plate, Swivel Support Channel	Ref Fig 1-3ca
2	A172117	2	Bar-Flat	
3	A123098	1	Junction Box 8 Assembly	
4	A100413H	4	Bolt, 1/2-13 Nc X 1-1/4" Gr 8 (Hex)	
5	A103004	4	Washer, 1/2" (Flat)	
6	A102613H	4	Nut, 1/2-13Nc Gr5 (Jam)	
7	A103000	4	Washer, 1/4 (Flat)	
8	A100000H	4	Bolt, 1/4-20Nc X 1/2" (Hex)	
9	A121116	4	Limit Switch, C/W Adj. Roller Lever	
10	FS00227	16	Bolt, 10-24Nc X 1-3/4" (Soc Hd Cap)	
11	A103239	16	Washer-Lock, #10	
12	A102551	16	Nut, #10-24 Nc (Hex)	
13	RM00449	60	Cable, 18-2 (Sow)	



SI

FIGURE 1-3ca

JUNCTION BOX 8 ASSEMBLY

Figure 1-3ca

A123098

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123086	1	Junction Box
2	RM02821	4	Din Rail, 1492-N1
3	A122763	6	Terminal Block, 1492-L3T
4	A122740	2	Terminal Block End Anchor, 1492-Erl35
5	A102210	2	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
6	A122828	4	Terminal Marker, Ab 1492, Blank
7	A122437	5	Connector, Skintite, 1/2 Npt, 1/2" Dia

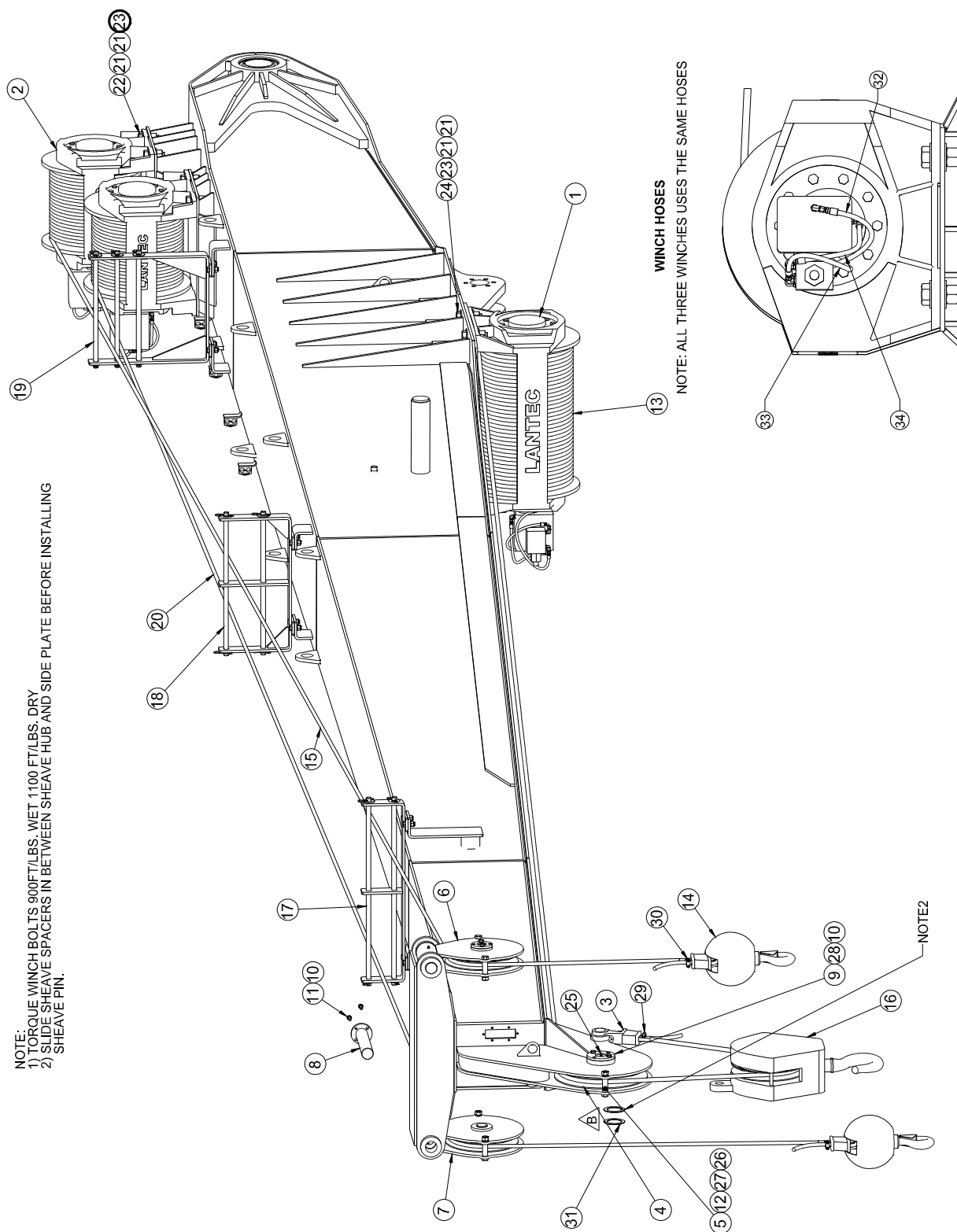


FIGURE 1-4

WINCH INSTALLATION

Figure 1-4

A172002

Drawing Rev C

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A171543	1	Winch, Lantec, LHS170	
2	A171544	2	Winch, Lantec, LHS100	
3	A172001	1	Open Wedge Socket 7/8"	
4	A171862	1	Sheave Assembly, 20"	
5	A171901	1	Sheave Spacer	
6	A171916	1	Whip Line Sheave Lh Assembly	Ref Fig 1-4a
7	A171917	1	Whip Line Sheave Rh Assembly	Ref Fig 1-4b
8	A171941	2	Sheavemount Pin Weldment	
9	A171943	1	Sheave Pin Weldment	
10	A103204	6	Washer-Lock, 1/2" (High Alloy)	
11	A100417H	4	Bolt, 1/2-13Nc X 1-1/2" Gr 8 (Hex)	
12	A100773	1	Bolt, 3/4-10Nc X 5" Gr 8 (Hex)	
13	A171925	1	Rope, Wire, 7/8" X 420'	
14	A171863	2	Hook, Overhaul Ball - 5 Ton	
15	A171926	1	Rope, Wire, 3/4"	
16	A171864	1	Block, Crane (Hook), Single - 15 Ton	
17	A172016	1	Wire Rope Stay Assembly - A	Ref Fig 1-4c
18	A172017	1	Wire Rope Stay Assembly - B	Ref Fig 1-4d
19	A172018	1	Wire Rope Stay Assembly - C	Ref Fig 1-4e
20	A171926	1	Rope, Wire, 3/4"	
21	A103030	24	Washer, 1-1/4"Sae (Flat Hard)	
22	A101068	8	Bolt, 1 1/4 -7 Nc Gr8 X 3 1/2" Lg, (Hex)	
23	A102554	12	Nut, 1-1/4-7Nc (Hex) Gr8	
24	A101038	4	Bolt, 1-1/4-7Nc X 4-1/2" Gr 8 (Hex)	
25	J00007	1	Fitting, Grease 1/8-27Npt	
26	A103207H	1	Washer-Lock, 3/4"	
27	A102525	1	Nut, 3/4-10Nc (Hex) Gr8	
28	A100425H	2	Bolt, 1/2-13Nc X 2" Gr 8 (Hex)	
29	A172059	1	Wire Rope Clip 7/8"	
30	A167207	2	Clip-Wire Rope, 3/4"	
31	A172151	2	Washer, Thrust, Sintered Bronze, 3-1/8 Id X 4-1/	
32	H15503-15	3	Hose Assembly 1/4"	
33	H15503-20.5	3	Hose Assembly 1/4"	
34	H15503-27	3	Hose Assembly 1/4"	

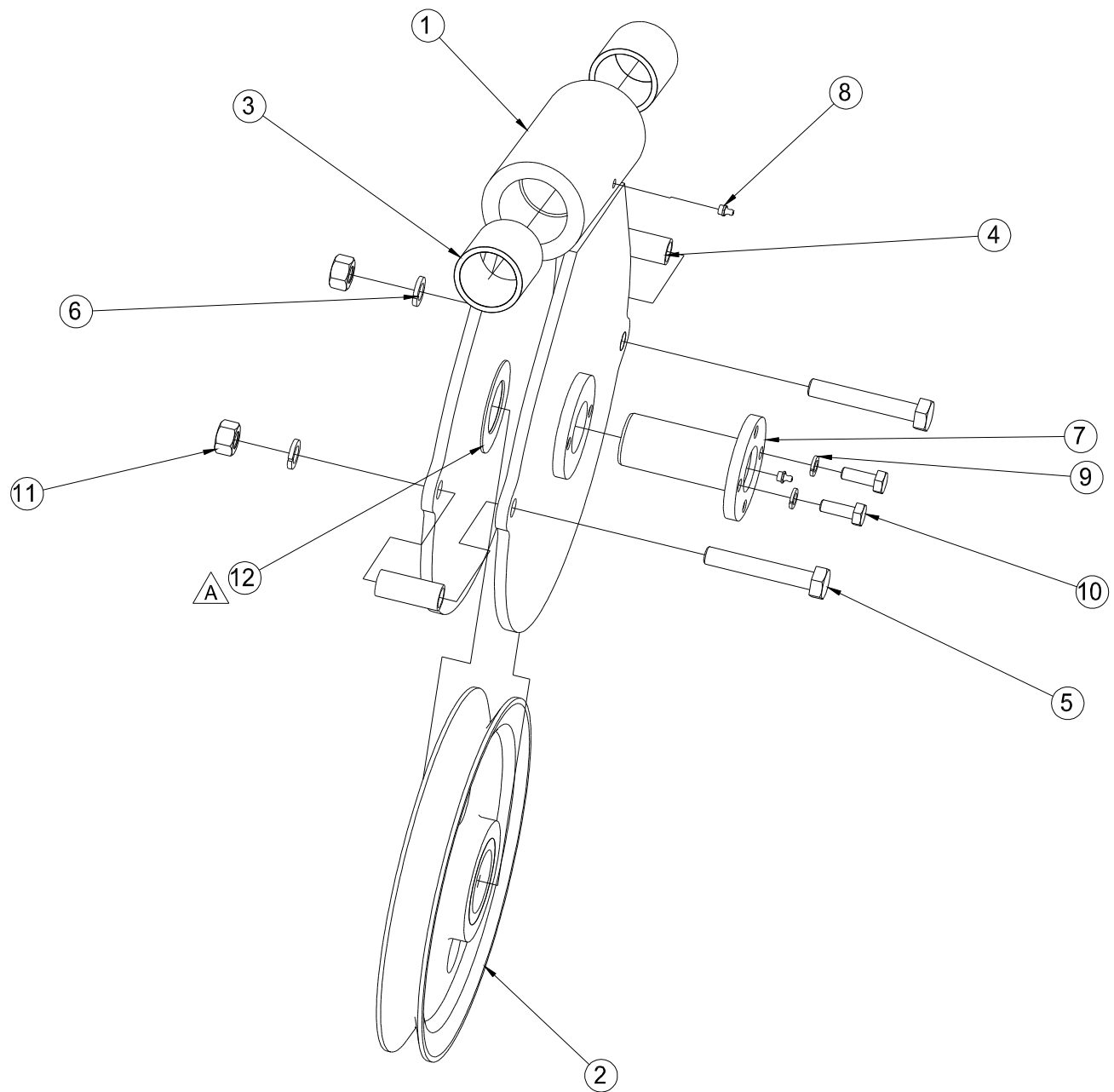


FIGURE 1-4a

WHIP LINE SHEAVE LH ASSEMBLY

Figure 1-4a

A171916

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171914	1	Whip Line Sheave Lh Machining
2	A167798	1	Sheave Assembly 3/4-16 Dia
3	A155232	2	Bushing, Oilite
4	A171936	2	Spacer, Sheave
5	A100769	2	Bolt, 3/4-10Nc X 4-3/4" Gr 8 (Hex)
6	A103207H	2	Washer-Lock, 3/4"
7	A171940	1	Sheave Pin Weldment Reva
8	J00007	2	Fitting, Grease 1/8-27Npt
9	A103204	2	Washer-Lock, 1/2" (High Alloy)
10	A100417H	2	Bolt, 1/2-13Nc X 1-1/2" Gr 8 (Hex)
11	A102525	2	Nut, 3/4-10Nc (Hex) Gr8
12	A172142	2	Washer,Thrust Bronze, 4 Od 2-5/16 Id X 3/32"

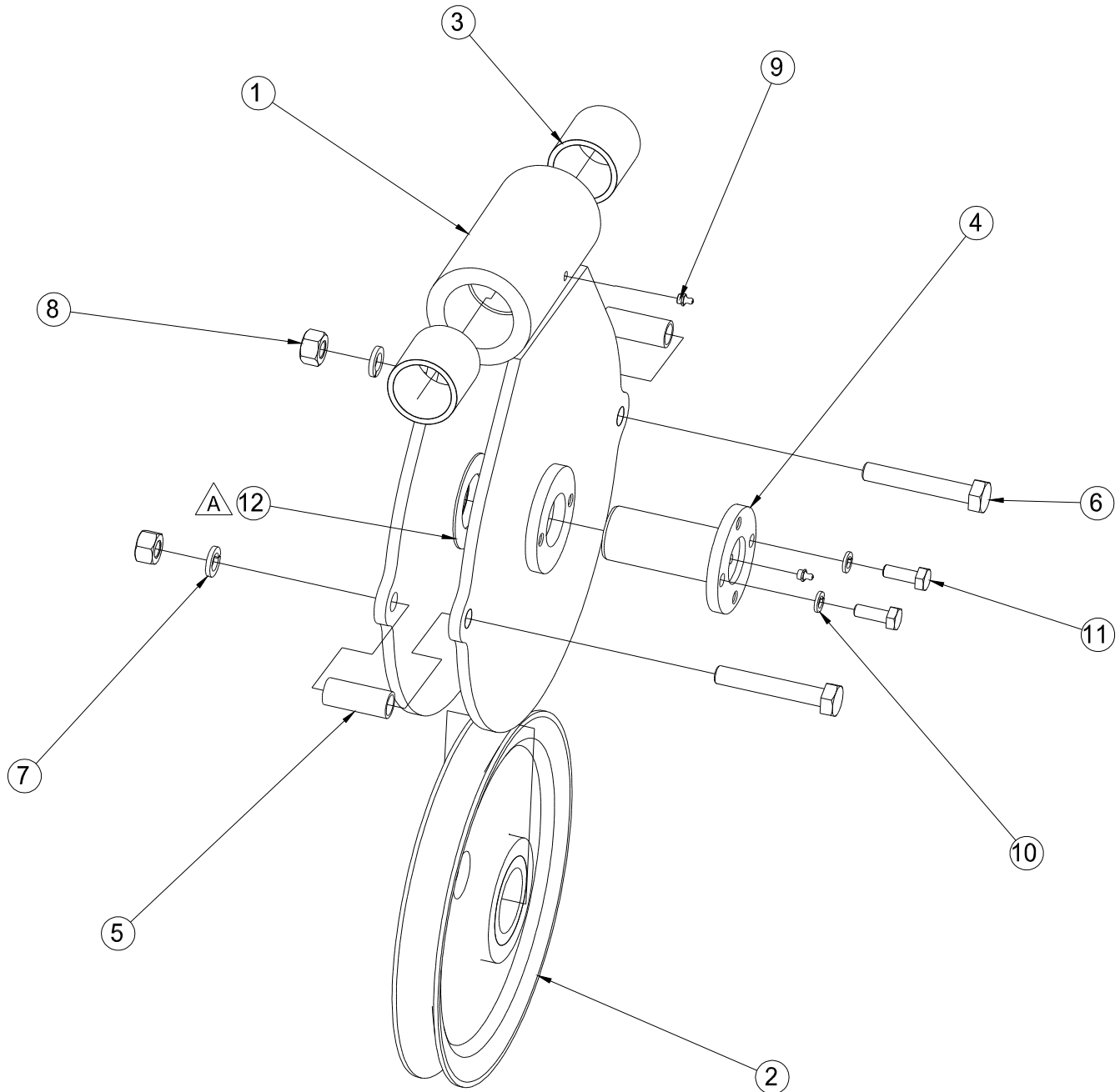


FIGURE 1-4b

WHIP LINE SHEAVE RH ASSEMBLY

Figure 1-4b

A171917

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171915	1	Whip Line Sheave Rh Machining
2	A167798	1	Sheave Assembly 3/4-16 Dia
3	A155232	2	Bushing, Oilite
4	A171940	1	Sheave Pin Weldment
5	A171936	2	Spacer, Sheave
6	A100769	2	Bolt, 3/4-10Nc X 4-3/4" Gr 8 (Hex)
7	A103207H	2	Washer-Lock, 3/4"
8	A102525	2	Nut, 3/4-10Nc (Hex) Gr8
9	J00007	2	Fitting, Grease 1/8-27Npt
10	A103204	2	Washer-Lock, 1/2" (High Alloy)
11	A100417H	2	Bolt, 1/2-13Nc X 1-1/2" Gr 8 (Hex)
12	A172142	2	Washer,Thrust Bronze, 4 Od 2-5/16 Id X 3/32"

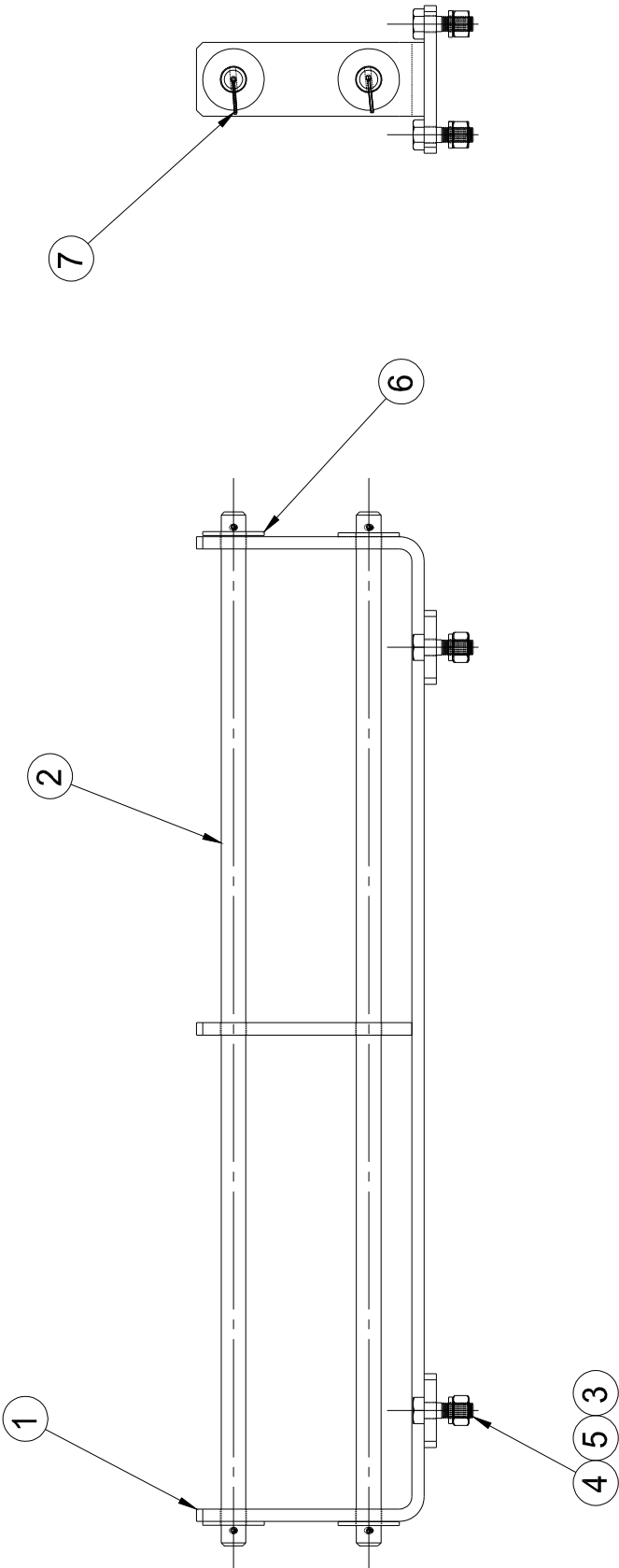


FIGURE 1-4c

WIRE ROPE STAY ASSEMBLY - A**Figure 1-4c****A172016****Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171988	1	Wire Rope Stay Weldment - A
2	A171993	2	Bar, Round Cold Rolled
3	A103206	4	Washer-Lock, 5/8" (High Alloy)
4	A100625	4	Bolt, 5/8-11Nc X 2" Gr 8 (Hex)
5	A102521	4	Nut, 5/8-11Nc (Hex) Gr8
6	A103009	4	Washer, 1" (Flat)
7	A109505	4	Pin, Cotter, 3/16 Dia x 2" (Lock)

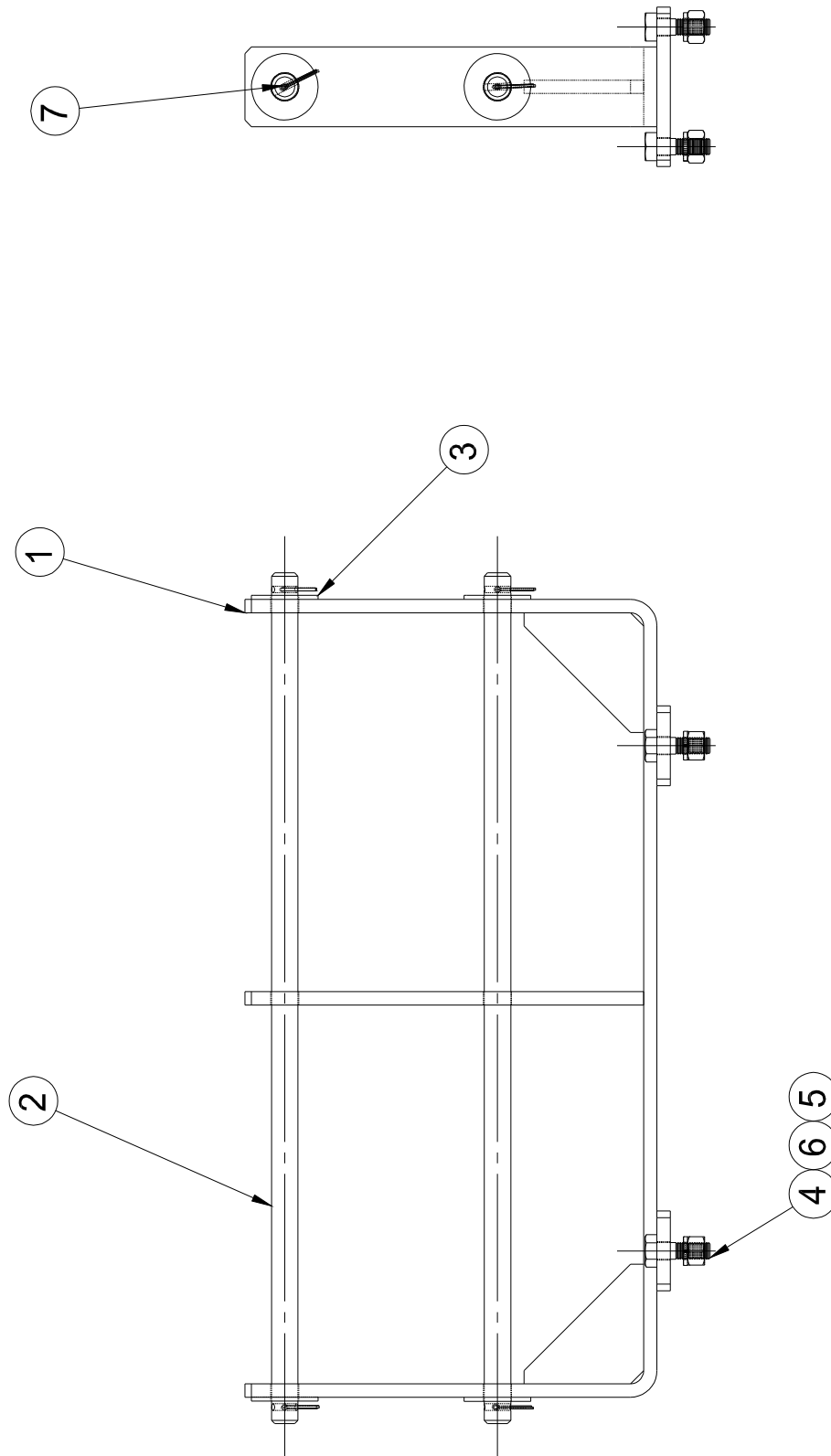


FIGURE 1-4d

WIRE ROPE STAY ASSEMBLY - B

Figure 1-4d

A172017

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171989	1	Wire Rope Stay Weldment - B
2	A172006	2	Bar, Round Cold Rolled, 1" Dia X 32"
3	A103009	4	Washer, 1" (Flat)
4	A100625	4	Bolt, 5/8-11Nc X 2" Gr 8 (Hex)
5	A103206	4	Washer-Lock, 5/8" (High Alloy)
6	A102521	4	Nut, 5/8-11Nc (Hex) Gr8
7	A109505	4	Pin, Cotter, 3/16 Dia x 2" (Lock)

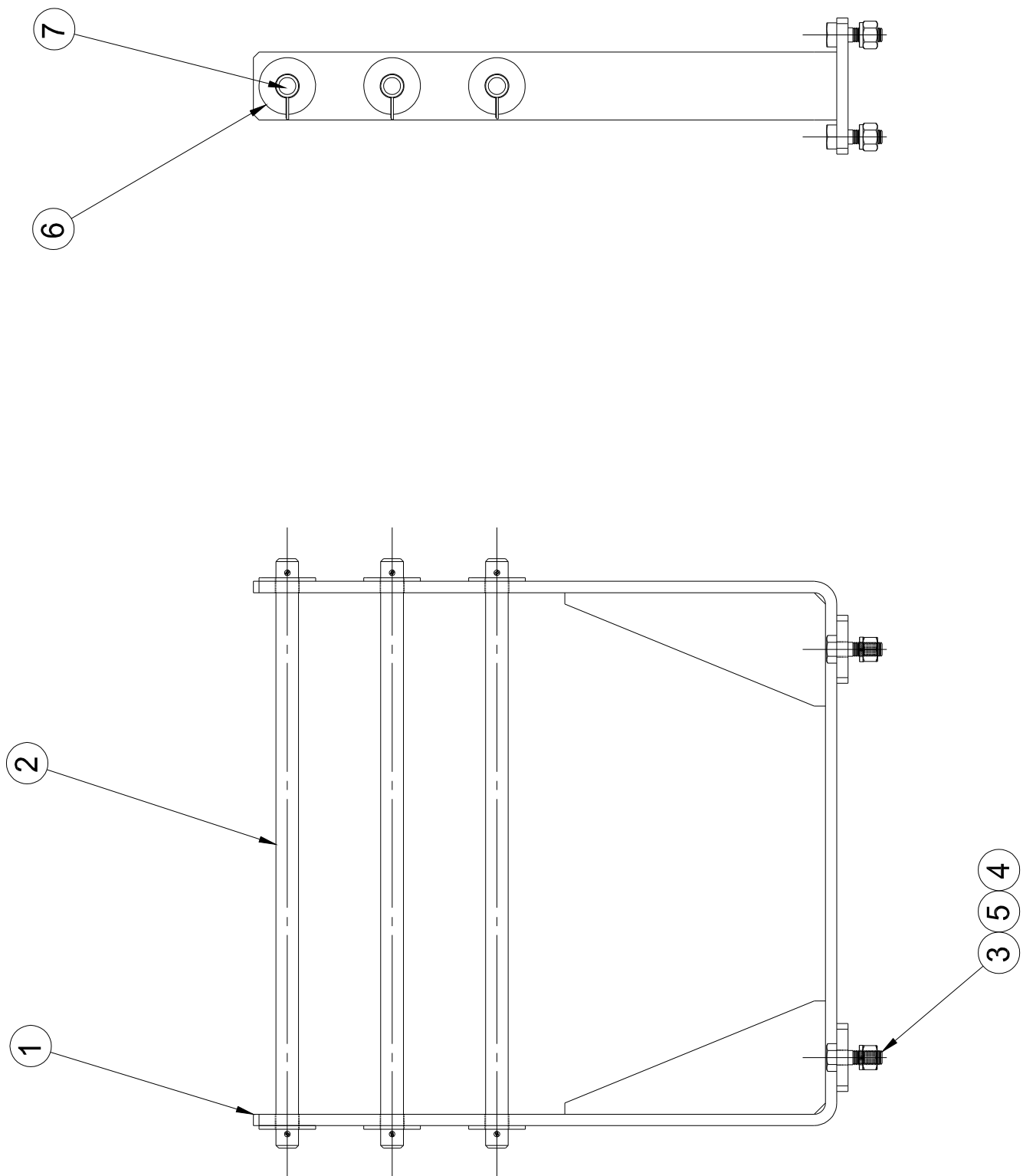


FIGURE 1-4e

WIRE ROPE STAY ASSEMBLY - C

Figure 1-4e

A172018

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171990	1	Wire Rope Stay Weldment - C
2	A172007	3	Bar, Round Cold Rolled, 1" Dia X 26"
3	A100625	4	Bolt, 5/8-11Nc X 2" Gr 8 (Hex)
4	A103206	4	Washer-Lock, 5/8" (High Alloy)
5	A102521	6	Nut, 5/8-11Nc (Hex) Gr8
6	A103009	4	Washer, 1" (Flat)
7	A109505	6	Pin, Cotter, 3/16 Dia x 2" (Lock)

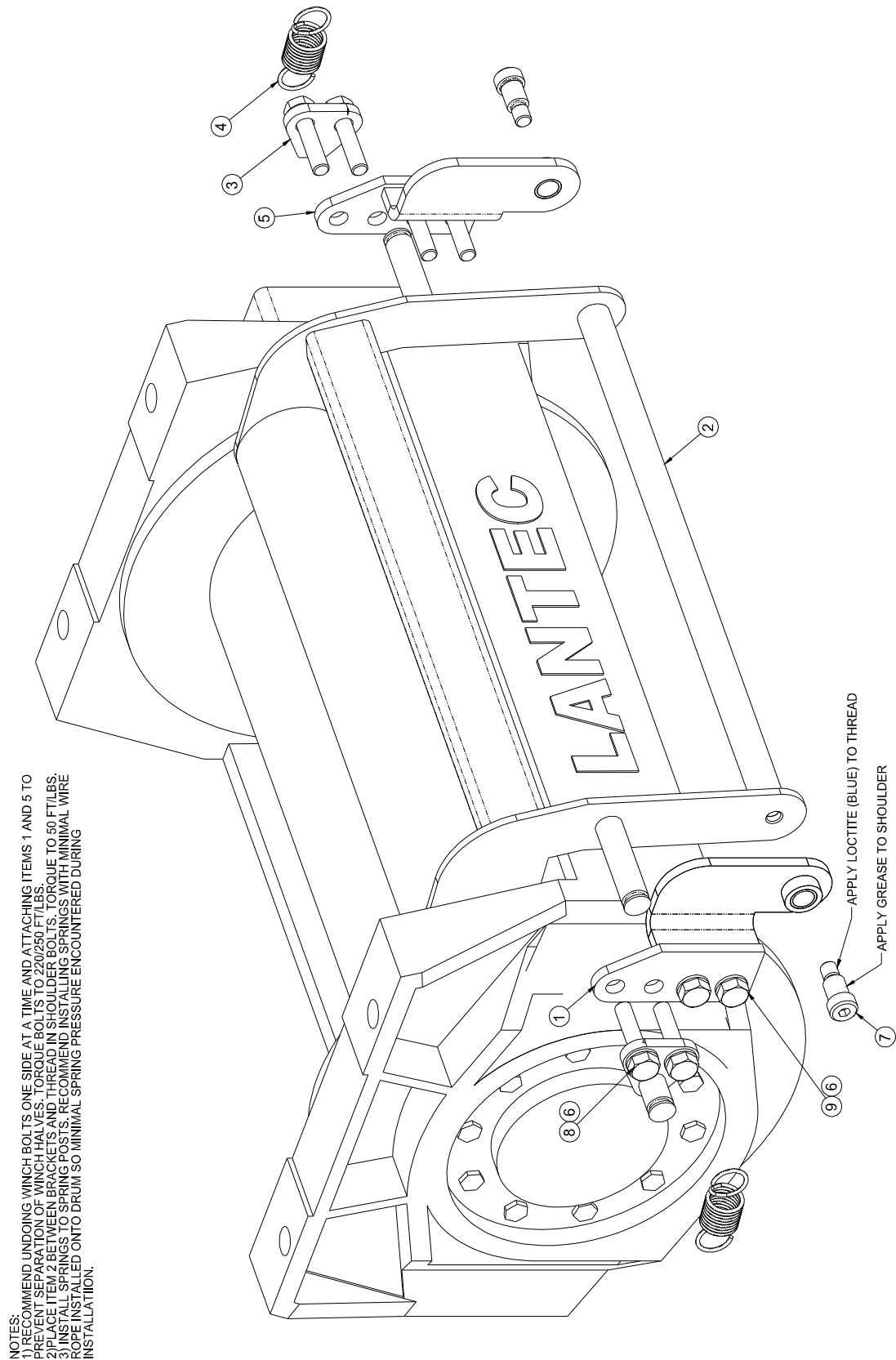


FIGURE 1-5

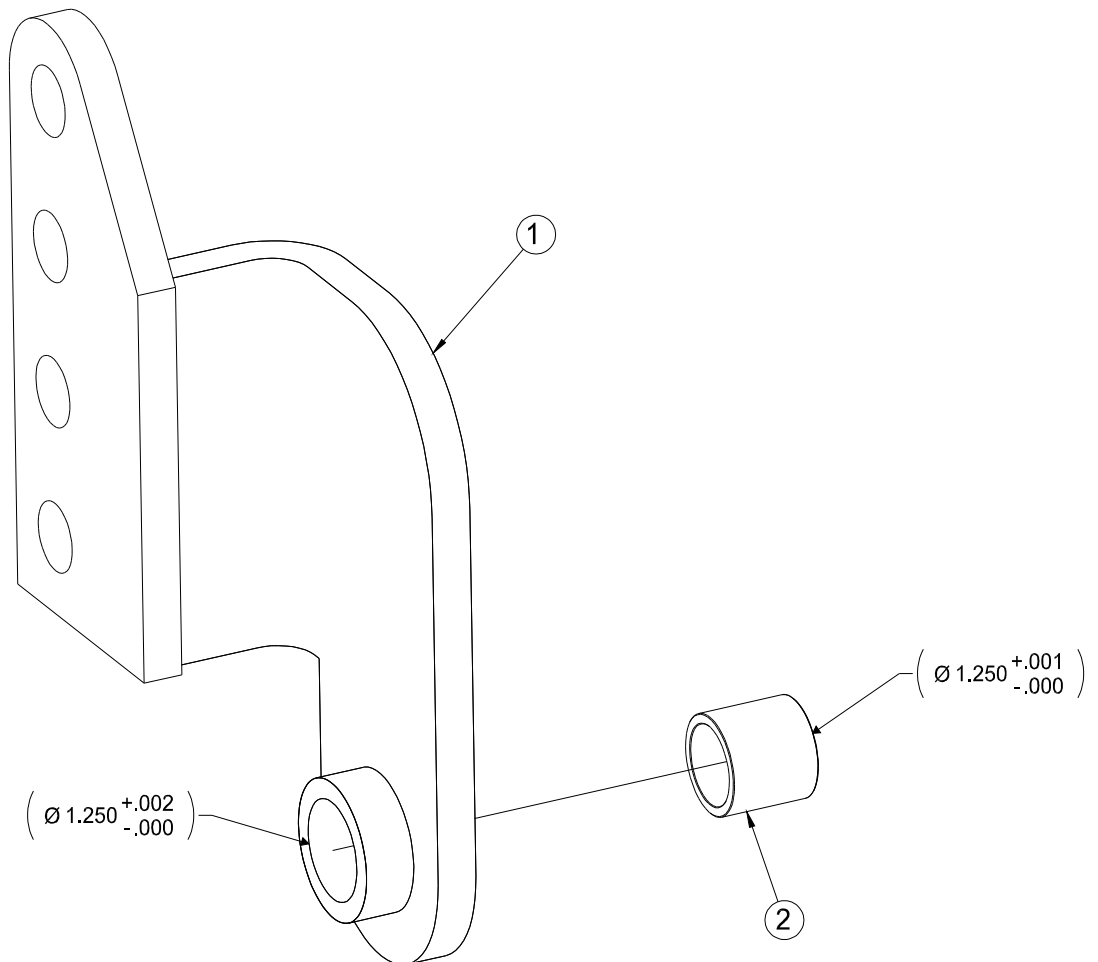
CABLE FOLLOWER INSTALLATION 32" SPOOL

Figure 1-5

A172079

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172078	1	Side Bracket Assembly Lh	Ref Fig 1-5a
2	A172070	1	Cable Follower Assembly	Ref Fig 1-5c
3	A172084	2	Spring End Mount Weldment	
4	A172213	2	Spring Tension 5"	
5	A172088	1	Side Bracket Assembly Rh	Ref Fig 1-5b
6	A103027	8	Washer, 3/4" Gr8 (Flat Hard)	
7	FS00204	2	Bolt, Shoulder, 1"Dia X 1 1/4 - 3/4-10 Nc	
8	A100749	4	Bolt, 3/4-10Nc X 3-1/2" Gr 8 (Hex)	
9	A100741	4	Bolt, 3/4-10Nc X 3" Gr 8 (Hex)	



NOTE:
1) INSERT BUSHING INTO MACHINED HOLE IN BRACKET.

FIGURE 1-5a

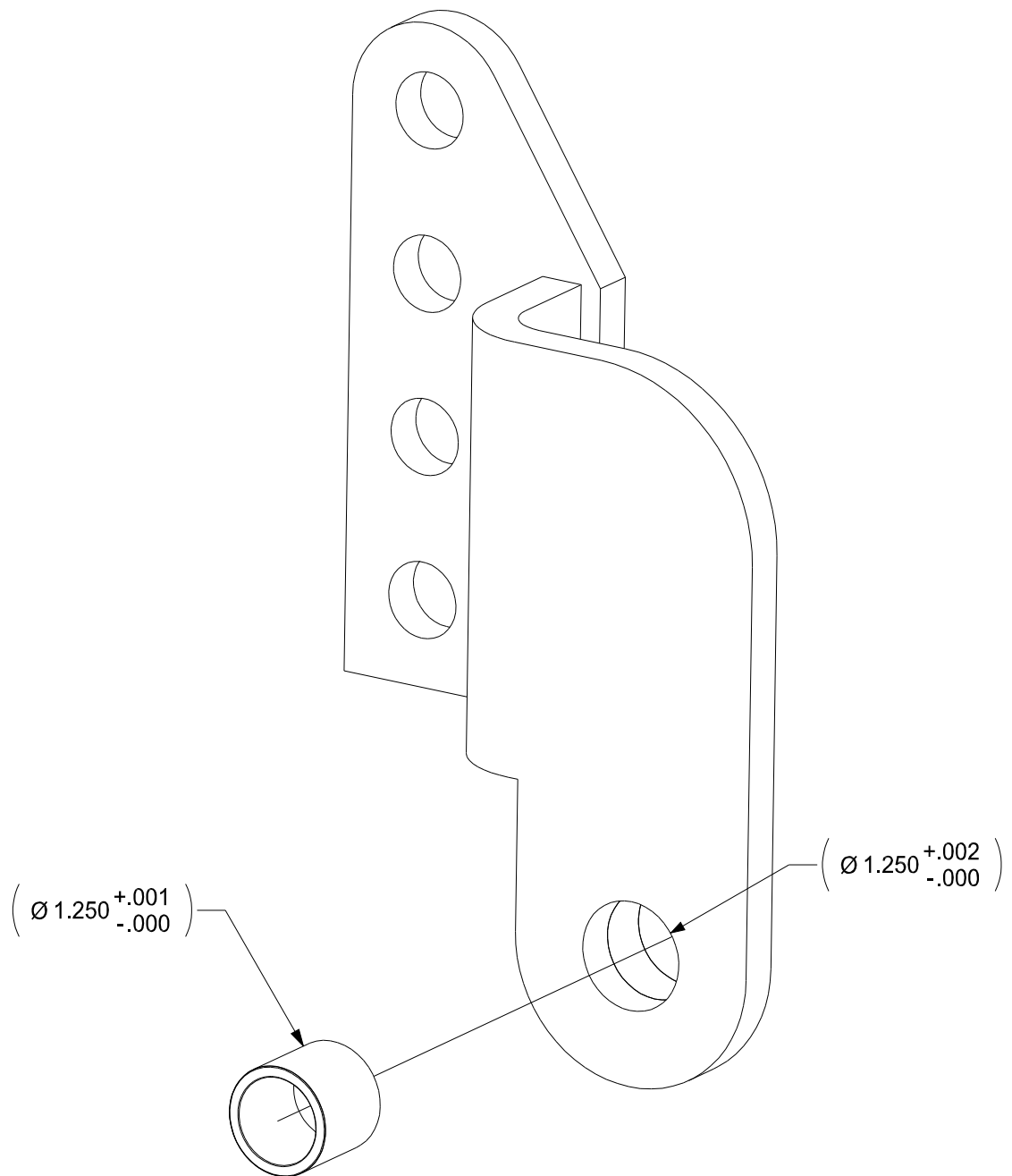
SIDE BRACKET ASSEMBLY LH

Figure 1-5a

A172078

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172077	1	Side Bracket Machining Lh
2	A172074	1	Bushing, Pivot



NOTES: 1) INSERT BUSHING INTO MACHINED HOLE IN BRACKET

FIGURE 1-5b

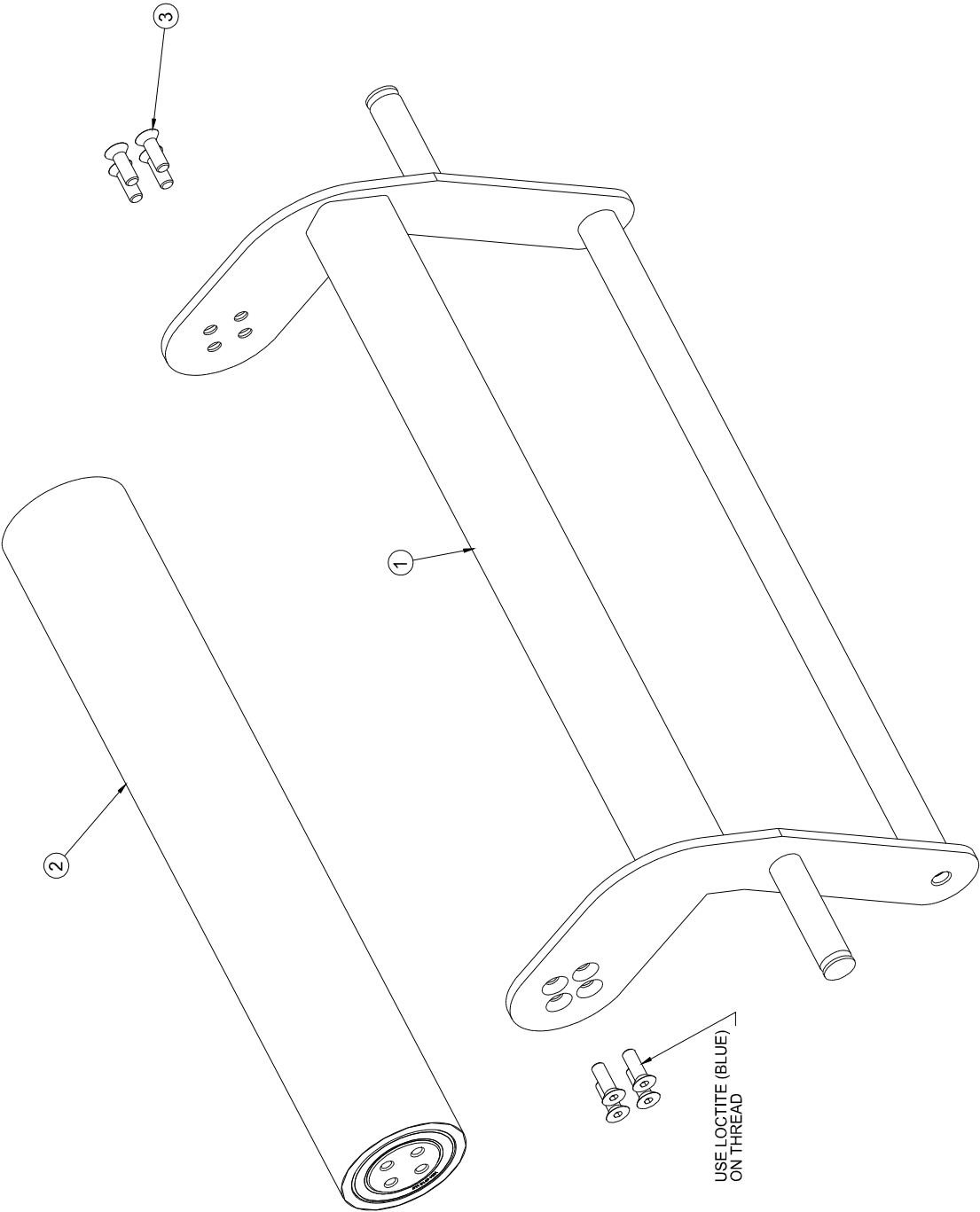
SIDE BRACKET ASSEMBLY RH

Figure 1-5b

A172088

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172087	1	Side Bracket Machining Rh
2	A172074	1	Bushing, Pivot



NOTE:
1) PLACE ROLLER BETWEEN ARMS AND ALIGN BOLT HOLES.
2) THREAD BOLTS INTO HOLES AND TORQUE TO 45/60 FT/LBS.

FIGURE 1-5c

CABLE FOLLOWER ASSEMBLY

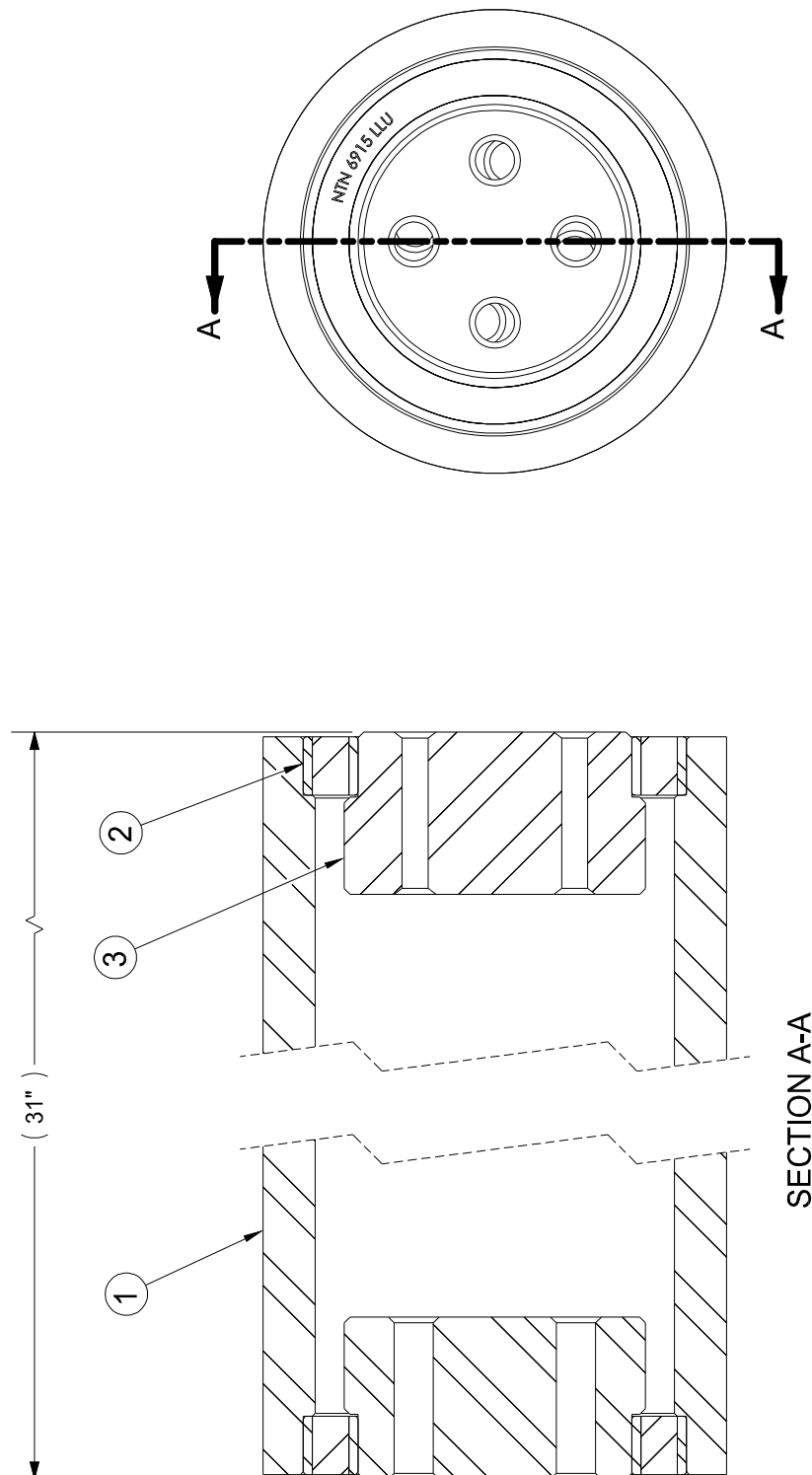
Figure 1-5c

A172070

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172065	1	Cable Follower Machining
2	A172069	1	Cable Follower Roller Assembly
3	A101438	8	Bolt, 1/2-13Nc X 1-1/2" (Soc Flat Head) Ss

Ref Fig 1-5ca



NOTES:
1) PREPARE BY PRESSING ITEM 3 INTO INNER RACE OF ITEM 2.
2) PRESS ITEM 2 WITH 3 INTO BORE OF ITEM 1 AT EACH END.

FIGURE 1-5ca

CABLE FOLLOWER ROLLER ASSEMBLY

Figure 1-5ca

A172069

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172068	1	Cable Follower Roller
2	A172067	2	Bearing, Ball, Ntn Deep Groove
3	A172066	2	Retainer, Bearing

NOTES:
1) RECOMMEND UNDOING WINCH BOLTS ONE SIDE AT A TIME AND ATTACHING ITEMS 1 AND 5 TO PREVENT SEPARATION OF WINCH HALVES. TORQUE BOLTS TO 220/250 FT/LBS.
2) PLACE ITEM 2 BETWEEN BRACKETS AND THREAD IN SHOULDER BOLTS. TORQUE TO 50 FT/LBS.
3) INSTALL SPRINGS TO SPRING POSTS. RECOMMEND INSTALLING SPRINGS WITH MINIMAL WIRE ROPE INSTALLED ONTO DRUM SO MINIMAL SPRING PRESSURE ENCOUNTERED DURING INSTALLATION.

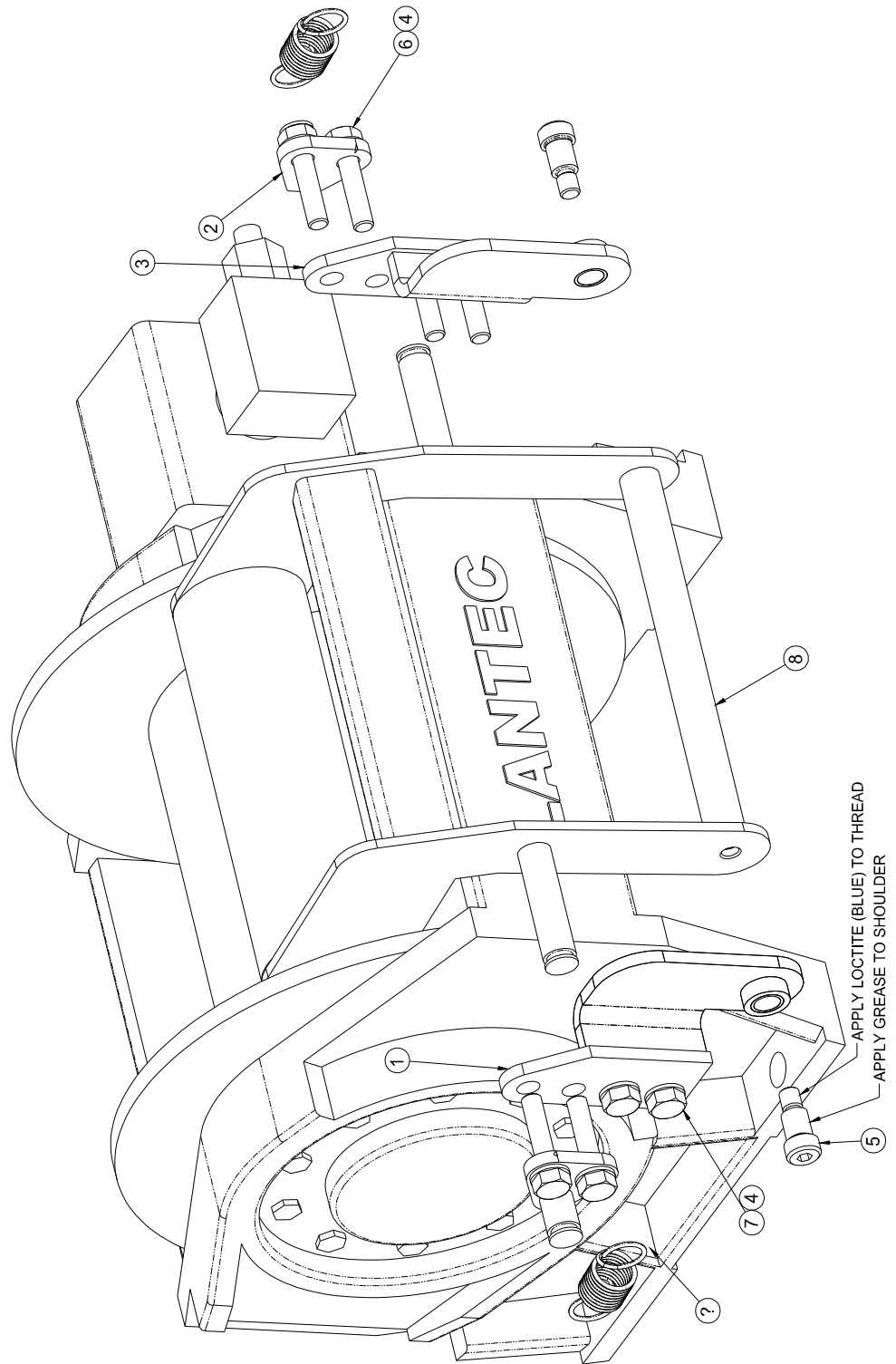


FIGURE 1-6

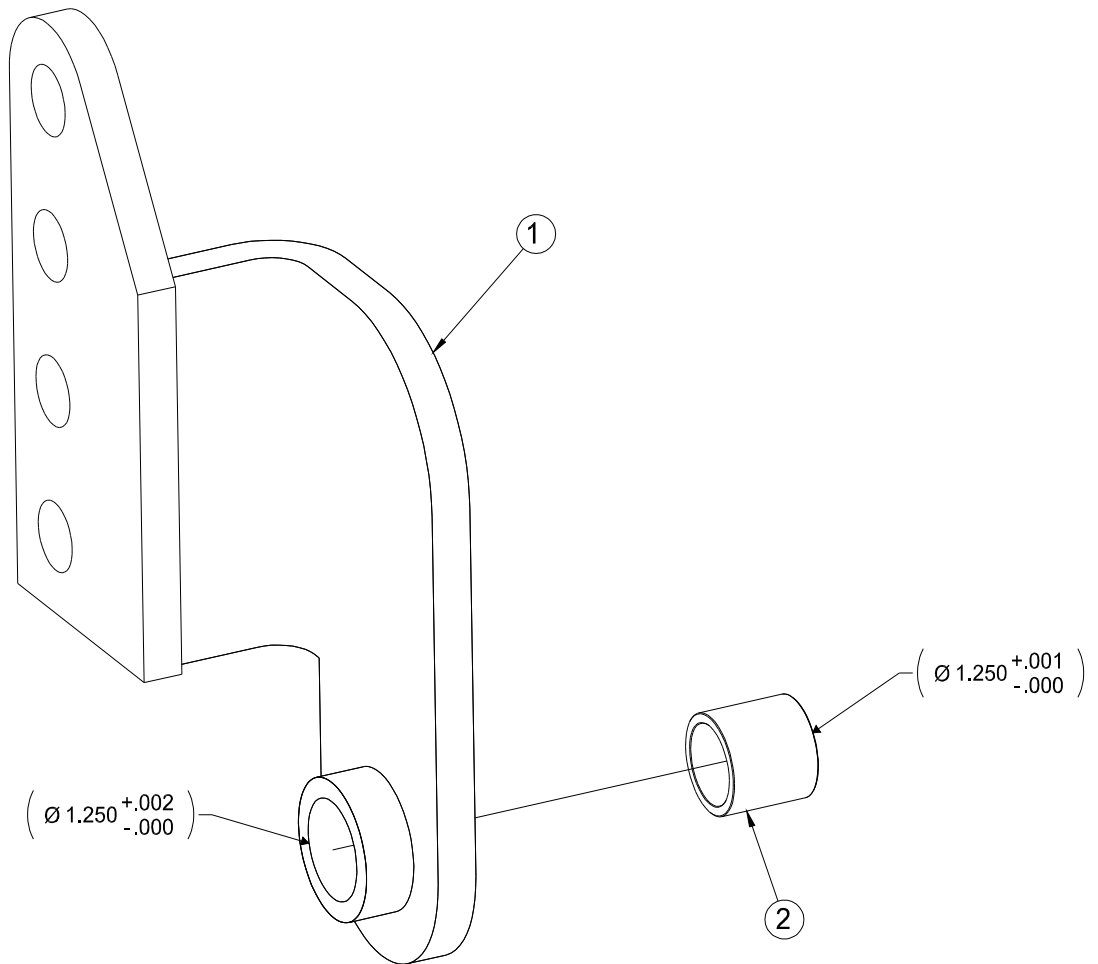
CABLE FOLLOWER INSTALLATION 17" SPOOL

Figure 1-6

A172091

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172078	1	Side Bracket Assembly Lh	Ref Fig 1-6a
2	A172084	2	Spring End Mount Weldment	
3	A172088	1	Side Bracket Assembly Rh	Ref Fig 1-6b
4	A103027	8	Washer, 3/4" Gr8 (Flat Hard)	
5	FS00204	2	Bolt, Shoulder, 1"Dia X 1 1/4 - 3/4-10 Nc	
6	A100749	4	Bolt, 3/4-10Nc X 3-1/2" Gr 8 (Hex)	
7	A100741	4	Bolt, 3/4-10Nc X 3" Gr 8 (Hex)	
8	A172092	1	Cable Follower Assembly	Ref Fig 1-6c
9	A172213	2	Spring Tension 5"	



NOTE:
1) INSERT BUSHING INTO MACHINED HOLE IN BRACKET.

FIGURE 1-6a

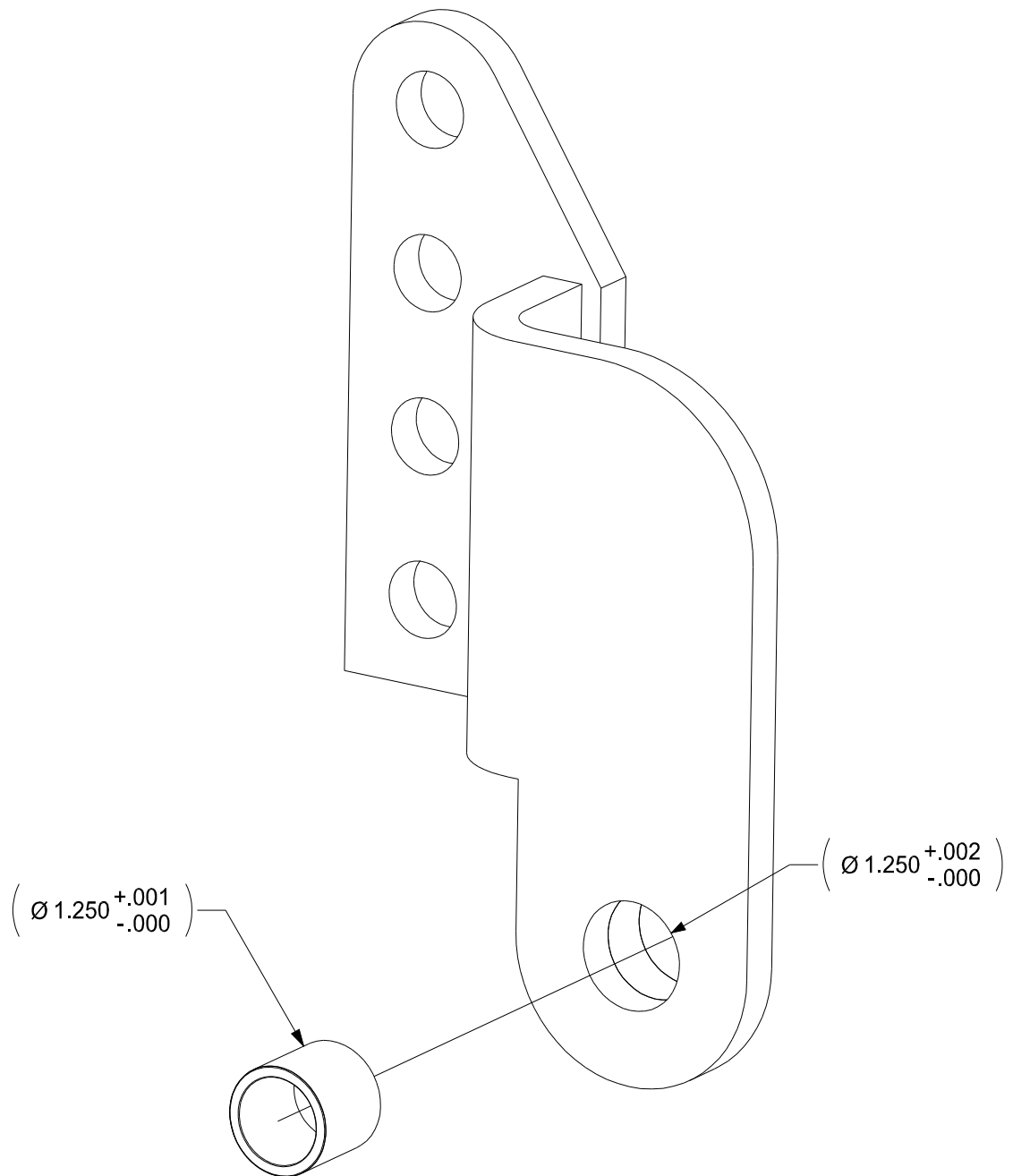
SIDE BRACKET ASSEMBLY LH

Figure 1-6a

A172078

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172077	1	Side Bracket Machining Lh
2	A172074	1	Bushing, Pivot



NOTES: 1) INSERT BUSHING INTO MACHINED HOLE IN BRACKET

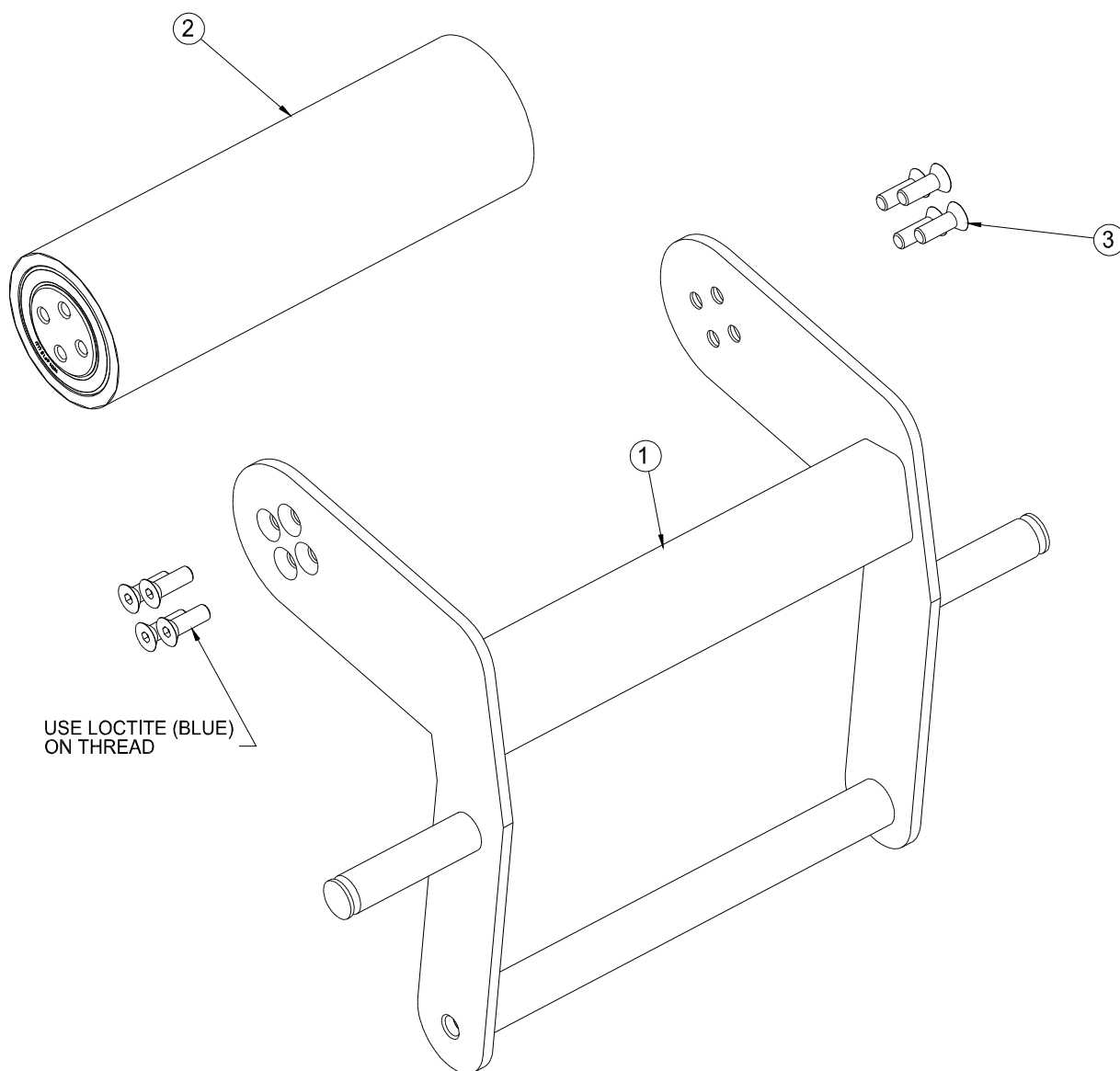
FIGURE 1-6b



Figure 1-6c

Drawing Rev -

A172180



NOTE:
1) PLACE ROLLER BETWEEN ARMS AND ALIGN BOLT HOLES.
2) THREAD BOLTS INTO HOLES AND TORQUE TO 45/50 FT/ LBS.

FIGURE 1-6c

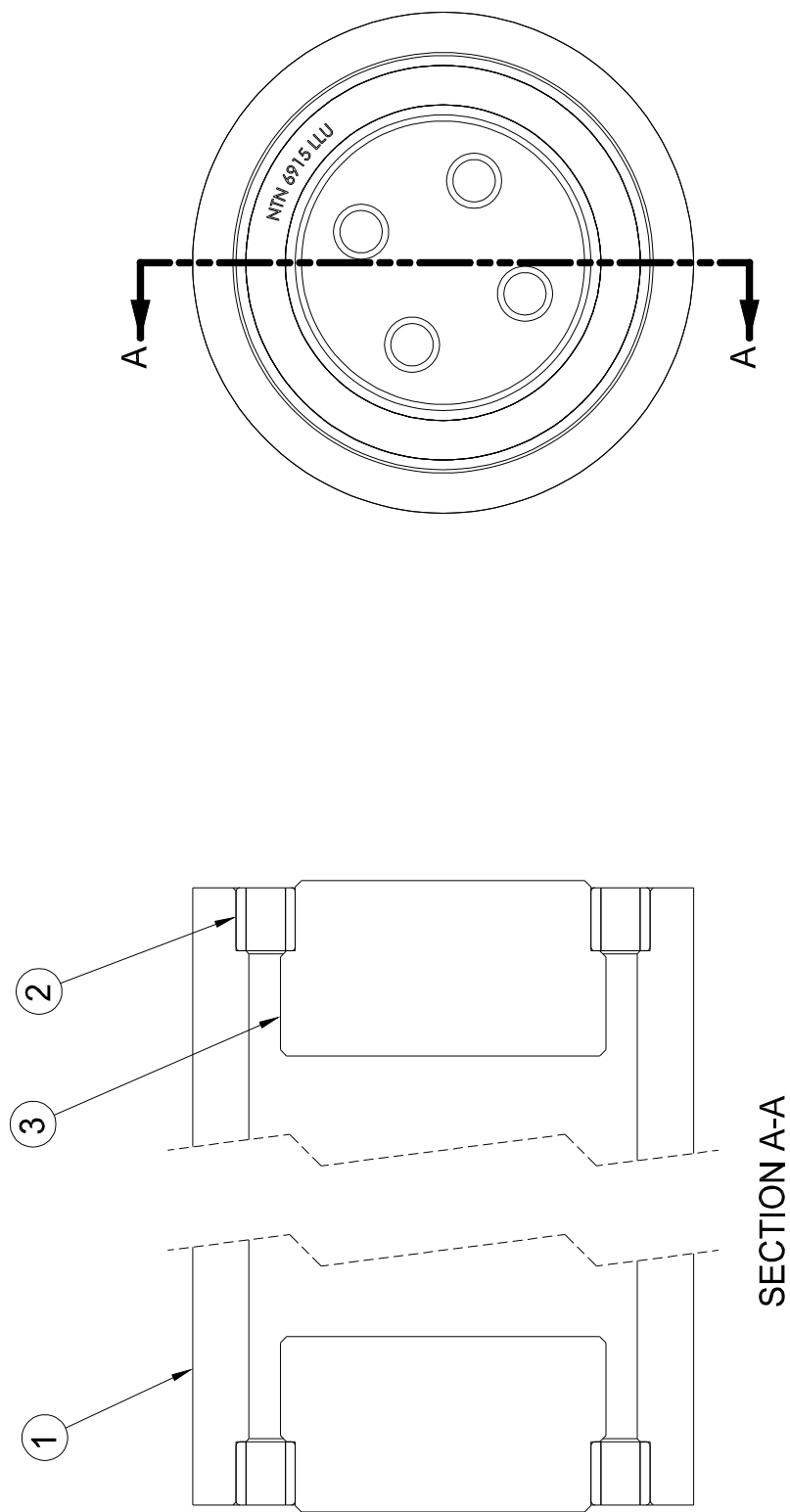
CABLE FOLLOWER ASSEMBLY

Figure 1-6c

A172092

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172095	1	Cable Follower Machining
2	A172094	1	Roller Assembly
3	A101438	8	Bolt, 1/2-13Nc X 1-1/2" (Soc Flat Head) Ss



NOTES:
1) PREPARE BY PRESSING ITEM 3 INTO INNER RACE OF ITEM 2.
2) PRESS ITEM 2 WITH 3 INTO BORE OF ITEM 1 AT EACH END.

FIGURE 1-6ca

CABLE FOLLOWER ROLLER ASSEMBLY

Figure 1-6ca

A172094

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172093	1	Cable Follower Roller
2	A172067	2	Bearing, Ball, Ntn Deep Groove
3	A172066	2	Retainer, Bearing

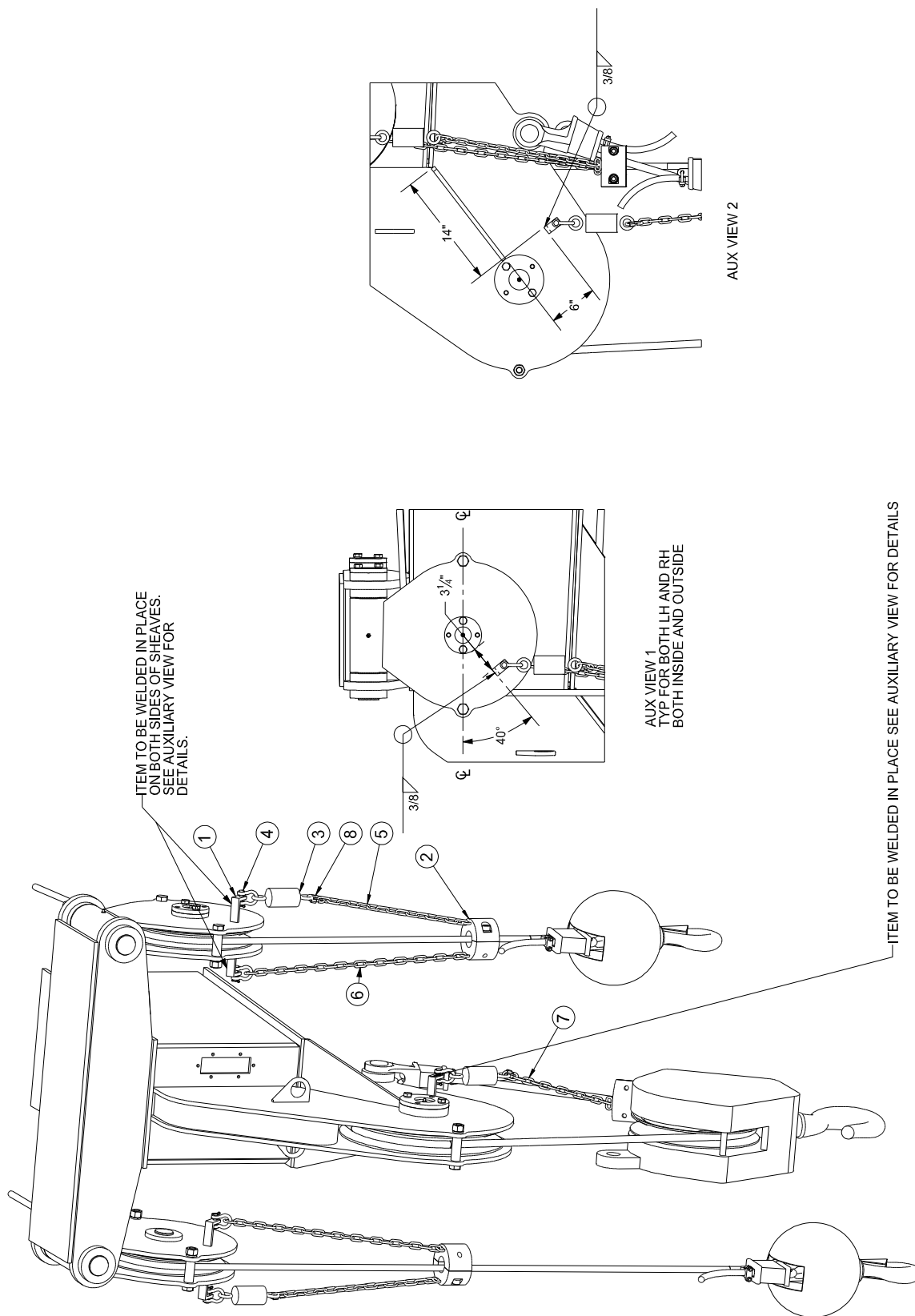


FIGURE 1-7

ATB INSTALLATION

Figure 1-7 **A172031** **Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172029	5	Mount, Atb, Angle
2	M00300	3	Weight, Anti Two Block
3	A123070	3	Switch, A2B, SS, C/W 85 Ft Cord
4	FS00182	5	Shackle, 3/8 1 Ton
5	RM00451-20	2	1/4" Chain 20" Lg
6	RM00451-27	2	1/4" Chain 27" Lg
7	RM00451-15	1	1/4" Chain 15" Lg
8	A172037	3	Chain Connector 1/4" SS

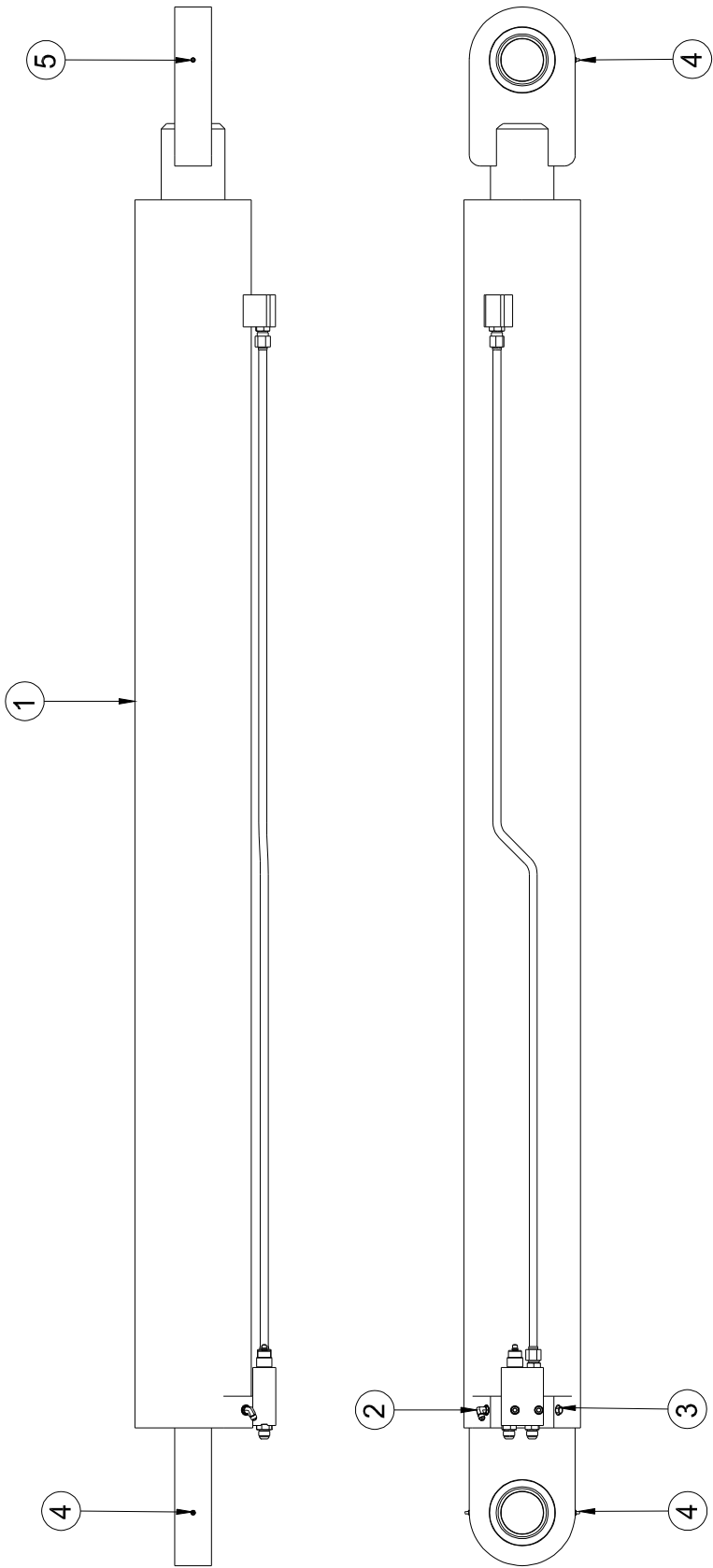


FIGURE 1-8

HYDRAULIC CYLINDER INSTALLATION LH

Figure 1-8

A115168

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171635	1	Hydraulic Cylinder Assembly
2	A13253	1	Adapt-90, 6Sae - 6Jicm
3	H00107	1	Plug, 6 Sae Hex Head
4	J00007	3	Fitting, Grease 1/8-27Npt
5	A114056	1	Plug, 1/8 Nptm Hex

Ref Fig 1-8a

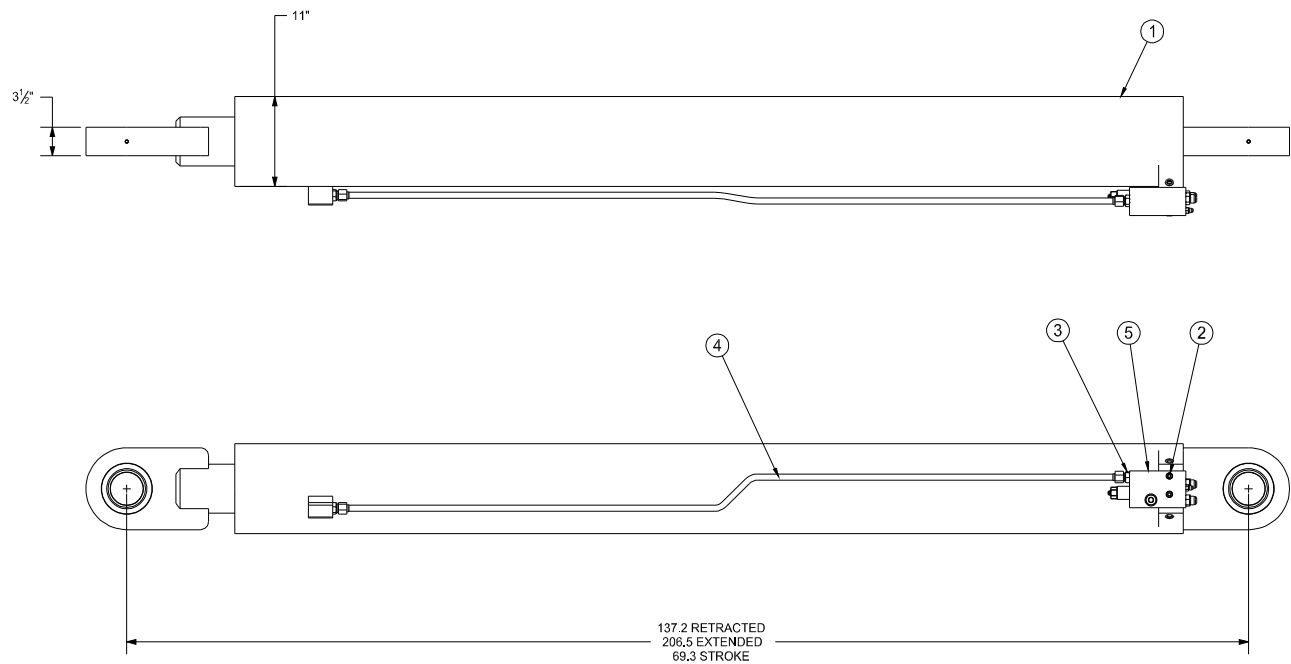


FIGURE 1-8a

HYDRAULIC CYLINDER ASSEMBLY

Figure 1-8a

A171635

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	A115110	1	Cylinder, Boom Lift, 10" X 69.3" Str	1-8aa
2	A101434	2	Bolt, 1/2-13Nc X 3-1/4" (Soc)	
3	A13850	2	Adapt, 12Sae - 12Jicm	
4	A115101	1	Hyd. Tube Assembly	
5	A115256	1	Cartridge, Vented Counterbalance, Adjustable	

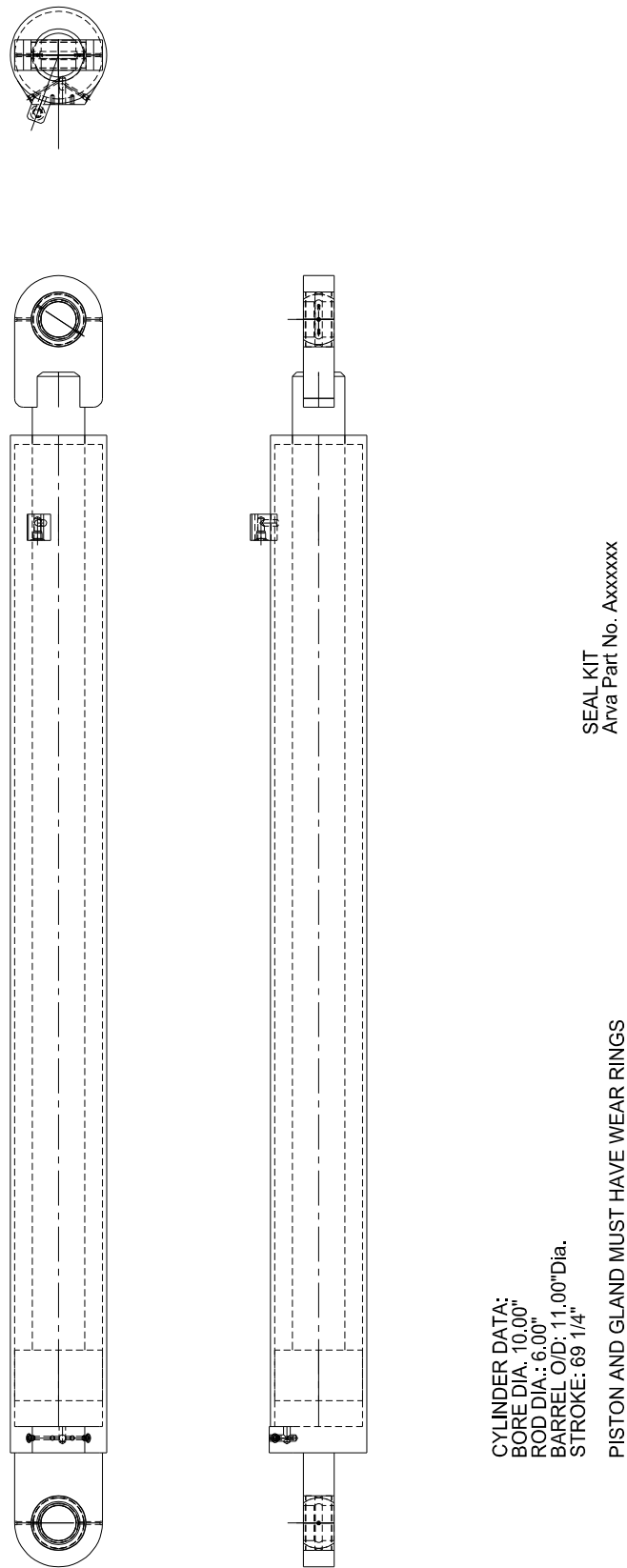


FIGURE 1-8aa

CYLINDER, BOOM LIFT

Figure 1-8aa

A115110

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115193	1	Seal Kit

Seal Kit Consists The Following:

1	Piston Seal
2	Wear Ring
1	O-Ring
1	O-Ring
1	Back Up Ring
2	Rod Seal
1	Wear Ring
1	Wiper
1	Shoulder O-Ring

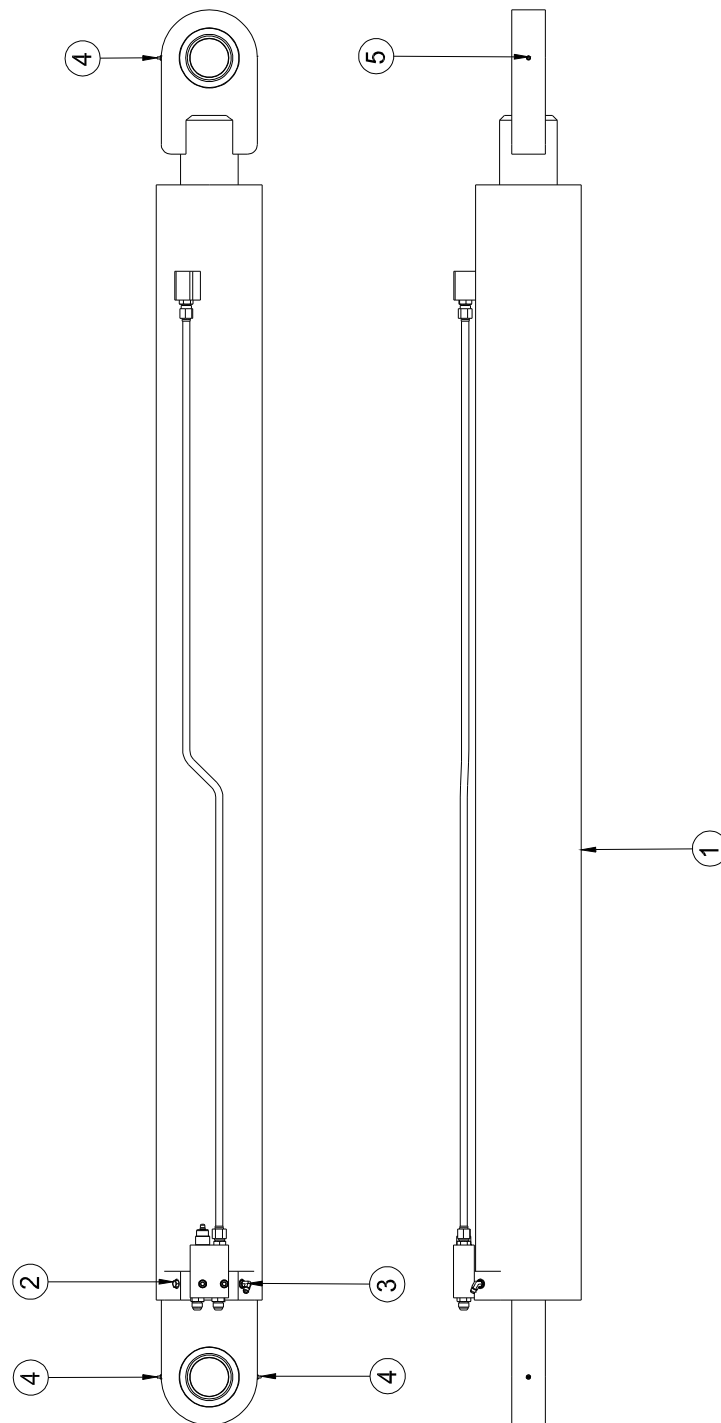


FIGURE 1-9

HYDRAULIC CYLINDER INSTALLATION RH

Figure 1-9

A115167

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171635	1	Hydraulic Cylinder Assembly
2	H00107	1	Plug, 6 Sae Hex Head
3	A13253	1	Adapt-90, 6Sae - 6Jicm
4	J00007	3	Fitting, Grease 1/8-27Npt
5	A114056	1	Plug, 1/8 Nptm Hex

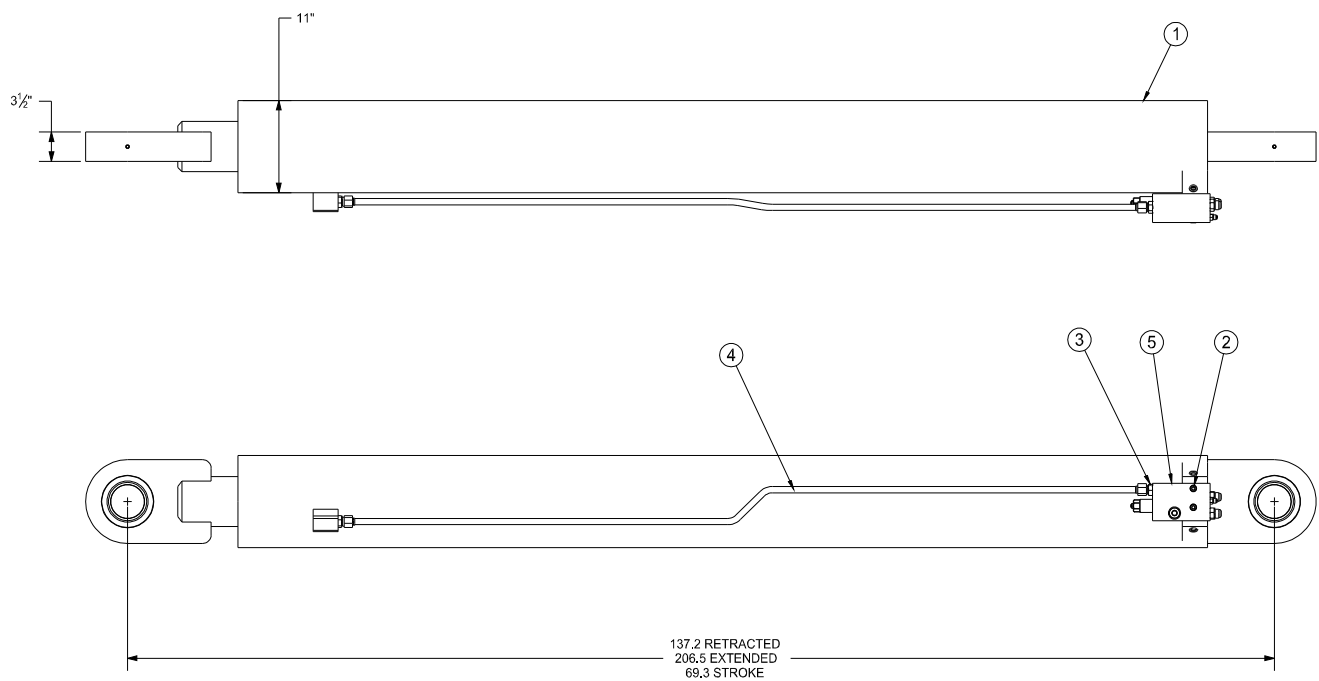


FIGURE 1-9a

HYDRAULIC CYLINDER ASSEMBLY

Figure 1-9a

A171635

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION	FIGURE
1	A115110	1	Cylinder, Boom Lift, 10" X 69.3" Str	1-9aa
2	A101434	2	Bolt, 1/2-13Nc X 3-1/4" (Soc)	
3	A13850	2	Adapt, 12Sae - 12Jicm	
4	A115101	1	Hyd. Tube Assembly	
5	A115256	1	Cartridge, Vented Counterbalance, Adjustable	

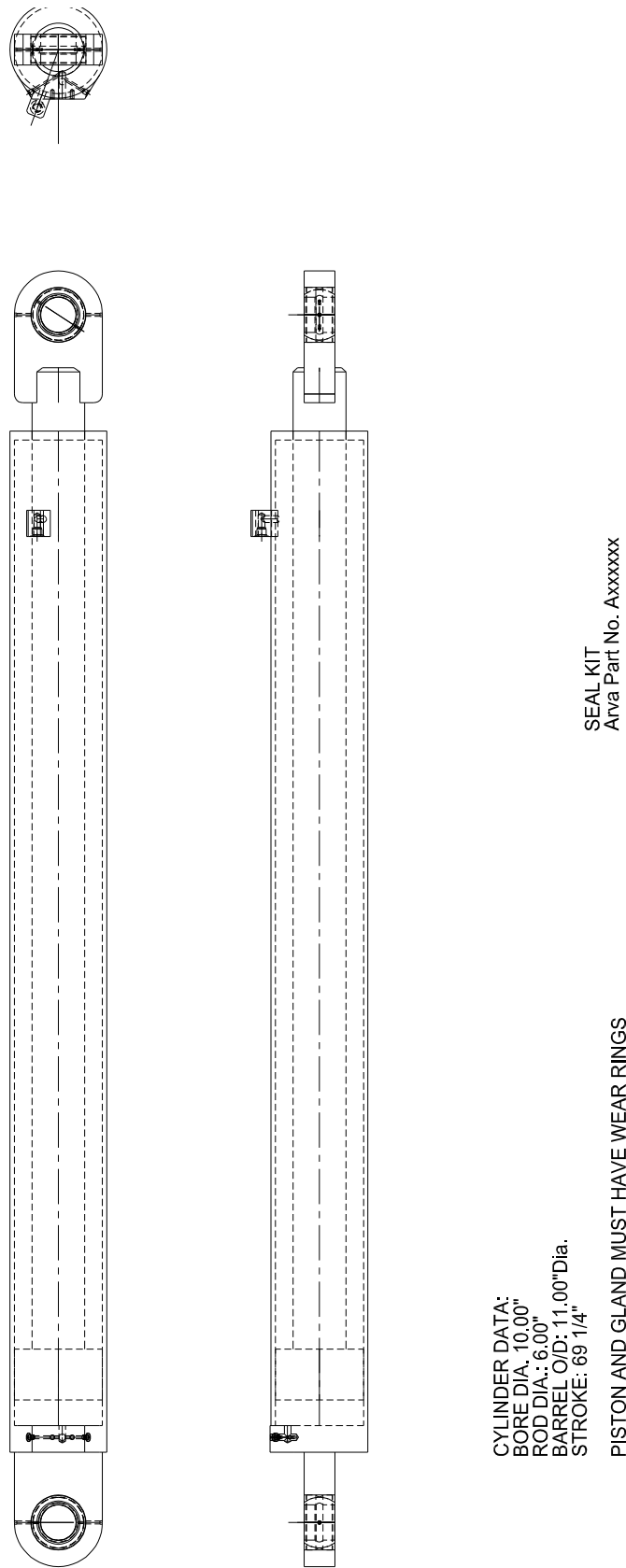


FIGURE 1-9aa

CYLINDER, BOOM LIFT

Figure 1-9aa

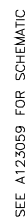
A115110

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115193	1	Seal Kit

Seal Kit Consists The Following:

1	Piston Seal
2	Wear Ring
1	O-Ring
1	O-Ring
1	Back Up Ring
2	Rod Seal
1	Wear Ring
1	Wiper
1	Shoulder O-Ring



A172180

ELECTRICAL INSTALLATION

Figure 2 **A123058** **Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A123091	1	Junction Box 1 Assembly	Ref Fig 2-1
2	A123092	1	Junction Box 2 Assembly	Ref Fig 2-2
3	A123093	1	Junction Box 3 Assembly	Ref Fig 2-3
4	A123094	1	Junction Box 4 Assembly	Ref Fig 2-4
5	A123095	1	Junction Box 5 Assembly	Ref Fig 2-5
6	A123096	1	Junction Box 6 Assembly	Ref Fig 2-6
7	A123097	1	Junction Box 7 Assembly	Ref Fig 2-7
8	A123098	Ref	Junction Box 8 Assembly	Ref Fig 2-8
9	A123099	1	Junction Box 9 Assembly	Ref Fig 2-9
10	A100000H	12	Bolt, 1/4-20Nc X 1/2" (Hex)	
11	A103200H	16	Washer-Lock, 1/4" (Plated)	
12	A100208H	2	Bolt, 3/8-16Nc X 1" Gr 5 (Hex)	
13	A103202H	2	Washer-Lock, 3/8"	
14	A102740H	1	Nut-Nylock, 5/16-18Nc Gr5	
15	A103001H	1	Washer, 5/16" (Flat)	
16	A169841	1	Retainer Weldment	
17	A172113	2	Standoff Weldment	
18	A171981	2	Seat And Control Assembly	Ref Fig 2-10
19	A100004H	4	Bolt, 1/4-20Nc X 3/4" Gr 5 (Hex)	
20	A123069	1	Electric Swivel 24 Way	

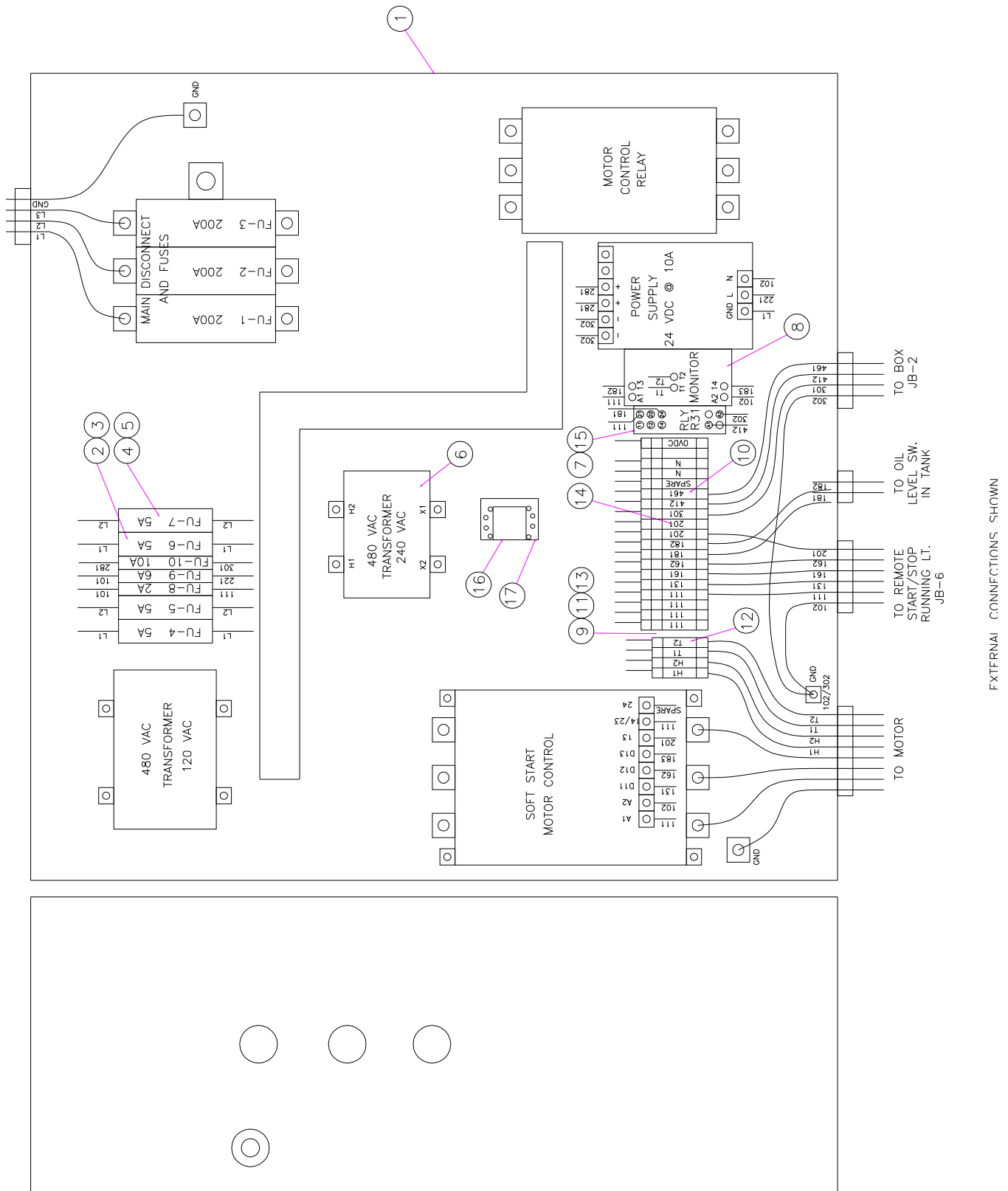


FIGURE 2-1

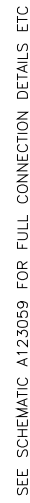
JUNCTION BOX 1 ASSEMBLY

Figure 2-1

A123091

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115104	Ref	Control Box
2	A123081	1	Fuse Holder
3	A123082	1	Fuse Atqr.5 (600V 050A)
4	A123081	1	Fuse Holder
5	A123082	1	Fuse Atqr.5 (600V 050A)
6	A123077	1	Transformer, 480-240 Volt ,100 VA
7	A123101	1	Relay 3Pdt, A-B
8	A123076	1	Thermistor, Monitor
9	RM02821	12	Din Rail, 1492-N1
10	A122763	19	Terminal Block
11	A122740	4	Terminal Block End Anchor
12	A122735	4	Terminal Block
13	A102210	4	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
14	A122828	19	Terminal Marker
15	A123100	1	Relay Socket
16	A123142	1	Relay
17	A123141	1	Base



A172180

JUNCTION BOX 2 ASSEMBLY

Figure 2-2 **A123092** **Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123087	1	Junction Box.
2	A123102	2	Terminal Block, Fused A-B
3	A123104	2	Fuse, 6 Amp
4	RM00393-8	1	Din Rail, 35Mm Hi-Rise
5	RM00393-12	1	Din Rail, 35Mm Hi-Rise
6	A102210	6	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
7	A123127	4	Socket, Blade 14
8	A123126	4	Relay, Square Base 24 Volt
9	A122763	53	Terminal Block, 1492-L3T
10	A122740	6	Terminal Block End Anchor
11	A122739	4	Terminal Block End Barrier
12	A122765	2	Terminal Block Jumper, 4 Pole
13	A122828	53	Terminal Marker, Ab
14	A120593	2	Connector, 3/4 Npt P/L
15	A122749	2	Strain Relief, Nylon
16	A123103	1	End Barrier, A-B

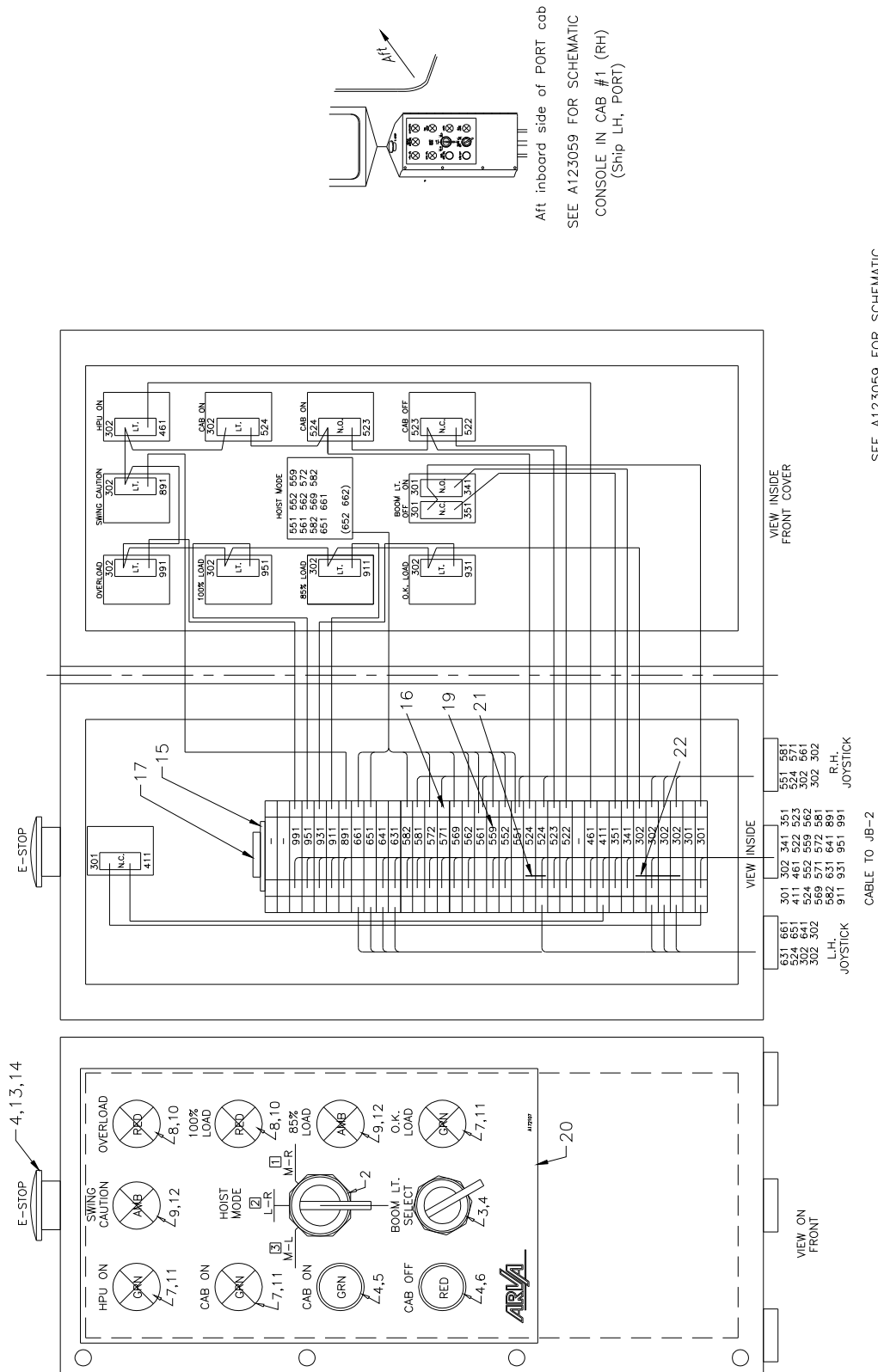


FIGURE 2-3

JUNCTION BOX 3 ASSEMBLY

Figure 2-3

A123093

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123087	1	Juction Box
2	A123107	1	Hoist Mode Sw Assembly
3	A123108	1	Operator
4	A123109	4	Contact Blk
5	A123110	1	Button, Pilot Push, Green
6	A123111	1	Button, Pilot Push, Red
7	A123112	3	Mount & Light, Green
8	A123113	2	Mount & Light, Red
9	A123114	2	Mount & Light, Amber
10	A123115	2	Led, Op, Red
11	A123116	3	Led, Op, Green
12	A123117	2	Led, Op, Amber
13	A123118	1	Push-Pull Twist
14	A123119	1	PI, E-Stop
15	A122740	2	Terminal Block End Anchor
16	A122763	30	Terminal Block
17	RM00549	10	Din Rail, 35Mm
18	A102210	4	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
19	A122828	30	Terminal Marker, Ab
20	A172107	1	Decal, Main Cover, Jb 3
21	A123106	2	Jumper, A-B
22	A122765	1	Terminal Block Jumper, 4 Pole

Ref Fig 2-3a

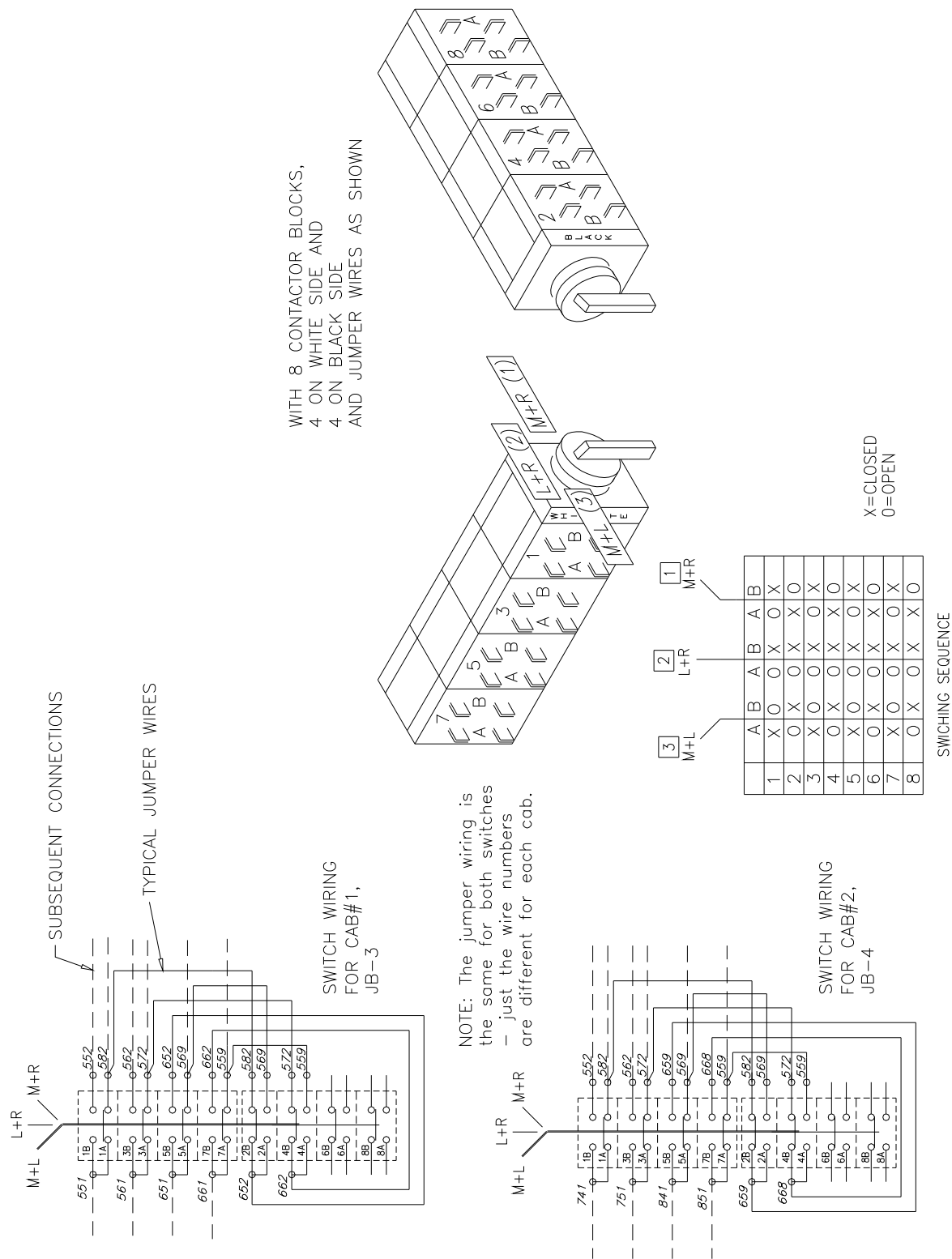


FIGURE 2-3a

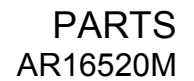


Figure 2-3a

Drawing Rev -

A172180

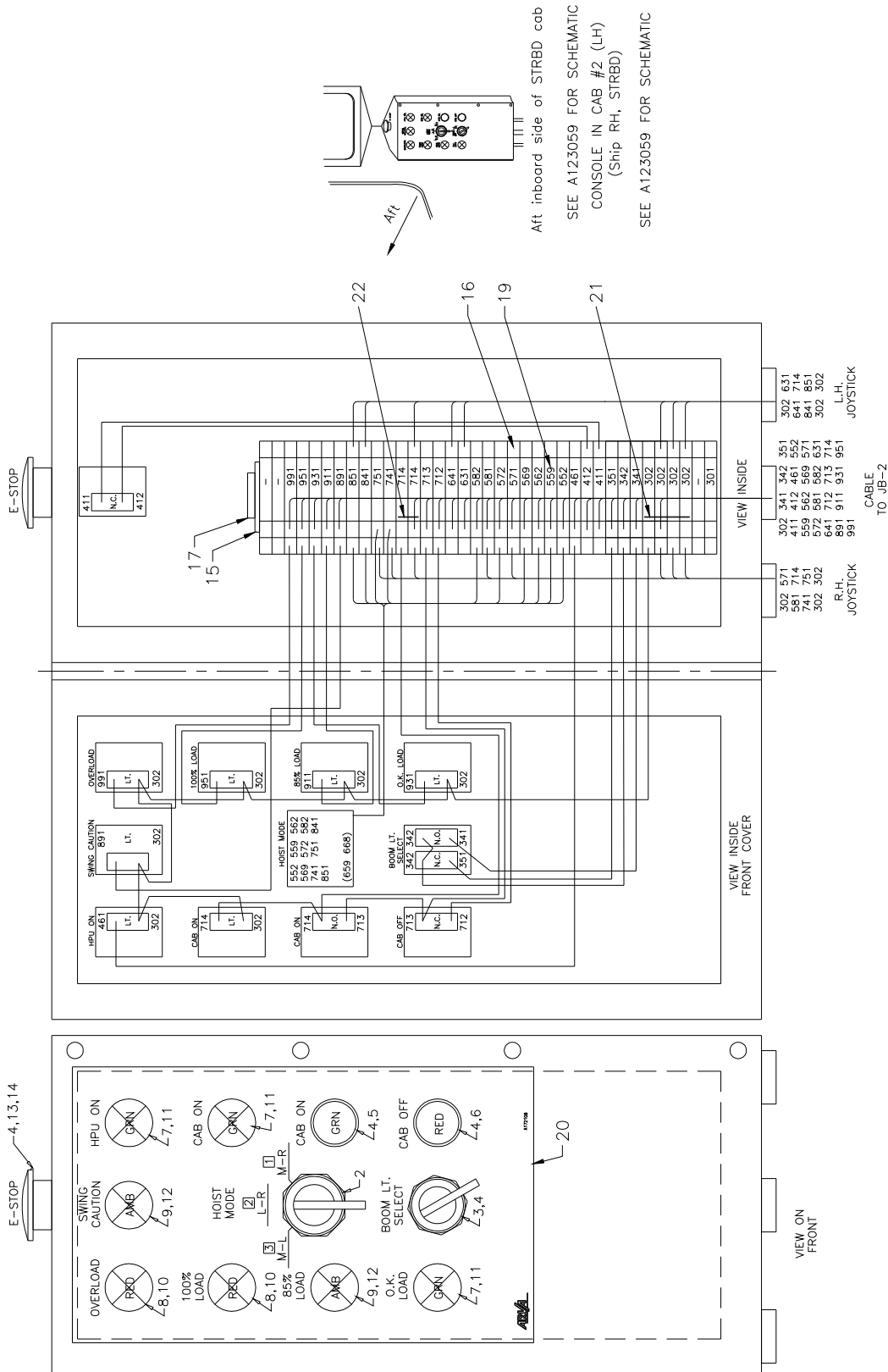


FIGURE 2-4

JUNCTION BOX 4 ASSEMBLY

Figure 2-4

A123094

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123087	1	Juction Box
2	A123107	1	Hoist Mode Sw Assembly
3	A123108	1	Operator
4	A123109	4	Contact Blk
5	A123110	1	Button, Pilot Push, Green
6	A123111	1	Button, Pilot Push, Red
7	A123112	3	Mount & Light, Green
8	A123113	2	Mount & Light, Red
9	A123114	2	Mount & Light, Amber
10	A123115	2	Led, Op, Red
11	A123116	3	Led, Op, Green
12	A123117	2	Led, Op, Amber
13	A123118	1	Push-Pull Twist
14	A123119	1	PI, E-Stop
15	A122740	2	Terminal Block End Anchor
16	A122763	30	Terminal Block
17	RM00549	10	Din Rail, 35Mm, 199-Dr1
18	A102210	4	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
19	A122828	30	Terminal Marker, Ab
20	A172108	1	Decal, Main Cover, Jb 4
21	A122765	2	Terminal Block Jumper, 4 Pole
22	A123106	1	Jumper, A-B

Ref Fig 2-4a

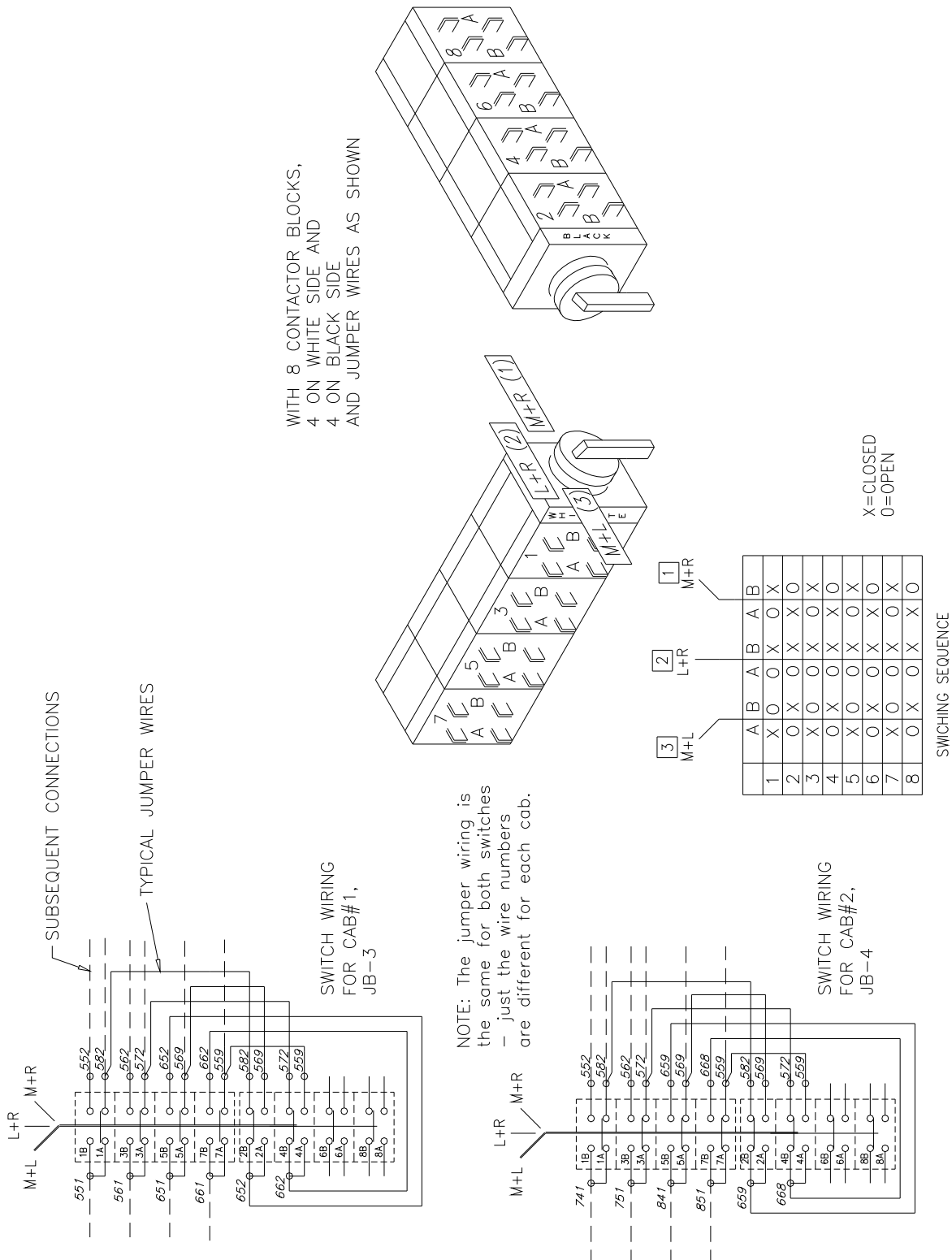


FIGURE 2-4a

HOIST MODE SW ASSEMBLY

Figure 2-4a

A123107

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123063	1	Switch, 3-Way
2	A121091-2	4	Contact Block For Push/Pull Switch

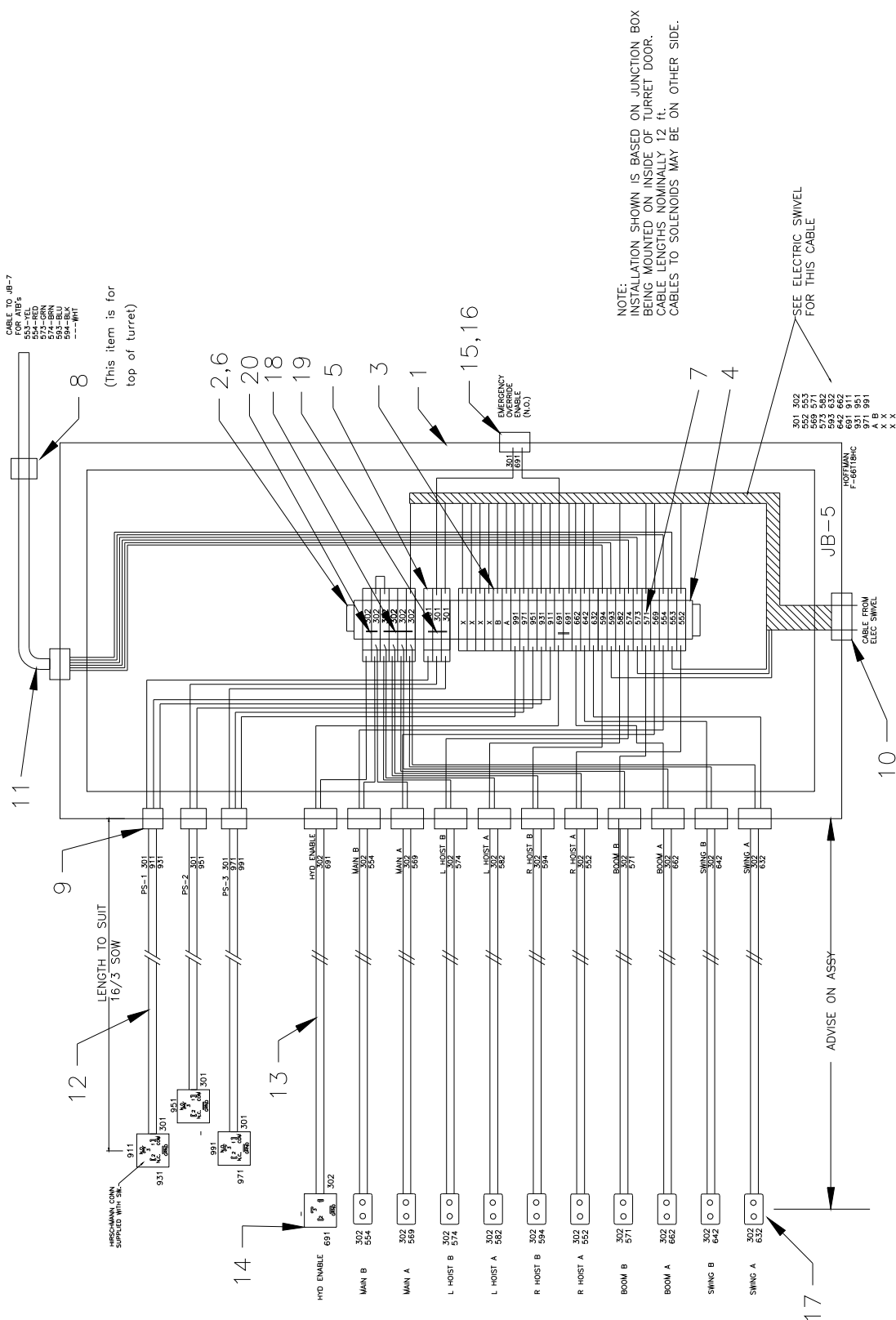


FIGURE 2-5

JUNCTION BOX 5 ASSEMBLY

Figure 2-5 **A123095** **Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123089	1	Enclosure
2	RM02821	10	Din Rail
3	A122763	7	Terminal Block
4	A122740	2	Terminal Block End Anchor
5	A122735	24	Terminal Block
6	A102210	2	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
7	A122828	4	Terminal Marker
8	A122437	3	Connector, Skintite, 1/2 Npt, 1/2" Dia
9	A121751	14	Strain Relief, 3/8" Npt
10	A120593	1	Connector, 3/4 Npt P/L
11	RM00387	84	Wire, 7 Conductor, Arctic Flex
12	RM00416-48	3	Cable, 16-3 (Sow) 300V Black
13	RM00417-96	11	Cable, 16-2 (Sow)
14	A192604	1	Connectors, Field Wired Din
15	A123109	1	Contact Blk
16	A123128	1	Switch, Push Button, Blk, Flush
17	A123129	10	Amp Connector Kit, 2 Pin
18	A122765	1	Terminal Block Jumper, 4 Pole
19	A123105	1	Terminal Block Jumper, 3 Pole
20	A123106	2	Jumper, A-B

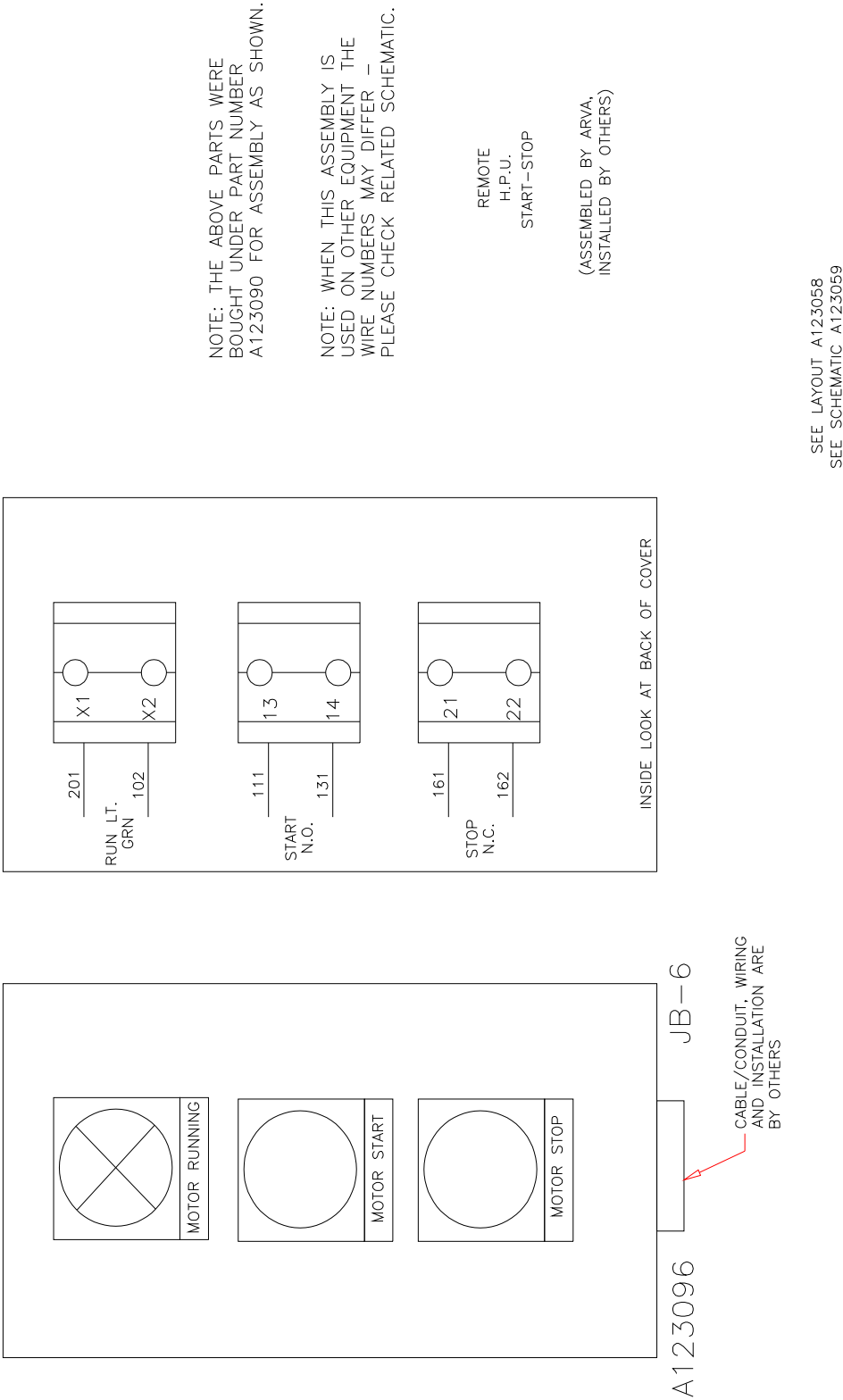
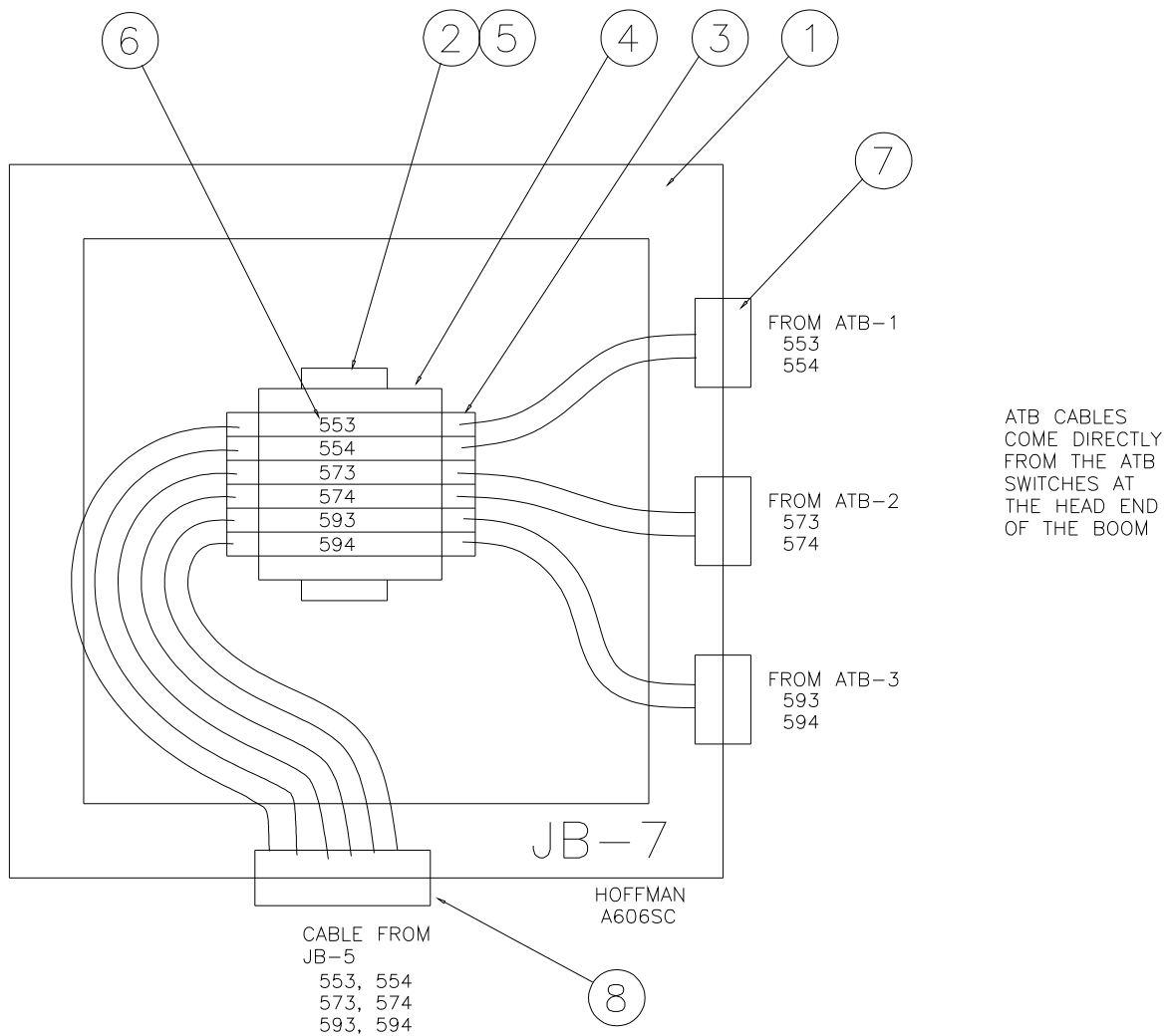


FIGURE 2-6

JUNCTION BOX 6 ASSEMBLY**Figure 2-6****A123096****Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123182	1	Enclosure
2	A123183	1	Plate
3	A123184	1	Plate
4	A123185	1	Plate
5	A123186	1	E-Stop
6	A123187	1	Push Button
7	A123188	1	Contact Block
8	A123189	1	Pilot Light, Green
9	A123190	1	Light Module, Green



SEE LAYOUT A123058
SEE SCHEMATIC A123059

FIGURE 2-7

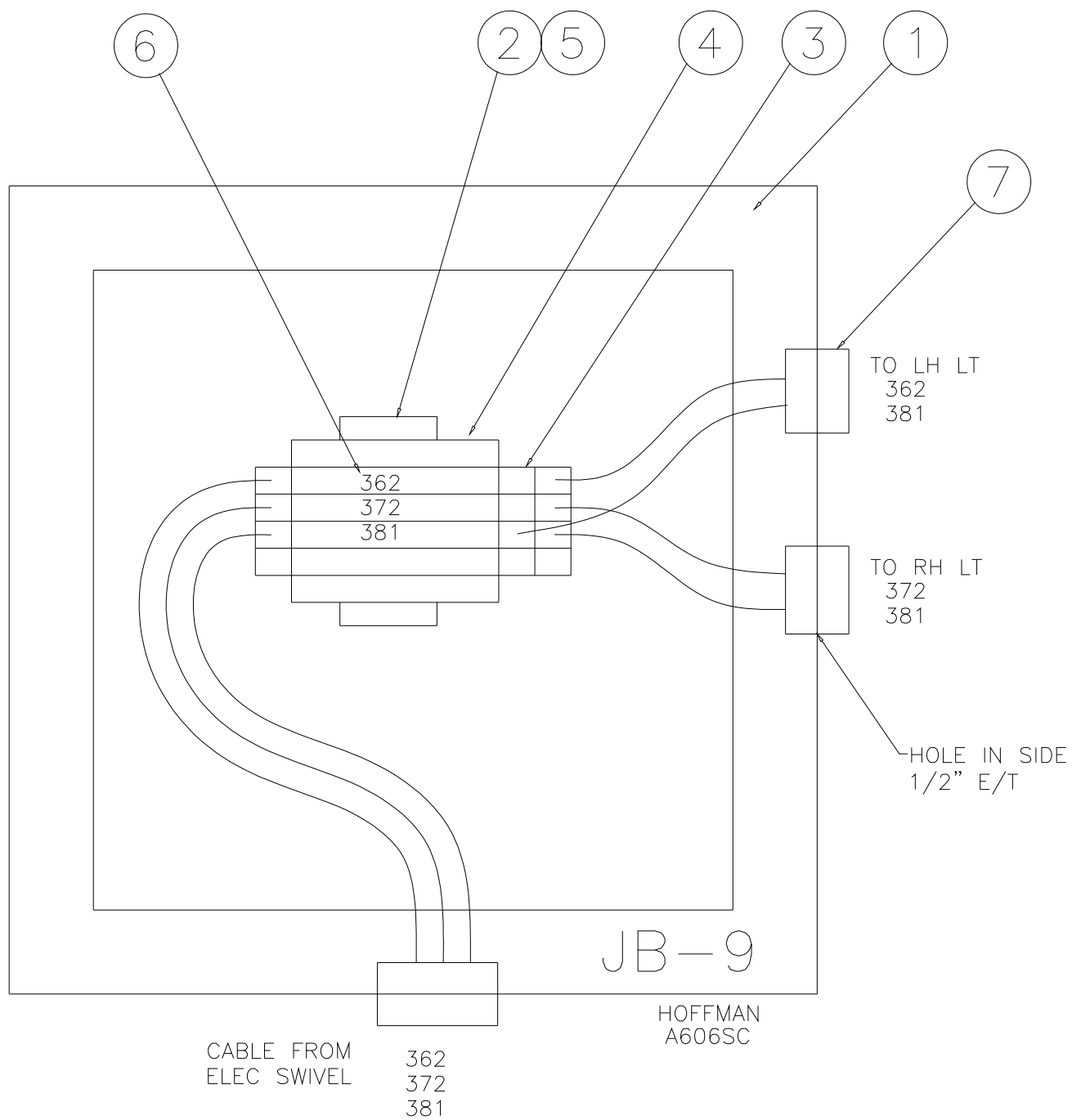
JUNCTION BOX 7 ASSEMBLY

Figure 2-8

A123097

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123086	1	Junction Box
2	RM02821	4	Din Rail
3	A122763	6	Terminal Block
4	A122740	2	Terminal Block End Anchor
5	A102210	2	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
6	A122828	4	Terminal Marker
7	A122438	3	Connector, Skintite
8	A122437	1	Connector, Skintite



SEE LAYOUT A123058
SEE SCHEMATIC A123059

FIGURE 2-9

JUNCTION BOX 9 ASSEMBLY**Figure 2-9****A123099****Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123086	1	Junction Box
2	RM02821	4	Din Rail
3	A122763	4	Terminal Block
4	A122740	2	Terminal Block End Anchor
5	A102210	2	Screw, #10-32 X 3/8 Mach Rnd Hd Slot
6	A122828	4	Terminal Marker
7	A122437	3	Connector, Skintite

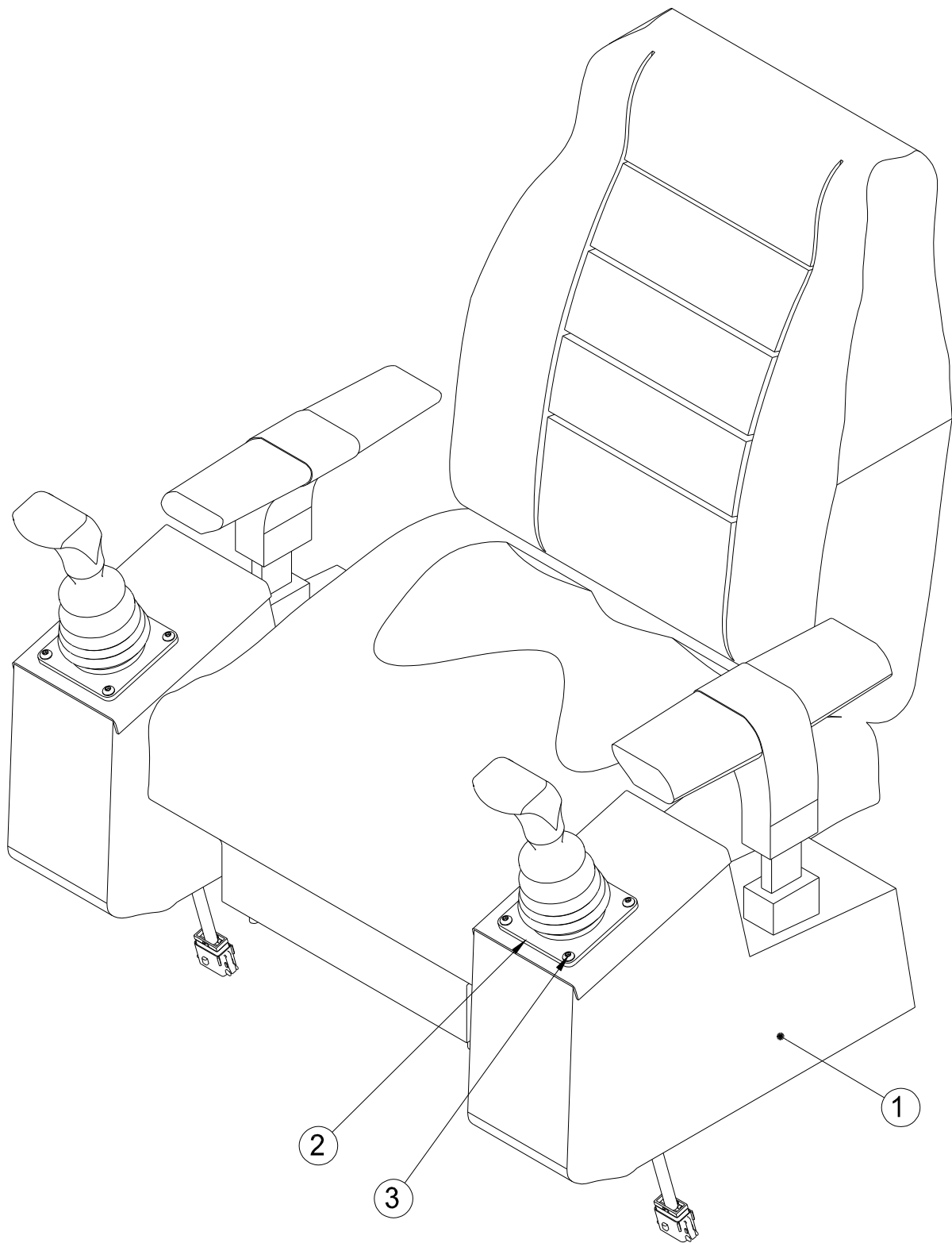


FIGURE 2-10

SEAT AND CONTROL ASSEMBLY

Figure 2-10

A171981

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171982	1	Seat Modification
2	A123073	2	Joystick Control Assembly
3	FS00099	8	Screw, 1/4-20Nc X 3/4 (Button Hd Cap)
4	A102700	8	Nut-Lock, 1/4-20Nc Gr5
5	A172049	1	Decal, Rh Joystick
6	A172050	1	Decal, Lh Joystick
7	A172060	1	Swivel Assembly, Seat Base
8	A103001H	4	Washer, 5/16" (Flat)
9	A102740H	4	Nut-Nylock, 5/16-18Nc Gr5

Ref Fig 2-10a

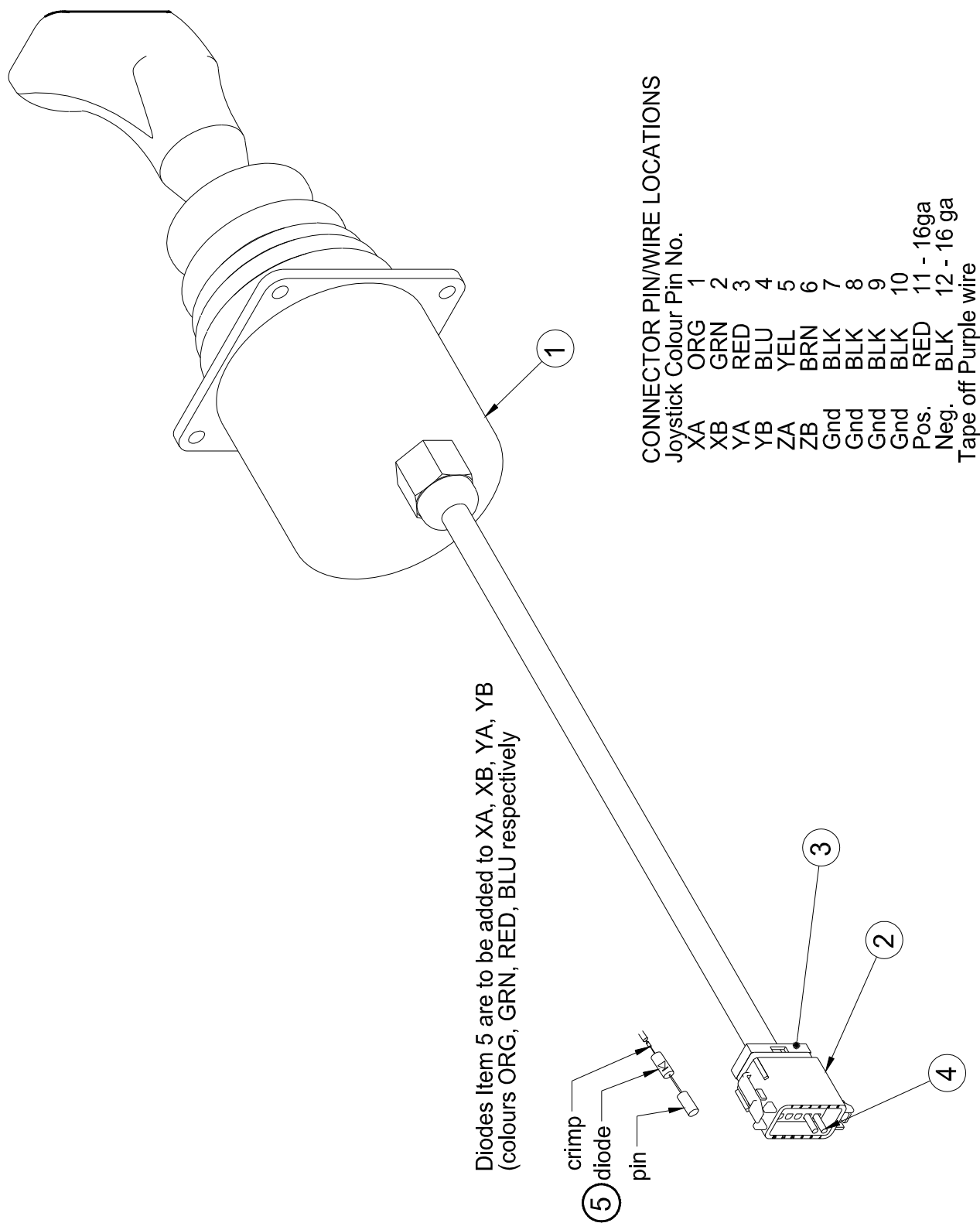


FIGURE 2-10a

JOYSTICK CONTROL ASSEMBLY

Figure 2-10a

A123073

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123071	1	Joystick
2	A121823	1	Connector, 12 Pos Deu Pin
3	A121824	1	Wedge, 12 Pos Deu Pin
4	A121756	12	Pin, Contact18-16 Ga
5	A120796	4	Diode

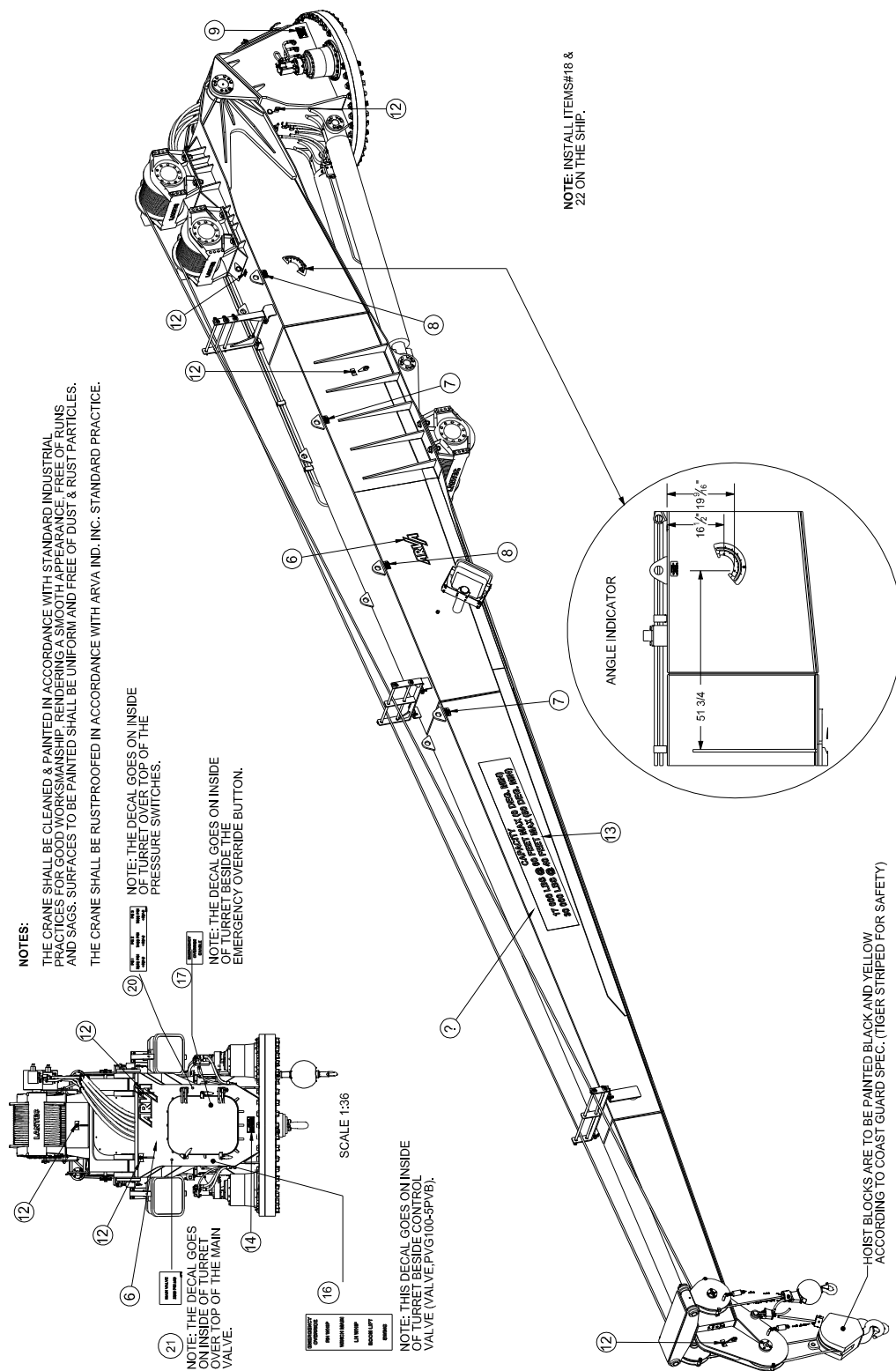


FIGURE 3

PAINT AND DECAL INSTALLATION

Figure 3

A172043

Drawing Rev C

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171777	15	Primer, Zinc Rich, Moisture Cure Urethane
2	A171778	17	Paint, Mid Coat Polymide-Epoxy Intergard 345
3	A171779	19	Paint, Enamel, Acrylic Urethane, Gloss,
4	A171780	0	Paint, Black Interthane 990
5	A171781	0	Paint, Yellow Interthane 990
6	A156813	3	Decal, Arva Logo
7	A172045	4	Decal, Lifting Lug (8000 Lbs)
8	A172046	4	Decal, Lifting Lug (12000 Lbs)
9	A158775	2	Decal, Address Arva
10	A167453	1	Boom Angle Indicator Right
11	A167454	1	Indicator, Boom Angle Left
12	A172047	10	Decal, Safety Loop
13			
14	A172052	2	Decal, Capacity
15	A168025	1	Decal, Serial Plate
16	A172154	1	Decal, Emergency Override
17	A172155	1	Decal, Emergency Override Enable
18	A172048	4	Decal. Cap. Chart - Ar16520M
19	A172240	2	Decal, Auxiliary Winch Capacities
20	A172241	1	Decal, Pressure Switches
21	A172242	1	Decal, Main Valve
22	A172231	2	Decal, Operation Instructions

SPARE PARTS

PART NUMBER	DESCRIPTION	QUANTITY	ASSEMBLY
A115220	SEAL KIT, BRAKE-SWING	1	A115062
A115221	SEAL KIT, SWING MOTOR	1	A115063
A115190	SEAL KIT, SWING DRIVE	1	A115102
A172182	FILTER ELEMENT, RETURN OIL	1	A115103
A115107-1	COIL, VALVE PVG100-PWM	1	A115107
A115193	SEAL KIT, LIFT CYLINDER	1	A115110
H00851-14A	HOSE ASSEMBLY 3/8"	2	A115118
H00851-22A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-23A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-25A	HOSE ASSEMBLY 3/8"	2	A115118
H00851-29A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-32A	HOSE ASSEMBLY 3/8"	2	A115118
H00851-33A	HOSE ASSEMBLY 3/8"	1	A115118
H00851-36A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-22A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-38A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-40A	HOSE ASSEMBLY 3/8"	1	A115118
H00853-45A	HOSE ASSEMBLY 3/8"	1	A115118
H00888-25A	HOSE ASSEMBLY 1/2"	2	A115118
H00888-29A	HOSE ASSEMBLY 1/2"	1	A115118
H00888-30A	HOSE ASSEMBLY 1/2"	1	A115118
H00902-29A	HOSE ASSEMBLY 3/4"	1	A115118
H00902-31A	HOSE ASSEMBLY 3/4"	2	A115118
H00906-29A	HOSE ASSEMBLY 3/4"	1	A115118
H00906-36A	HOSE ASSEMBLY 3/4"	2	A115118
H15679-29A	HOSE ASSEMBLY 1"	7	A115118
H15679-32A	HOSE ASSEMBLY 1"	1	A115118
H16569-38A	HOSE ASSEMBLY 3/8"	1	A115118
H16736-54A	HOSE ASSEMBLY 1-1/4"	1	A115118
H16764-43A	HOSE ASSEMBLY 1"	3	A115118
H16764-50A	HOSE ASSEMBLY 1"	3	A115118
H16766-27A	HOSE ASSEMBLY 1-1/2"	1	A115118
H16768-36A	HOSE ASSEMBLY 1/2"	2	A115118
H00851-165A	HOSE ASSEMBLY 3/8"	1	A115118/A171602
H00900-165A	HOSE ASSEMBLY 3/4"	1	A115118/A171602
H16763-165A	HOSE ASSEMBLY 1-1/4"	1	A115118/A171602
A111137	VALVE, SHUTTLE 6SAE (GRESEN)	1	A115158
H00883-18A	HOSE ASSEMBLY 1/2"	1	A115161
A123068-1	PRESSURE SWITCH, 2050 +50/-0 PSI	1	A115163
A123068-2	PRESSURE SWITCH, 2400 +50/-0 PSI	1	A115163
A123068-3	PRESSURE SWITCH, 2800 +50/-0 PSI	1	A115163
A123057	BULB, LAMP, 400W METAL HALIDE	2	A123056
A123082	FUSE ATQR.5 (600V 050A)	2	A123091
A123101	RELAY 3PDT, A-B 700HF33Z24	2	A123091
A123104	FUSE, 6 AMP	2	A123092
A123126	RELAY, SQUARE BASE 24 VOLT	2	A123092
A123110	BUTTON, PILOT PUSH, GREEN	1	A123093/A123094

SPARE PARTS

PART NUMBER	DESCRIPTION	QUANTITY	ASSEMBLY
A123111	BUTTON, PILOT PUSH, RED	1	A123093/A123094
A123115	LED, OP, RED	2	A123093/A123094
A123116	LED, OP, GREEN	2	A123093/A123094
A123117	LED, OP, AMBER	2	A123093/A123094
A123118	PUSH-PULL TWIST, PALM TYPE E-STOP	1	A123093/A123094
H16767-165A	HOSE ASSEMBLY 1-1/2"	1	A171602
A115111	VALVE, C.B., 60GPM	2	A171635
A123073	JOYSTICK CONTROL ASSEMBLY	1	A171981
A171925	ROPE, WIRE, 7/8" X 420', WR 7/8 19 X 19 RRL DYPAC-CC	1	A172002
A171926	ROPE, WIRE, 3/4" X 330', WR 3/4 19 X 7 IWRC RRL	2	A172002
H15503-15A	HOSE ASSEMBLY 1/4"	3	A172002
H15503-20.5	HOSE ASSEMBLY 1/4"	3	A172002
H15503-27A	HOSE ASSEMBLY 1/4"	3	A172002
A123070	ATB SWITCH C/W 85 FT CORD	1	A172031
A172213	SPRING, 5" .2070 WIRE DIA STAINLESS STEEL	2	A172079/A172091
A121116	LIMIT SWITCH (COMPLETE WITH ARM)	1	A172176

