



ARVA MODEL PE48M CRANE

TECHNICAL ORDER NUMBER;



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

Serial Number
1831-A171660

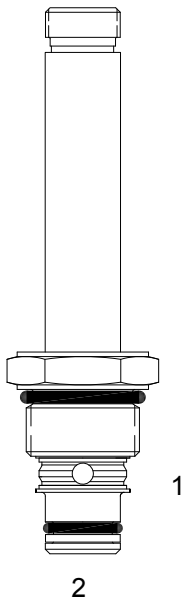
SO. 09070

ARVA INDUSTRIES INC.

Manual No. A172908 Book 1 of 1

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PB-S2C PILOT OPERATED POPPET, 2 WAY NORMALLY OPEN



DESCRIPTION

8 size, 3/4-16 thread, "Power" series, solenoid operated, 2 way normally open, pilot operated poppet valve with free reverse flow energized.

OPERATION

When de-energized the PB-S2C allows flow from (1) to (2) and restricted flow from (2) to (1). When energized the valve blocks flow from (1) to (2) and allows flow from (2) to (1).

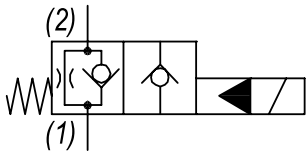
OPERATION OF MANUAL OVERRIDE OPTION: to override, turn the manual override screw clockwise. To release turn the manual override screw counterclockwise.

FEATURES

- Hardened parts for long life.
- Efficient wet-armature construction.
- Cartridges are voltage interchangeable.
- Manual override option.
- Industry common cavity.
- Unitized, molded coil design.
- Continuous duty rated solenoid.
- Optional coil voltages and terminations.
- Optional "I" Coil: Weatherproof, Thermal Shock, Immersion Safe.

**** Used this valve instead of ARVA supplied v/v referenced in dwg A115241, page SP.10; and found in schematics Page 7.2 and Page 7.3.**

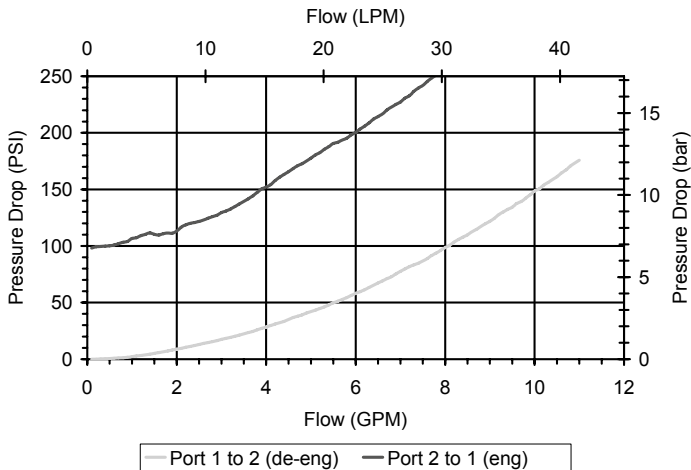
HYDRAULIC SYMBOL



Unshifted limit 10 GPM (38 LPM) from (1) to (2) when deenergized. For shifted flow performance consult chart.

PERFORMANCE

Actual Test Data (Cartridge Only)



VALVE SPECIFICATIONS

Nominal Flow	10 GPM (38 LPM)
Rated Operating Pressure	3500 PSI (241 bar)
Typical Internal Leakage (150 SSU)	0-5 drops/min
Viscosity Range	36 to 3000 SSU (3 to 647 cSt)
Filtration	ISO 18/16/13
Media Operating Temp. Range	-40° to 250°F (-40° to 120°C)
Weight	.22 lbs (.10 kg)
Operating Fluid Media	General Purpose Hydraulic Fluid
Cartridge Torque Requirements	25 ft-lbs (34 Nm)
Coil Nut Torque Requirements	4-6 ft-lbs (5.4-8.1 Nm)
Cavity	POWER 2W
Cavity Tools Kit	
(form tool, reamer, tap)	40500005
Seal Kit	21191100

WARNING: the specifications/application data shown in our catalogs and data sheets are intended only as a general guide for the product described (herein). Any specific application should not be undertaken without independent study, evaluation, and testing for suitability.

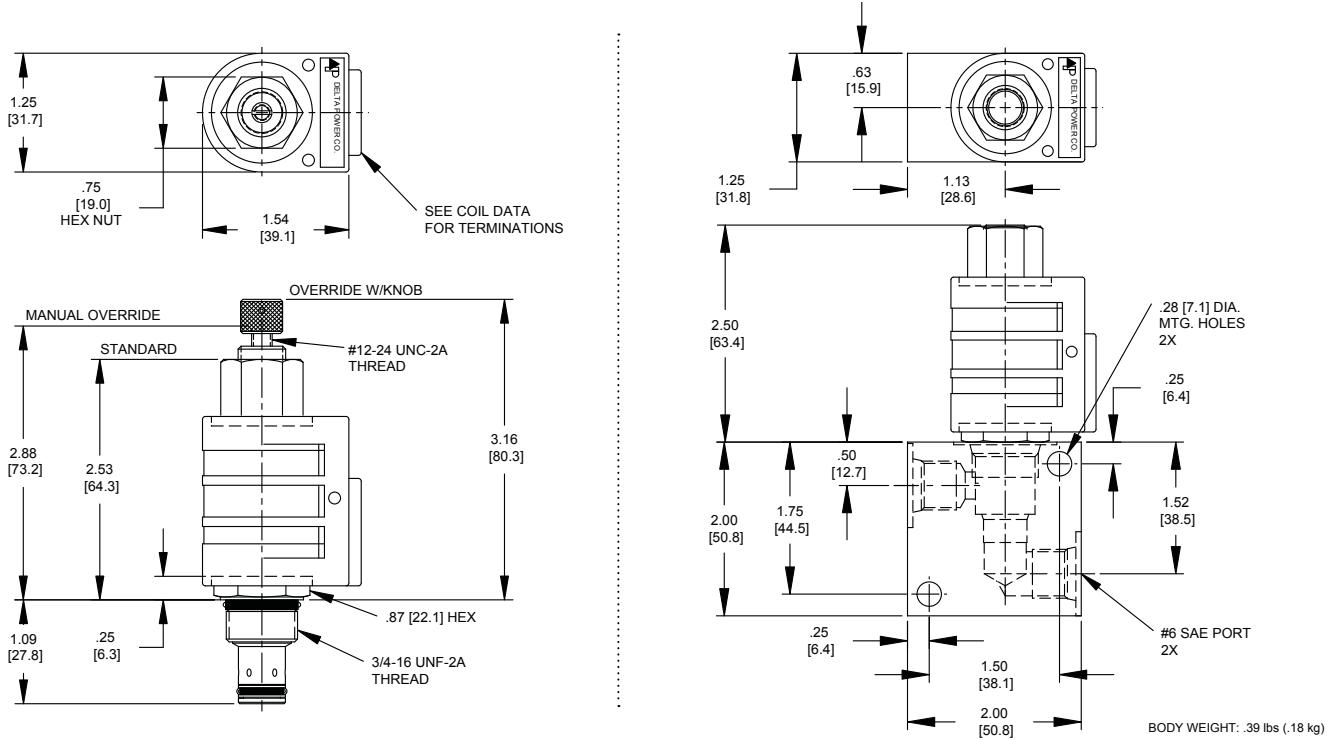


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DIMENSIONS



ORDERING INFORMATION

Approximate Coil Weight: .42 lbs (.19 kg)

PB-S2C

OPTIONS

Buna Standard	00
Viton Standard	V0
Buna, Override, Detent	0M
Viton, Override, Detent	VM
Buna, Override, Knob	0K
Viton, Override, Knob	VK
Buna, Screen	A0
Viton, Screen	W0
Buna, Screen, Override	B2
Viton, Screen, Override	V2
Buna, Screen, Override, Knob	B5
Viton, Screen, Override, Knob	V5

Note: use screen only if flow direction is from (1) to (2)

"P" COIL TERMINATION

(All DC Except as Noted)

DL Double Lead
DT Deutsch on Leads DT04-2P
ML Metri-Pack on Leads
PL Packard on Leads
WL Weatherpack on Leads

SS Single Spade
DS Double Spade
HC DIN 43650 (Hirschmann) - (AC&DC)
CL Conduit Lead - (AC Only)
DI Deutsch - Integral DT04-2P

BODIES

Blank Without Body
N 1/4 NPTF Ports
S #6 SAE Ports

VOLTAGE

06 6 VDC
12 12 VDC
24 24 VDC
36 36 VDC
48 48 VDC
25 24 VAC
11 120 VAC
22 220 VAC
44 440 VAC

IMMERSION PROOF "P" TYPE

IA "I" Coil AMP Superseal - Integral
ID "I" Coil Deutsch - Integral DT04-2P
IJ "I" Coil AMP Jr. Timer - Integral
IM "I" Coil Metri-Pack - Integral

W 18 / 2017

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New soft start installed October 7, 2019. Parameters changed to match the old starter programming are shown below. All other parameters left at the factory settings. Dip Switch 8 was also switched to the on position.

Parameter	Description	Set value
P000	Access to parameters (this resets to 0 each time the power is cycled)	5
P102	Acceleration ramp time	20
P104	Deceleration ramp time	0
P110	Current limitation (%)	150
P202	Type of control	1
P206	Auto reset time	3
P219	Parameterization via keypad	1
P220	Local/Remote supply selection	3
P263	Input DL1 function	1
P264	Input DL2 function	1
P265	Input DL3 function	1
P277	Relay R1 function	6
P278	Relay R2 function	1
P295	Nominal current	7
P313	Serial communication error action	0
P400	Motor nominal voltage	440
P401	Motor current setting	89
P406	Service factor	1.15
P520	Voltage pulse at start	1
P521	Pulse time at start	.2
P522	Voltage pulse level at start (%)	70
P620	RST phase sequence (would not start with factory setting)	0

Parameters that were not options on the last soft starter, I left them all at the factory default setting

Parameter	Description	Factory set values
P105	End deceleration voltage	30
P111	Current limitation of soft starter	150
P112	Time for current ramp	20
P207	Auto reset	0
P502	DC braking (no value could be entered on last software)	30
P510	Jog	0
P511	Jog level	30
P621	E77 enabling	1
P622	SSW short circuit	0

SSW-07 / SSW-08 Quick Parameter Reference

Referência Rápida de los Parámetros SSW-07 / SSW-08

Referência Rápida dos Parâmetros SSW-07 / SSW-08

10000506541 / 02
Software V1.5X

Par.	English	Español	Português	Factory Setting
P000	Access to parameters 0 to 9999	Acceso a los parámetros 0 a 9999	Acesso aos parâmetros 0 a 9999	0 (5)
P001	READ ONLY PARAMETERS P001 to P099	PARÁMETROS DE LECTURA P001 a P099	PARÁMETROS DE LEITURA P001 a P099	
P001	Motor current %In of SSW-07/SSW-08 0.0 to 999.9 %	Corriente del motor %In de alimentación 0.0 a 999.9 %	Corrente do motor %In da SSW-07/SSW-08 0.0 a 999.9 %	-
P002	Motor current %In of Motor 0.0 to 999.9 %	Corriente del motor %In del Motor 0.0 a 999.9 %	Corrente do motor %In do Motor 0.0 a 999.9 %	-
P003	Motor current 0.0 to 6553 A	Corriente del motor 0.0 a 6553 A	Corrente do motor 0.0 a 6553 A	-
P005	Power supply frequency 0.0 to 99.9 Hz	Frecuencia de la red de alimentación 0.0 a 99.9 Hz	Frequência da rede de alimentação 0.0 a 99.9 Hz	-
P006	Soft-Starter Status 0 = rdy - ready 2 = Ex - Error 3 = rUP - Ramp Up 5 = PASS - By-pass 7 = rdo - Ramp Down 8 = br - Braking 9 = rV - FWD/REV 10 = JoG - Jog 11 = dly - Delay P630 12 = G.dl - General Disable	Estado del Arrancador Suave 0 = rdy - ready 2 = Ex - Error 3 = rUP - Ramp p 5 = PASS - By-pass 7 = rdo - Ramp Down 8 = br - Braking 9 = rV - FWD/REV 10 = JoG - Jog 11 = dly - Delay P630 12 = G.dl - General Disable	Estado da Soft-Starter 0 = rdy - ready 2 = Ex - Error 3 = rUP - Ramp p 5 = PASS - By-pass 7 = rdo - Ramp Down 8 = br - Braking 9 = rV - FWD/REV 10 = JoG - Jog 11 = dly - Delay P630 12 = G.dl - General Disable	-
P007	Voltage imposed by the Soft-Starter over the load (%Un) 0 to 100 %	Tensión impuesta por el Arrancador sobre la carga (%Un) 0 a 100 %	Tensão imposta pela chave sobre a carga (%Un) 0 a 100 %	-
P011	Apparent output power 0.0 to 999.9 kVA	Potencia aparente de salida 0.0 a 999.9 kVA	Potência aparente de saída 0.0 a 999.9 kVA	-
P012	D11 to D13 status 0 = Inactive 1 = Active	Estado D11 a D13 0 = Inactiva 1 = Activa	Estado D11 a D13 0 = Inativa 1 = Ativa	-
P013	Relay RL1 and RL2 output status 0 = Inactive 1 = Active	Estado de las salidas a relé RL1 y RL2 0 = Inactiva 1 = Activa	Estado das saídas a relé RL1 e RL2 0 = Inativa 1 = Ativa	-
P014	Last fault occurred E00 to E77	Ultimo error ocurrido E00 a E77	Ultimo erro ocorrido E00 a E77	0
P015	Second fault occurred E00 to E77	Segundo error ocurrido E00 a E77	Segundo erro ocorrido E00 a E77	0
P016	Third fault occurred E00 to E77	Tercero error ocurrido E00 a E77	Tercero erro ocorrido E00 a E77	0
P017	Fourth fault occurred E00 to E77	Cuarto error ocurrido E00 a E77	Quarto erro ocorrido E00 a E77	0
P020	Actual Fault 0...99	Actual Error 0...99	Erro Atual 0...99	-
P023	Software version	Versión de software	Versão de software	-
P030	Phase R current 0.0 to 6553 A	Corriente de la fase R 0.0 a 6553 A	Corrente da fase R 0.0 a 6553 A	-
P031	Phase S current 0.0 to 6553 A	Corriente de la fase S 0.0 a 6553 A	Corrente da fase S 0.0 a 6553 A	-
P032	Phase T current 0.0 to 6553 A	Corriente de la fase T 0.0 a 6553 A	Corrente da fase T 0.0 a 6553 A	-
P050	Motor thermal protection status 0 to 250 %	Estado de la protección térmica del motor 0 a 250 %	Estado da proteção térmica do motor 0 a 250 %	-
P081	Heatsink temperature 10.0 to 110.0 °C	Temperatura del disipador 10.0 a 110.0 °C	Temperatura do dissipador 10.0 a 110.0 °C	-
P090	CAN Controller Status 0 = Inactive 1 = Autobaud 2 = Active CAN Interface 3 = Warning 4 = Error passive 5 = Bus off 6 = No Bus Power	Estado del controlador CAN 0 = Inactivo 1 = Autobaud 2 = Active CAN 3 = Warning 4 = Error pasivo 5 = Bus off 6 = No alimentación	Estado controlador CAN 0 = Inativo 1 = Autobaud 2 = Active CAN 3 = Warning 4 = Error passivo 5 = Bus off 6 = Não alimentado	-
P091	DeviceNet Network Status 0 = Offline 1 = Online, Not Connected 2 = Online, Connected 3 = Expire Connection 4 = Connection Failure 5 = Auto-Baud	Estado Rede DeviceNet 0 = Offline 1 = OnLine, No conectado 2 = OnLine, Conectado 3 = Conexión Caduco 4 = Falha Conexión 5 = Auto-Baud	Estado Rede DeviceNet 0 = Offline 1 = OnLine, Não conectado 2 = OnLine, Conectado 3 = Conexão Expirou 4 = Falha Conexão 5 = Auto-Baud	-
P092	DeviceNet Master Status 0 = Run 1 = Idle	Estado Maestro DeviceNet 0 = Run 1 = Idle	Estado Mestre DeviceNet 0 = Run 1 = Idle	-
P093	Received CAN Telegram Counter 0 to 9999	Telegramas CAN RX 0 a 9999	Telegramas CAN RX 0 a 9999	-
P094	Transmitted CAN Telegram Counter 0 to 9999	Telegramas CAN TX 0 a 9999	Telegramas CAN TX 0 a 9999	-
P095	Bus Off Error Counter 0 to 9999	Contador de Bus Off 0 a 9999	Contador de Bus Off 0 a 9999	-
P096	Lost CAN Message Counter 0 to 9999	Mensajes CAN perdidos 0 a 9999	Mensagens CAN perdidas 0 a 9999	-
	REGULATION PARAMETERS P100 to P199	PARÁMETROS DE REGULACION P100 a P199	PARÁMETROS DE REGULAÇÃO P100 a P199	
P101 ^(a)	Initial voltage (%Un) 30 to 90 %	Tensión inicial (%Un) 30 a 90 %	Tensão inicial (%Un) 30 a 90 %	50
P102 ^(a)	Acceleration ramp time 1 to 999 s	Tiempo de la rampa de aceleración 1 a 999 s	Tempo da rampa de aceleração 1 a 999 s	20
P103	Deceleration Voltage Step (% Un) 100 = Inactive 99...60	Escalaón de tensión en la desaceleración (%Un) 100 = Inactiva 99...60	Degrau de tensão na desaceleração (% Un) 100 = Inativa 99...60	100
P104 ^(a)	Deceleration ramp time 0=Inactive 1 to 240 s	Tiempo de la rampa de desaceleración 0 = Inactiva 1 a 240 s	Tempo da rampa de desaceleração 0 = Inativa 1 a 240 s	0
P105	End Deceleration Voltage (% Un) 30...55	Tensión Final de Desaceleración (% Un) 30...55	Tensão Final de Desaceleração (% Un) 30...55	30
	Current Limitation	Limitación de Corriente	Limitação de Corrente	
P110 ^(a)	Current limitation (%In of the Soft-Starter) 30 to 500 %	Limitación de corriente (%In del Arrancador Suave) 30 a 500 %	Limitação de corrente (%In da Soft-Starter) 30 a 500 %	300
P111	Initial Current for Current Ramp (%In of the Soft- Starter) 30...500	Corriente Inicial para Rampa de Corriente (% In del Arrancador Suave) 30...500	Corrente Inicial para Rampa de Corrente (% In da Soft- Starter) 30...500	150

Par.	English	Español	Português	Factory Setting
P112	Time for the Current Ramp (% of P102) 1...99	Tiempo para Rampa de Corriente (% de P102) 1...99	Tempo para Rampa de Corrente (% de P102) 1...99	20
	CONFIGURATION PARAMETERS P200 to P299	PARÁMETROS DE CONFIGURACION P200 a P299	PARÁMETROS DE CONFIGURAÇÃO P200 a P299	
	Generic Parameters	Parámetros Genéricos	Parâmetros Genéricos	
P200	The password is 0 = Inactive 1 = Active	La clave esta 0 = Inactiva 1 = Activa	A senha está 0 = Inativa 1 = Ativa	1
P202	Type of Control 0=Voltage Ramp 1=Current Limit 2=Pump Control 3=No Function 4=Current Ramp 5=Direct Online (DOL)	Tipo de Control 0=Rampa de tensión 1=Limitación de corriente 2=Control de bombas 3=Sin Función 4=Rampa de Corriente 5=Partida directa (DOL)	Tipo de Controle 0=Rampa de tensão 1=Limitação de corrente 2=Controle de bombas 3=Sem função 4=Rampa de corrente 5=Partida direta (DOL)	0
P203	Fan Control 0 = Fan is always OFF 1 = Fan is always ON 2 = Fan controlled by software	Control del ventilador 0 = Ventilador siempre apagado 1 = Ventilador siempre encendido 2 = Ventilador controlado por el software	Controle do ventilador 0 = Ventilador sempre desligado 1 = Ventilador sempre ligado 2 = Ventilador controlado por software	2
P204 ^(a)	Load parameters with factory default values 0 = No function 1 = Sin función 2 = No function 3 = Sin función 4 = No function 5 = Loads factory default values	Carga parámetros con valor padrón de fábrica 0 = Sin función 1 = Sin función 2 = Sin función 3 = Sin función 4 = Sin función 5 = Carga padrón de fábrica	Carrega parâmetros com padrão de fábrica 0 = Sem função 1 = Sem função 2 = Sem função 3 = Sem função 4 = Sem função 5 = Carrega padrão de fábrica	0
P205	Reading parameter selection 0 to 999	Selección del parámetro de lectura 0 a 999	Seleção do parâmetro de leitura 0 a 999	1
P206	Auto-reset time 3 to 1200 s	Tiempo de autoreset 3 a 1200 s	Tempo de Auto-Reset 3 a 1200 s	900
P207 ^(a)	Auto-reset 0 = Inactive 1 = Active	Autoreset 0 = Inactivo 1 = Activo	Auto-Reset 0 = Inativo 1 = Ativo	0
P215 ^(a)	Copy function 0 = Inactive 1 = SSW → Keypad 2 = Keypad → SSW	Función copy 0 = Inactiva 1 = SSW → HMI 2 = HMI → SSW	Função copy 0 = Inativa 1 = SSW → HMI 2 = HMI → SSW	0
P219	Parameterization via Keypad / (Trim pots and DIP Switch) 0=Trim pots and DIP Switch 1=Keypad 2=P202-2 / Trim pots and DIP	Parametrización via HMI / (Trim pots y DIP Switch) 0=Trim pots y DIP Switch 1=HMI 2=P202-2 / Trim pots y DIP	Parametrização via HMI / (Trim pots e DIP Switch) 0=Trim pots e DIP Switch 1=HMI 2=P202-2 / Trim pots e DIP	0
	Local/Remote Definition	Definición de Local/Remoto	Definição de Local/Remoto	
P220 ^(a)	Local/remote supply selection 0 = Always local 1 = Always remote 2 = Keypad (local default) 3 = Keypad (remote default) 4 = D11 to D13 5 = Serial (local default) 6 = Serial (remote default) 7 = Fieldbus (Default Local) 8 = Fieldbus (Default Remote)	Selección de la fuente local/ remoto 0 = Siempre local 1 = Siempre remoto 2 = HMI (default local) 3 = HMI (default remoto) 4 = D11 a D13 5 = Serial (default local) 6 = Serial (default remoto) 7 = Fieldbus (Default Local) 8 = Fieldbus (Default Remoto)	Seleção da fonte local/ remoto 0 = Sempre local 1 = Sempre remoto 2 = HMI (default local) 3 = HMI (default remoto) 4 = D11 a D13 5 = Serial (default local) 6 = Serial (default remoto) 7 = Fieldbus (Default Local) 8 = Fieldbus (Default Remoto)	3
P229 ^(a)	Command selection - local situation 0 = Keypad 1 = Digital Input Dix 2 = Serial 3 = Fieldbus	Selección de los comandos - situación local 0 = HMI 1 = Borne 2 = Serial 3 = Fieldbus	Seleção de comandos - situação local 0 = HMI 1 = Borne 2 = Serial 3 = Fieldbus	0
P230 ^(a)	Command selection - remote situation 0 = Keypad 1 = Digital Input Dix 2 = Serial 3 = Fieldbus	Selección de los comandos - situación remoto 0 = HMI 1 = Borne 2 = Serial 3 = Fieldbus	Seleção de comandos - situação remoto 0 = HMI 1 = Borne 2 = Serial 3 = Fieldbus	1
	Digital Inputs	Entradas Digitales	Entradas Digitais	
P263	Digital Input D11 Function 0=No Function 1=Start/Stop (two wires) or Start (three wires) 2=Local/Remote 3=No External Fault 4=FWD/REV 5=Brake Off 6=Reset 7=No Function 8=Jog	Función entrada D11 0=Sin función 1=Start/Stop (dos cables) o Start (tres cables) 2=Local/Remoto 3=Sin error externo 4=Sentido de giro 5=Sin Frenado 6=Reset 7=Sin función 8=Jog	Função entrada D11 0=Sem função 1=Start/Stop (dois fios) ou Start (três fios) 2=Local/Remoto 3=Sem erro externo 4=Sentido de giro 5=Sem frenagem 6=Reset 7=Sem função 8=Jog	1
P264	Digital Input D12 Function 0=No Function 1=Stop (three wires) 2=Local/Remote 3=No External Fault 4=FWD/REV 5=Brake Off 6=Reset 7=Emergency Start 8=Jog	Función entrada D12 0=Sin función 1=Stop (tres cables) 2=Local/Remoto 3=Sin erro externo 4=Sentido de giro 5=Sin Frenado 6=Reset 7=Arranque de Emergencia 8=Jog	Função entrada D12 0=Sem função 1=Stop (três fios) 2=Local/Remoto 3=Sem erro externo 4=Sentido de giro 5=Sem frenagem 6=Reset 7=Partida de emergência 8=Jog	6
P265	Digital Input D13 Function 0=No Function 1=General Enabling 2=Local/Remote 3=No External Fault 4=FWD/REV 5=Brake Off 6=Reset 7=Emergency Start 8=Jog	Función entrada D13 0=Sin función 1=Habilita general 2=Local/Remoto 3=Sin erro externo 4=Sentido de giro 5=Sin Frenado 6=Reset 7=Arranque de Emergencia 8=Jog	Função entrada D13 0=Sem função 1=Habilita geral 2=Local/Remoto 3=Sem erro externo 4=Sentido de giro 5=Sem frenagem 6=Reset 7=Partida de emergência 8=Jog	6
	Relay Outputs	Salidas a Relé	Saídas a Relé	
P277	RL1 Relay Function 0=No Function 1=Running 2=Full Voltage 3=No Function 4=FWD/REV - K1 5=DC-Brake 6=No Fault 7=Fault 8=No Function 9=Serial 13 = Shunt Trip	Función Relé RL1 0=Sin función 1=En Funcionamiento 2=En Tensión Plena 3=Sin función 4=Sentido de giro K1 5=Frenado CC 6=Sin Error 7=Con Error 8=Sin función 9=Serial 13 = Grupo de Erros	Função Relé RL1 0=Sem função 1=Em Funcionamento 2=Em Tensão Plena 3=Sem função 4=Sentido de giro K1 5=Frenagem CC 6=Sem Erro 7=Com Erro 8=Sem função 9=Serial 13 = Grupo de Erros	1
P278	RL2 Relay Function 0=No Function 1=Running 2=Full Voltage 3=No Function 4=FWD/REV - K2 5=DC-Brake 6=No Fault 7=Fault 8=No Function 9=Serial 13 = Shunt Trip	Función Relé RL2 0=Sin función 1=En Funcionamiento 2=En Tensión Plena 3=Sin función 4=Sentido de giro K2 5=Frenado CC 6=Sin Error 7=Con Error 8=Sin función 9=Serial 13 = Grupo de Erros	Função Relé RL2 0=Sem função 1=Em Funcionamento 2=Em Tensão Plena 3=Sem função 4=Sentido de giro K2 5=Frenagem CC 6=Sem Erro 7=Com Erro 8=Sem função 9=Serial 13 = Grupo de Erros	2

Par.	English	Español	Português	Factory Setting
	Soft-Starter Data	Datos del Arrancador Suave	Dados da Soft-Starter	
P295 ⁽¹⁾⁽²⁾	Nominal current 0 = 1.7 A 1 = 17 A 2 = 24 A 3 = 30 A 4 = 45 A 5 = 61 A 6 = 85 A 7 = 130 A 8 = 171 A 9 = 200 A 10 = 255 A 11 = 312 A 12 = 365 A 13 = 412 A	Corriente nominal 0 = 1.7 A 1 = 17 A 2 = 24 A 3 = 30 A 4 = 45 A 5 = 61 A 6 = 85 A 7 = 130 A 8 = 171 A 9 = 200 A 10 = 255 A 11 = 312 A 12 = 365 A 13 = 412 A	Corrente nominal 0 = 1.7 A 1 = 17 A 2 = 24 A 3 = 30 A 4 = 45 A 5 = 61 A 6 = 85 A 7 = 130 A 8 = 171 A 9 = 200 A 10 = 255 A 11 = 312 A 12 = 365 A 13 = 412 A	
	COMMUNICATION PARAMETERS P300 to P399	PARÁMETROS DE COMUNICACIÓN P300 a P399	PARÁMETROS DE COMUNICAÇÃO P300 a P399	
P308 ⁽¹⁾⁽²⁾	Serial Communication Soft-Starter address 1 to 247	Comunicación Serial Dirección del Arrancador Suave 1 a 247	Comunicação Serial Endereço da Soft-Starter 1 a 247	1
P312 ⁽¹⁾⁽²⁾	Type of protocol and serial communication transmission rate 1 = Modbus 9600 bps no parity 2 = Modbus 9600 bps odd parity 3 = Modbus 9600 bps even parity 4 = Modbus 19200 bps no parity 5 = Modbus 19200 bps odd parity 6 = Modbus 19200 bps even parity 7 = Modbus 38400 bps no parity 8 = Modbus 38400 bps odd parity 9 = Modbus 38400 bps even parity	Tipo de protocolo y tasa de transmisión de la comunicación serial 1 = Modbus 9600 bps sin paridad 2 = Modbus 9600 bps impar 3 = Modbus 9600 bps par 4 = Modbus 19200 bps sin paridad 5 = Modbus 19200 bps impar 6 = Modbus 19200 bps par 7 = Modbus 38400 bps sin paridad 8 = Modbus 38400 bps impar 9 = Modbus 38400 bps par	Tipo de protocolo e taxa de transmissão da comunicação serial 1 = Modbus 9600 bps sem paridade 2 = Modbus 9600 bps impar 3 = Modbus 9600 bps par 4 = Modbus 19200 bps sem paridade 5 = Modbus 19200 bps impar 6 = Modbus 19200 bps par 7 = Modbus 38400 bps sem paridade 8 = Modbus 38400 bps impar 9 = Modbus 38400 bps par	1
P313	Serial communication error action (E28) 0 = Inactive 1 = Disable 2 = General disable 3 = Change to local	Acción del error de comunicación serial (E28) 0 = Inactiva 1 = Deshabilita 2 = Deshabilita General 3 = Se va para local	Ação do erro de comunicação serial (E28) 0 = Inativa 1 = Desabilita 2 = Desabilita geral 3 = Vai para local	1
P314 ⁽¹⁾	Serial communication verification time 0 = Inactive 1 to 999 s	Tiempo de verificación de la comunicación serial 0 = Inactiva 1 a 999 s	Tempo de verificação da comunicação serial 0 = Inativa 1 a 999 s	0
P331	Fieldbus Communication CAN Address 0 to 63	Comunicación Fieldbus Dirección CAN 0 a 63	Comunicação Fieldbus Endereço CAN 0 a 63	63
P332	CAN Baud Rate 0 = 125 Kbps 1 = 250 Kbps 2 = 500 Kbps 3 = Autobaud	Tasa Comunicación CAN 0 = 125 Kbps 1 = 250 Kbps 2 = 500 Kbps 3 = Autobaud	Taxa Comunicação CAN 0 = 125 Kbps 1 = 250 Kbps 2 = 500 Kbps 3 = Autobaud	3
P333	Bus Off Reset 0 = Manual 1 = Automatic	Reset de Bus Off 0 = Manual 1 = Automático	Reset de Bus Off 0 = Manual 1 = Automático	0
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P615 ⁽¹⁾	Current imbalance time between phases 0 = Inactive 1 to 99 s	Tiempo de desbalanceo de corriente entre fases 0 = Inactiva 1 a 99 s	Tempo de desbalanceamento de corrente entre fases 0 = Inativa 1 a 99 s	0
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- (1) Changeable parameters only when the motor is disabled.
Solamente se permite modificar el valor del parámetro con el motor parado.
Parâmetros alteráveis somente com motor parado.
- (2) Unchanged parameters at factory default settings (P204=5).
No cambia el valor del parámetro cuando se ejecuta el comando cargar valores padrón de fábrica (P204 = 5).
Parâmetros não alterados no padrão de fábrica (P204 = 5).
- (3) Changeable parameters only in keypad mode (P219=1). If P219=0 the parameters are read only.
Se permite modificar el parámetro solamente en el modo HMI (P219 = 1). Con P219 = 0 los parámetros son considerados del tipo lectura.
Parâmetros alteráveis somente em modo HMI (P219 = 1). Com P219 = 0 os parâmetros são considerados do tipo leitura.

Fault Messages / Mensajes de Error / Mensagens de Erro

	English	Español	Português
E03	Phase loss or undercurrent	Falta de Fase o Subcorriente	Falta de Fase ou Subcorrente
E04	Overtemperature on power	Sobrettemperatura en la potencia	Sobrettemperatura na potência
E05	Overload on motor	Sobrecarga en el motor	Sobrecarga no motor
E06	External fault (DI)	Error externo (DI)	Erro externo (DI)
E10	Function copy fault	Error en la función copy	Erro na função copy
E19	SSW short circuit	Cortocircuito en la SSW	Curto-circuito na SSW
E24	Programming fault	Error de programación	Erro de programação
E28	Timeout fault at telegram reception	Error de timeout en la recepción de los telegramas	Erro de timeout na recepção de telegramas
E31	Keypad connection failure	Fallo en la conexión de la HMI	Falha na conexão da HMI
E62	Current limitation start timeout	Exceso de tiempo de limitación de corriente durante el arranque	Excesso de tempo de limitação de corrente durante a partida
E63	Stall	Rotor bloqueado	Rotor bloqueado
E66	Overcurrent	Sobrecorriente	Sobrecorrente
E67	Inverted phase sequence	Secuencia de fase invertida	Sequência de fase invertida
E70	Undervoltage at electronic supply	Subtensión en la alimentación de la electrónica	Subtensão na alimentação da eletrônica
E71	By-pass contact open	Contacto del By-pass abierto	Contato do By-pass aberto
E72	Overcurrent before By-pass	Sobrecorriente antes del By-pass	Sobrecorrente antes do By-pass
E74	Current imbalance	Desbalanceo de corriente	Desbalanceamento de corrente
E75	Power supply frequency out of allowed range	Frecuencia de la red de alimentación fuera del rango permitido	Frequência da rede de alimentação fora da faixa permitida
E76	Overcurrent before closing By-pass	Subcorriente antes del cierre del By-pass	Subcorrente antes do fechamento do By-pass
E77	Closed by-pass contact or shorted SCR's	Contactor de By-pass cerrado o SCR's en cortocircuito	Contato de By-pass fechado ou SCR's em curto-circuito

To get the detailed description of the parameters, consult the Programming Manual. This manual is supplied in electronic format on CD-ROM and at WEG's web site: www.weg.net
Para obtener la descripción detallada de los parámetros, consulte el Manual de Programación. Este manual es suministrado en formato electrónico en CD-ROM y en la página web de WEG www.weg.net
Para obter a descrição detalhada dos parâmetros, consulte o Manual de Programação. Este manual é fornecido em formato eletrônico no CD-ROM e no site da WEG www.weg.net



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OPERATOR'S MANUAL REVISION LIST

A172908, Originally issued March 2010

# of Hard Copies	# of Operator only small E/F	# of E-Copies	# of Provisional Manuals	LOCATION
1	1	1		Arva Industries
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REVISION

DATE

DESCRIPTION



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.

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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 read 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 PE-48M marine crane is an electro/hydraulic three (3) section, full powered boom crane. It has a rated capacity of 10,000 pounds (4,535 kg) at 30 foot (914 cm) radius. It has a zero degree boom angle with a minimum horizontal reach of 20 feet (609 cm), up to a maximum of 40 feet (1,219 cm). The crane is powered by a 75 Hp motor, coupled to a 47 GPM (178 liters) variable displacement pump, powering the hydraulic functions. Crane controls are armrest mounted joysticks.

CRANE DESCRIPTION

Controls

Crane controls are armrest mounted, pilot pressure controlling joysticks, providing infinitely variable speed and performance.

Boom Telescope

The boom is a three (3) section hydraulically sequenced telescoping boom.

The three (3) boom sections are fabricated utilizing a rectangular box section design. The steel used in fabrication is SAE A-572 grade 50.

The boom extension cylinders are connected in a parallel circuit. They are sequenced by a geared equal displacement flow divider controlled by a single lever. Two (2) feed festoons located between the base and mid sections feed oil to the outer boom cylinder. A pilot operated double holding valve is incorporated in the boom extend/retract circuit.

The boom extension cylinders are sized to permit telescoping with rated load to maximum extension. Replaceable nyatron wear pads are used in each boom section.

Cylinders have holding valves, to hold boom position when functional lever is in its neutral position.

Boom Lift

The boom luffing function is powered by two (2) hydraulic cylinders with a holding valve directly mounted to each cylinder. The boom elevation is variable from 0 to +75 degrees.

Swing

Crane rotation is 360 degrees continuous. A shear type ball swing bearing used for turret rotation is driven by two gerotor type motors mounted on two planetary gear boxes. Function speed is 1 rpm.

The swing bearing is a large diameter 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 base mount plate of the pedestal.

Fail safe hydraulically released spring applied disc brakes are located between the motor and planetary reductions.

Boom Head

The boom head has positions for three (3) sheaves with dead end for single, two, four, or six part reeving.

Winch and Cable

The hoist is mounted on the top back of the boom. Hoist has planetary reduction dynamic braking with an integral disc type holding brake. The winch has 6,000 lb (2,721 kg) single line pull capacity on the top cable layer of the drum. The winch has equal speed up and down, with maximum line speed of 145 fpm (4,419 cm/min) and 450 feet (137 m) of 9/16 inch (14 mm) diameter cable drum capacity. The crane is supplied with 6x26 RRL IWRC cable and a cable follower.

NOTE:
Line Pull may vary due to manufacturer tolerance, oil viscosity, and/or oil temperature.

Hook Block

A 15 ton (15.24 tonne) hook block is supplied with the crane. It has three (3) load sheaves for up to 6 part reeving.

Overhaul Ball

A 5 ton (5.8 tonne) capacity overhaul ball for single part reeving is supplied. It is a non-swivel type hook.

Load Monitor System

The load moment indicating system with warning and anti two block cut-off is incorporated into the crane controls. (See service package section of these manuals and section 3 for more details).

Power Source

The cranes electro/hydraulic power unit is powered via 460 Volt AC, 3 phase, 60 hertz. It provides power through an electrical collector ring which permits 360 degrees continuous rotation and provides a means for low voltage power to access circuits from the crane to the ships communication center. A 75 hp (1800 rpm) motor drives a pressure and flow compensated pump. Pump supplies hydraulic power on demand. The oil reservoir is mounted below the pump. Power unit assembly with return filter, suction screen, breather, and oil level indicator is bolted to the crane turret base.

Hydraulic System

The hydraulic system consists of a pressure compensated load sensing variable displacement pump with a capacity of 47 GPM. Pump is driven by a 75 hp electric motor. The pump supplies oil flow to a directional control valve stack located on the rear of the turret. It provides function and direction for the following; Boom swing, extend/retract, lift, and hoist. The crane may only be operated when attached to an external electrical power source.

Electrical System

The crane electrical control system is 24 volts DC. Main input power is 460 Volt AC. There is an additional emergency start /stop button on the electrical panel, on the side of the electrical control box, which stops the hydraulic pump motor and transformer for 24 volt DC control power.

WARNING:

ELECTRICAL PANEL HAS DUAL VOLTAGE.

DIMENSIONAL DATA**PE-48M Marine Crane**

Working Radius:	
Crane	4'-0" to 40'-0" (1.22 m to 12.2 m)
Height:	
Boom Horizontal, measure from bottom of pedestal to top of hoist	119" (0.3 m)
Length:	
Boom Horizontal Retracted	21' 0 (6.4 m)"
Boom Horizontal Extended	42' 5" (13 m)
Width: (Boom Horz. & Retracted)	102" (2.6 m)
Swing:	360° Continuous

PERFORMANCE DATA**PE-48M Marine Crane**

Boom Angle:	0 deg. to +75 deg.
Boom Luffing Time: Up (0 deg to +70)	26 sec.
Down (+70 deg to 0)	20 sec.
Swing 90°:	
Left	1 rpm
Right	1 rpm

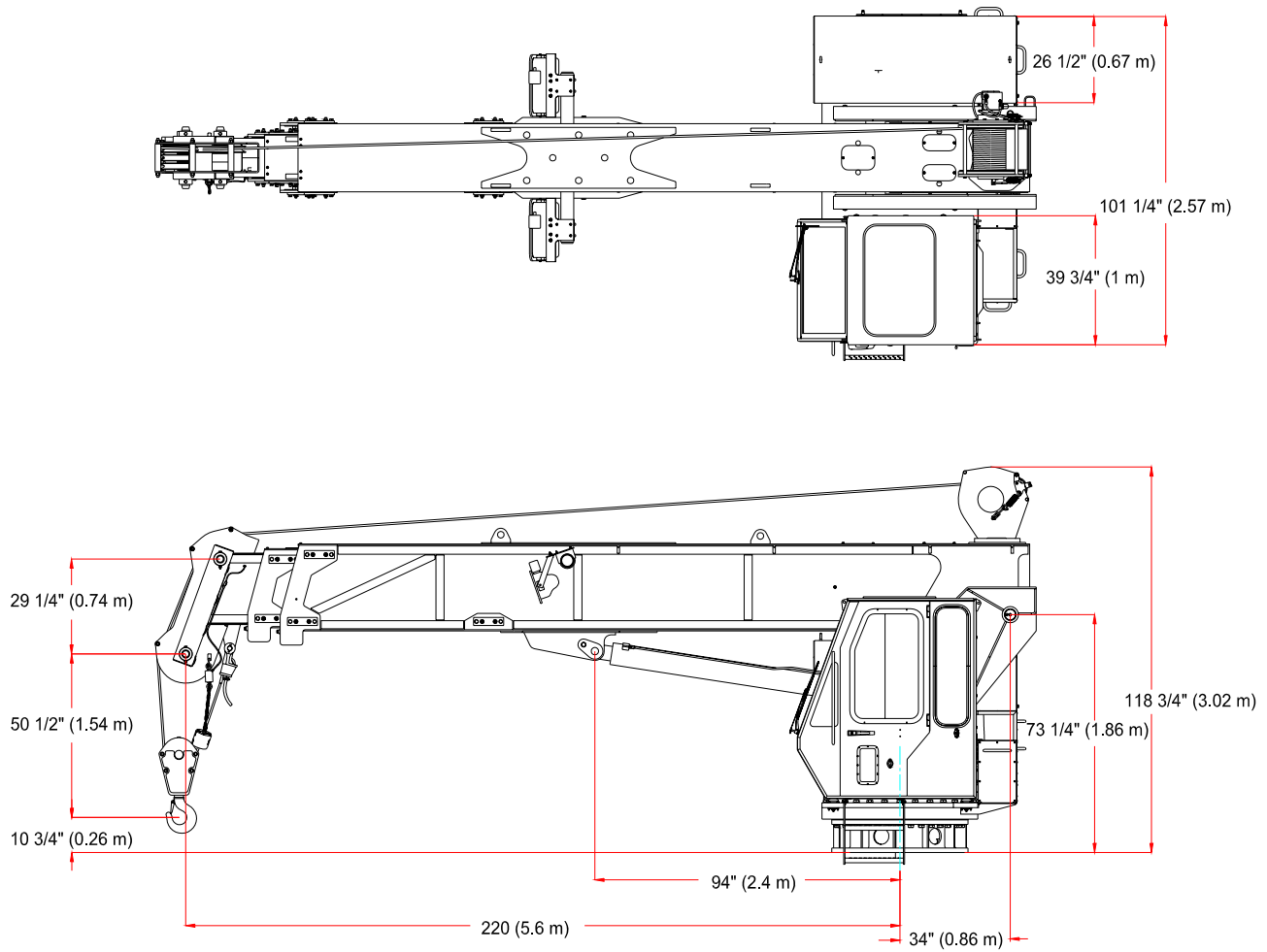
Hoist Speed @ 6 part reeve: 30 ft (9.14 m)	
Up	- 28 fpm (853 cm/min)
Dn	- 28 fpm (853 cm/min)

See capacity chart for rated line pull.

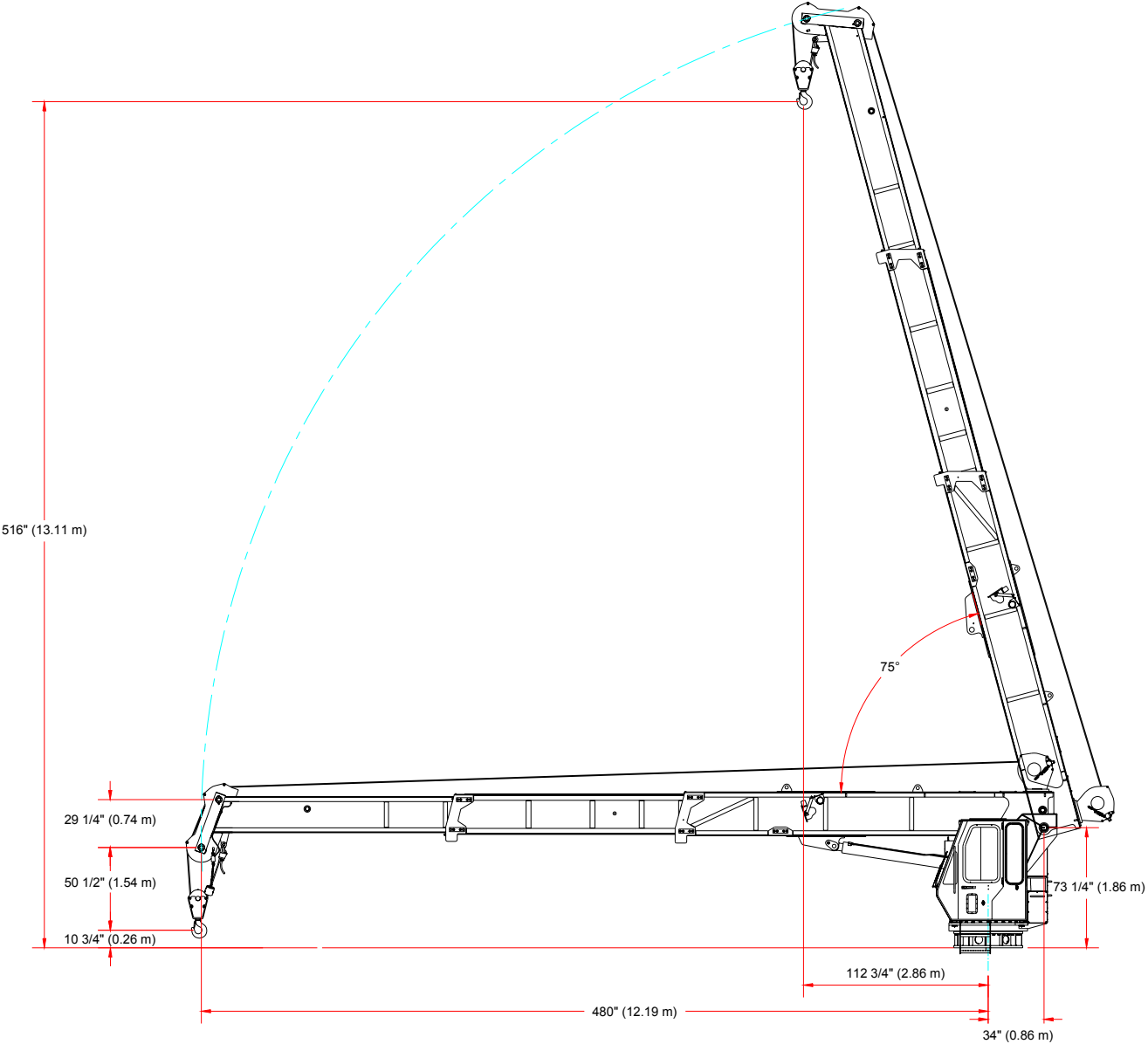
COMPONENT WEIGHTS

Pedestal Assembly:		- 9,240 lbs (4,191 kg)
Boom Assembly: (with hoist and cables& less hook block)		- 10,579 lbs (4,798 kg)
Boom Lift Cylinders: (each)		- 500 lbs (227 kg)
Main Hoist:		- 510 lbs (231 kg)
Hook Block:		- 346 lbs (157 kg)
Overhaul Ball:(each)		- 60 lbs (27 kg)
Boom Extension Retract Cylinders:	Top	- 450 lbs (204 kg)
	Bottom	- 450 lbs (204 kg)
Total Weight at Shipping:		- 19,819 lbs (8,990 kg)

CONFIGURATION



CONFIGURATION



CAPACITY CHART

CAPACITY CHART - ARVA Model PE48M

Serial No 1831-A171660

LOAD RADIUS		RETRACTED		50% EXTEND		100% EXTEND	
Ft.	M.	21.2 ft. lb.	6.46M Kg.	32.0 ft. lb.	9.75M Kg.	42.8 ft. lb.	13.05M Kg.
4	1.2	30,000	13,600	-	-	-	-
6	1.8	30,000	13,600	-	-	-	-
8	2.4	30,000	13,600	30,000	15,680	-	-
10	3.0	30,000	13,600	29,350	13,350	27,900	12,690
12	3.7	27,400	12,400	25,500	11,610	24,200	10,990
14	4.3	23,800	10,800	22,550	10,250	21,300	9,680
16	4.9	20,250	9,200	20,100	9,150	19,000	8,640
18	5.5	15,000	6,600	18,100	8,220	17,100	7,780
20	6.1			16,300	7,400	15,550	7,060
22	6.7			14,700	6,650	14,200	6,450
24	7.3			13,150	5,900	13,000	5,900
26	7.9			11,500	5,030	11,950	5,420
28	8.5			9,350	4,250	10,900	4,980
30	9.1					10,000	4,560
32	9.8					9,150	4,160
34	10.4					8,250	3,760
36	11.0					7,300	3,320
38	11.6					6,100	2,790
40	12.2					3,400	1,540

NOTES TO CHART:

- (1) Load system will prohibit lifting at 110% of rated capacity.
- (2) Loads shown are maximum for 100% Rated.
- (3) Single line pull is 6,000 lb. (2727 Kg.)
- (4) Capacities shown are combined line loads - hook, ball, rigging and load handling equipment are to be considered part of the load.
- (5) Capacities shown are based on horizontal deck: trim and list angles may vary the capacity shown and warning/cutoff limits due to change in load radius.



ARVA INDUSTRIES INC.
43 GAYLORD ROAD ST THOMAS ONT. CAN. N5P 3R9

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SECTION 2

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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.

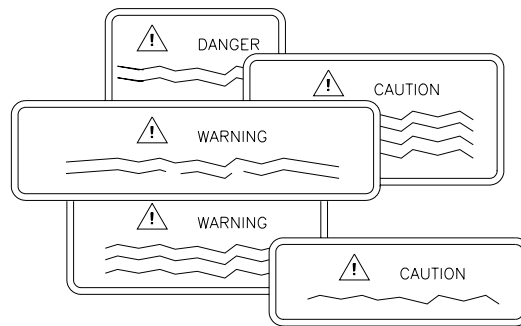
Ensure you and those working with you are aware of any special dangers where you are operating the crane. Be especially careful of dangerous ground and objects, including buildings near the crane.

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.
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.

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

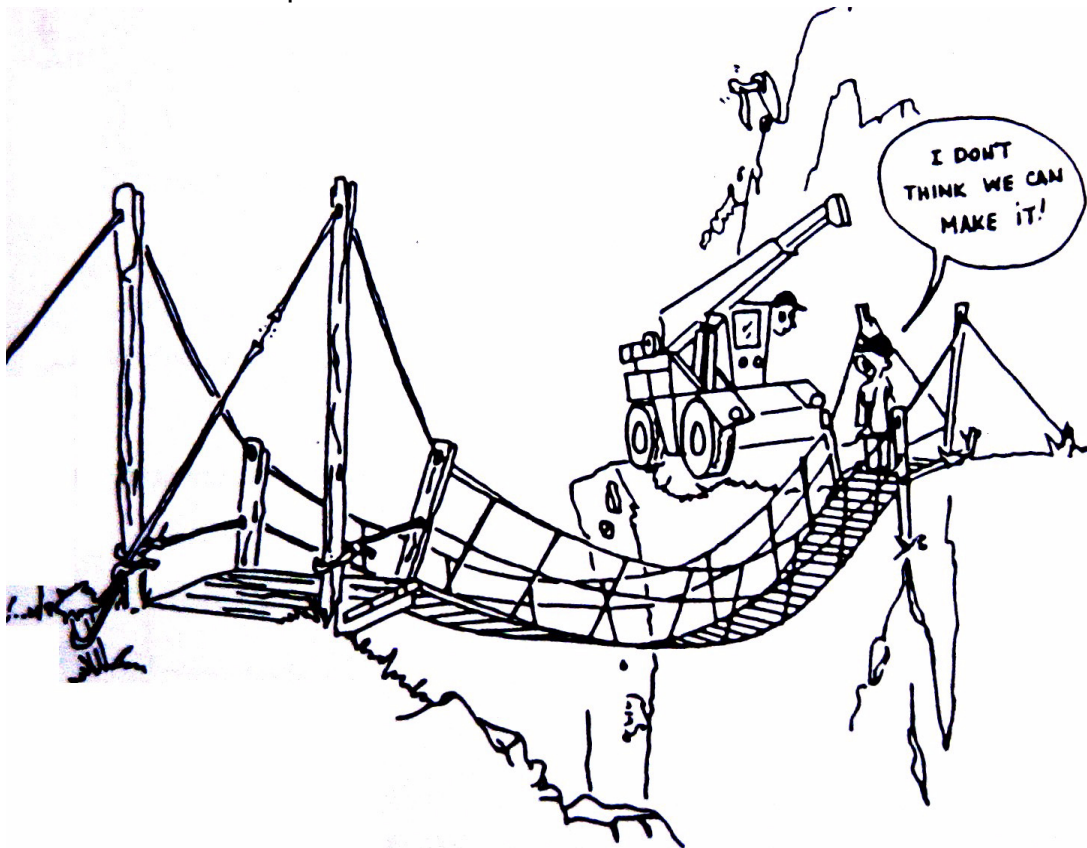
During travel operation, check load limit of bridges. Before travelling across bridges, ensure they will carry a load greater than the machines weight and the decking is suitable for wheel loads.

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 PE-48M Marine crane is electrically driven, hydraulically powered crane.

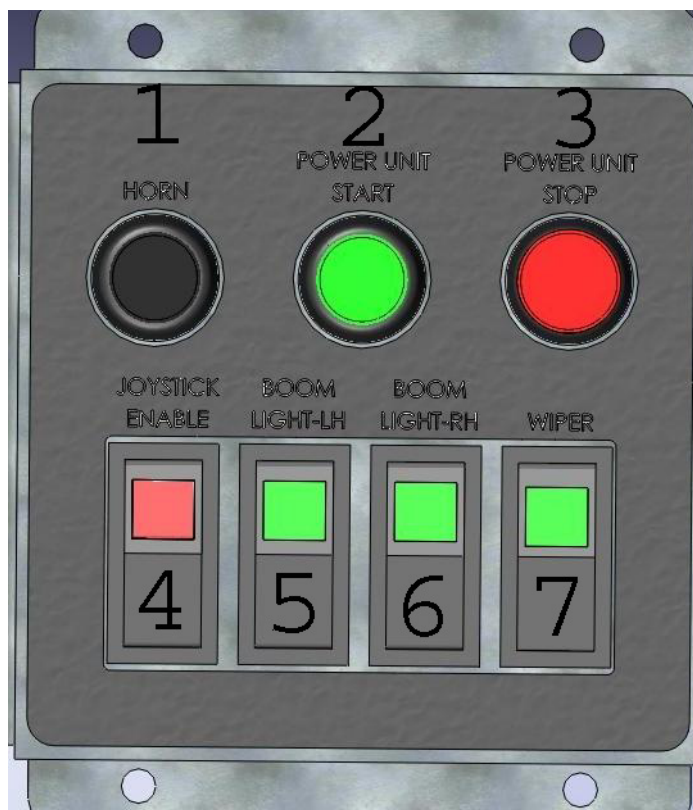
The PE-48M marine crane has a telescoping three (3) section boom, consisting of a rectangular box section design, with replaceable nylatron wear pads used in each boom section.

The boom is controlled through the use of boom lift and extension cylinders. The boom lift cylinders are positioned to give maximum clearance when handling loads with fully retracted boom.

The crane turret is mounted on a shear ball type swing bearing and is powered by two (2) hydraulic gerotor type motor through planetary style gear reducers with internal hydraulically released, spring applied, disk brakes. Swing function is 360 degrees continuous. A Limit switch stops the boom from hitting the structure. Provision to override the switch for rearward boom storage or lifting is provided on the left joystick control.

The crane is operated using seat armrest mounted joystick style controls.

CRANE CONTROLS

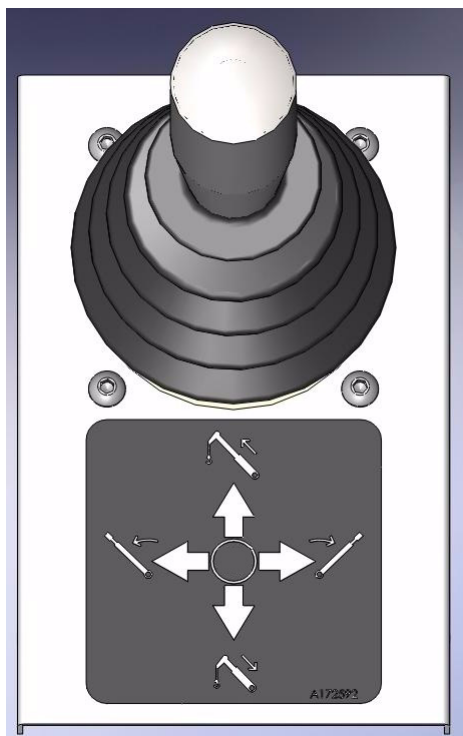


Dash Control Panel

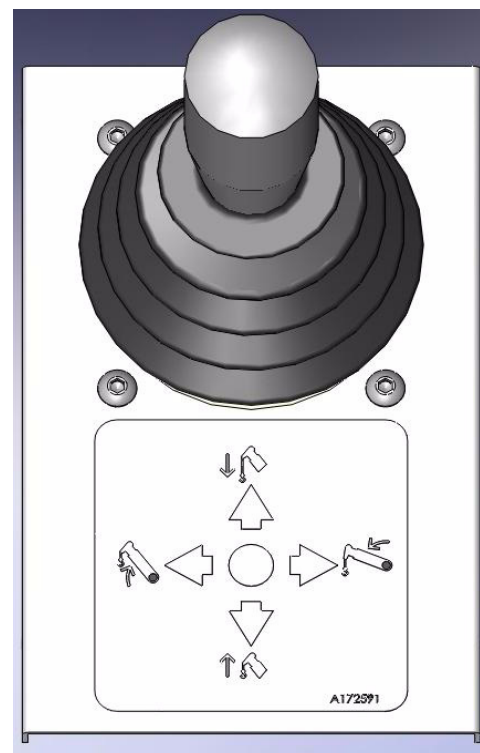
1. **Horn** – Press to activate the horn. The horn will sound until button is released.
2. **Power Unit Start** – Push to start the power unit.
3. **Power Unit Stop** – Push to stop the power unit.
4. **Joystick Enable** – Push Enable the armrest joysticks. Always disengage when joystick operation is not required.

5. **Boom Light LH** – Turns the light on the left hand side of the boom on and off.
6. **Boom Light RH** – Turns the light on the right hand side of the boom on and off.
7. **Wiper** – Used to activate the front window wiper blade.

To STOP crane operation, press the 'Power Unit Stop' button.



Left Armrest Joystick



Right Armrest Joystick

CAUTION

ALWAYS FEATHER CONTROLS FROM ZERO TO MAXIMUM, WHEN INCREASING SPEED OF FUNCTION AND WHEN DECREASING FUNCTION SPEED. DO NOT PERMIT CONTROLS TO SNAP TO NEUTRAL POSITION.

Boom Swing, Extend/Retract, Boom Lift, Hoist

Swing Left/Right – Move the left armrest joystick right to swing the boom in clockwise direction, and move it left to swing the boom in a counter clockwise direction. Push button on top of control will bypass switch cut out solenoid to allow operator to swing past the ship's structure for rear storage and crane operations.

Boom Extend/Retract – Move the left armrest joystick forward to extend the boom, pull it back to retract the boom.

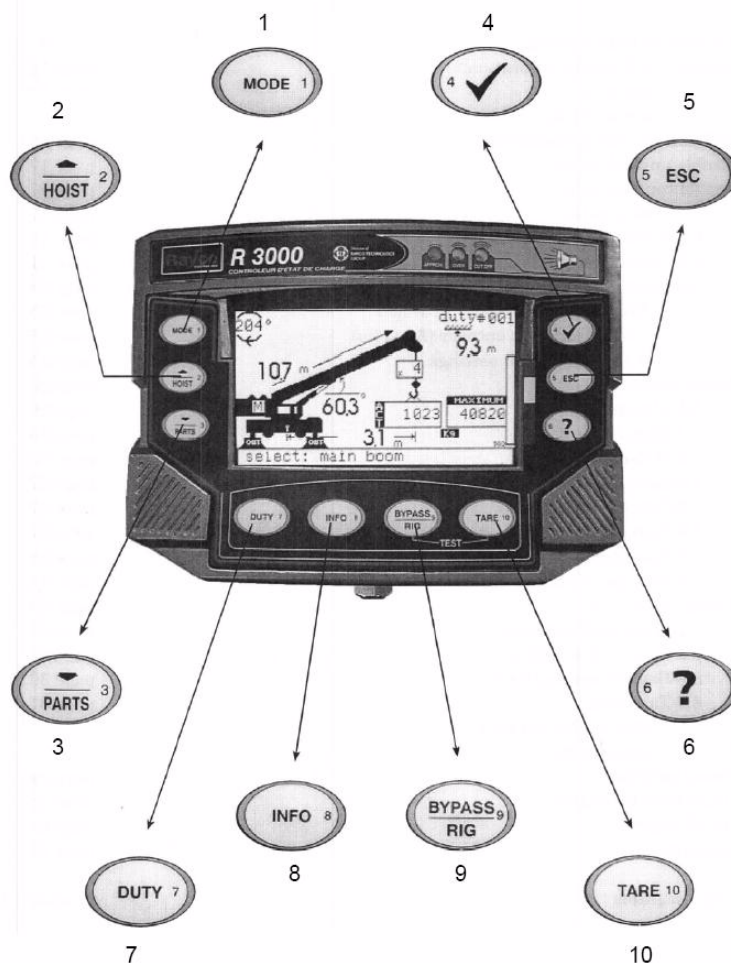
Boom Raise/Lower – Move the right armrest joystick to the left to raise the boom, and move it right to lower the boom.

Hoist Up/Down – Move the right armrest joystick forward to lower the cable, and move it back to raise the cable.

ACCESSORIES

LOAD MONITOR SYSTEM

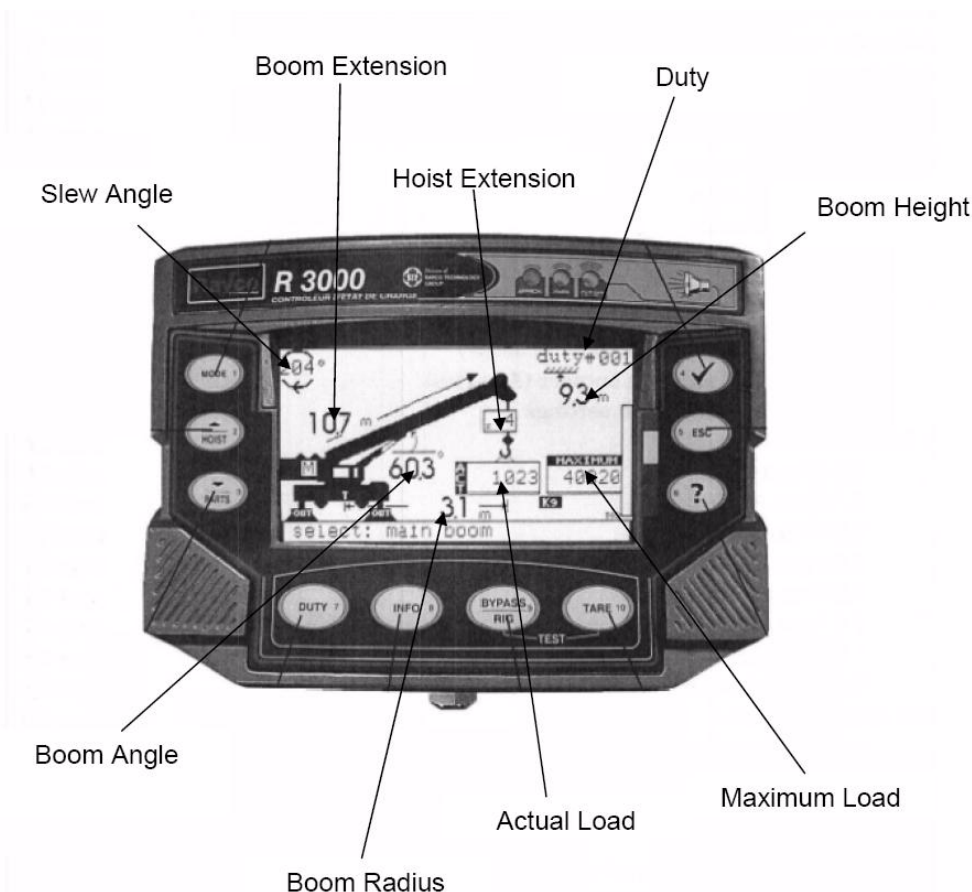
The crane is supplied with a load moment indicator system (RaycoWylie i3000). It consists of two pressure transducer(s) mounted into boom lift cylinders, a boom length indicator, boom angle indicator, boom tip mounted anti-two block switch and the cab mounted display screen (computer). Refer to manual in the service package section of these manuals for more display operation and programming.



1. **MODE:** Allows the user to select a different operating mode (Normal, Limit Setting, System Configuration, Diagnostic, and Calibrations Mode). Normal mode is for regular crane operations.
2. **HOIST/SCROLL UP:** There is only one hoist function of this boom, because there is only one hoist. The scroll function is used in the section of other operations.
3. **PARTS/SCROLL DOWN:** Used to select the number of reeving parts used (from 1 to 6). The scroll function is used in the section of other operations.
4. **SELECTION:** Used to activate a desired selection.
5. **ESCAPE:** Used to cancel a modification or menu option. Press ESC several times to return to Normal Mode.

6. HELP: When a fault occurs, the button can be used to show the fault source and a description.
7. DUTY: Shows the menu selection of duty by number or by crane type.
8. INFO: Shows the information about the crane configuration.
9. BYPASS: When held, it allows a maximum 15 second temporary override of a lock-out.
10. TARE: Will zero the displayed load, or return the actual load.

To reset the system, press the MODE and SELECT button simultaneously.



The screen of the load moment indicator system displays:

"Slew Angle: The crane's measured rotational angle. **(N/A)**

"Boom Extension: The boom's currently measured length.

"Hoist Extension: The hoist's measure extension. **(N/A)**

"Duty: The current duty selected. **(N/A)**

"Boom Height: The calculated height to the top of the boom (uses boom angle and extension).

"Boom Angle: The boom's currently measured elevation angle.

"Boom Radius: The calculated boom radius (uses boom angle and extension).

"Actual Load: The load on the hook block, can be the total load or from a tare point.

"Maximum Load: The determined maximum load based on the radius and load chart.

ANTI-TWO BLOCK

The Arva Model PE-48M Marine Crane is equipped with an anti-two block switch and weight assembly.

It is pre-assembled on the crane prior to shipping. The theory is to prevent sheave block from contacting the boom sheave, by means of a weighted switch. When the weight is lifted via contact with the hook block, the switch will disconnect causing the crane hoist up, boom extend, and boom down functions to stop.

With anti-two block switch activated, the hoist may be lowered, which can permit the operation of boom luff or extend/retract functions once the hook is no longer contacting the Anti-Two Block weight.



MANUAL ANGLE INDICATOR

There is a visual angle indicator located on the left side near the front of the boom base.

It can be used in the event that the electronic angle indicator is non functional, or as a quick visual reference guide to the operator.

Figure 1 - Visual Angle Indicator

OIL LEVEL INDICATOR

The oil level indicator (1) on the hydraulic oil tank is located on the back of the crane. It is part of the power unit package. The indicator is a thermometer style gauge. The oil fill and vent (2) is located on the top of the tank.



Figure 2 - Oil Level Indicator

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 OR DAMAGE TO CRANE 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 safe of operations. The following checklist items are suggested specifically for the operator's benefit to make certain his 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 sound condition.

1. 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; ensure that it is at the upper 'FULL' mark. Check breather for cleanliness and security.
2. Assure that all components requiring daily lubrication have been serviced (refer to lubrication chart for specified lubricants).
3. 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.
4. Hook block 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.
5. A visual inspection of the machine will allow for inspection for leaks at all valves, cylinders, hydraulic lines and fittings.

VISUAL INSPECTION

1. 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.
2. Look for tags which may indicate that the machine is under repair. Refuse to operate the machine until authorized personnel remove these tags
3. 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;

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.

BOOM LIFT/ LOWER FUNCTION

Check boom lift/lower function raise, lower a minimum of 45 degrees. Is operation smooth?

BOOM TELESCOPE FUNCTION

Check crane extend and retract function, telescope the boom in and out. Is operation smooth?

CAUTION

BE SURE SUFFICIENT SPACE AVAILABLE BEFORE EXTENDING BOOM, DAMAGE TO EQUIPMENT OR PERSONNEL MAY RESULT.

HOIST FUNCTION

Check hoist up and down function. Is operation smooth?

SWING CHECK

Swing CW & CCW function. Is operation smooth?

ANTI TWO-BLOCK

Check that anti two-block is working by bringing hook up and activating Anti-Two Block, the load monitor light should illuminate and the alarm should sound. Check that the hoist up, telescope out and boom down functions are not active.

OVERLOAD CHECK

Check overload system every week with load for proper operation, the load monitor light should illuminate and the alarm should sound.

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.

POWER SOURCE

A 75 HP, 460V AC, motor drives the pressure and flow compensated pump. The pump supplies hydraulic power on demand. The oil reservoir level is below the pump. Power unit assembly with return filter, suction screen and breather is bolted to the crane turret. Electric slip ring assembly, located in swing bearing support structure, for main power supply permits 360 degree continuous swing.

STARTING POWER UNIT

1. Be sure that all safety measures required have been followed (ie, clear area, no obstructions for crane, etc.)
2. Push the 'Power Unit On' button; the power unit will start.
3. Check that the machine functions correspond with operations.

CAUTION

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

4. Push the 'Power Unit Stop' button. Be sure that no functions can be activated with the 'Power Unit Stop' button depressed.

CAUTION

TO AVOID ACCIDENTAL START-UP, ALWAYS ENGAGE THE 'POWER UNIT STOP' BUTTON WHEN POWERING OFF.

NOTE

'Power Unit Stop' may be used as an emergency stop. It will stop the power unit.

FUNCTION CONTROLS

Function and function direction decals are mounted on the front of the controls.

Crane functions are controlled by moving the lever in the direction of indicated by the decal. Function speed increases as lever is moved from the neutral position.

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

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 function is located on the left controller and is marked with swing right and swing left decals. Swing is operated by moving the control lever right for swing right and left for swing left. Function will hold position when lever is in its neutral position.

The momentary push button, located on top of the joystick, will need to be pushed and held if the operator wants to operate the crane in the area of the ship stacks and stern of the ship.

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 control lever is located to the right controller and is marked with Boom up and Boom down decals. The boom lift is operated by moving the control lever left for boom up and right for boom down. Function will hold position when lever is in its neutral position.

TELESCOPING THE BOOM

The boom telescope function is located on the left controller and is marked with extend and retract decals. To extend the boom move the control lever forward, and rearward to retract the boom. The function will hold its position when the lever is in its neutral position.

CAUTION

WHEN EXTENDING BOOM, LET OUT CABLE SIMULTANEOUSLY TO PREVENT TWO-BLOCKING BOOM NOSE AND HOOK BLOCK.

Should “two-blocking” occur, correct the situation immediately by letting out cable or retracting the boom. Anti-two block override may be used when rigging crane.

CAUTION

WHEN RETRACTING BOOM, LOAD WILL LOWER UNLESS CABLE IS TAKEN IN.

LOWERING & RAISING THE CABLE

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/Raising the Cable

To lower/raise the cable, use the control lever on the right controller. To lower the cable, move the lever forward, and rearward to raise the cable. The function will hold its position when the lever is in its neutral position.

ANTI-TWO BLOCK

The anti-two block system supplied with the PE-48M crane consisting of a switch and weight assembly mounted on the nose of the boom, it helps prevent the operator from damaging sheaves and hook block. When the hook block reaches the weight attached to the switch, crane motion will stop and the alarm in the load monitor will sound.

The override switch can be used to lower the hoist and/or retract the boom to correct anti-two blocking.

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 in the crane cab.

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 boom length, angle and radius. If the operator knows the radius required for a specific lift and the tip height necessary, they can calculate the required boom length and angle needed for the lift. The operator then checks the capacity chart for the specific boom length and radius 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 overload occur the crane functions affected will stop hoist up, boom extend and boom lower. When overload occurs the load monitor alarm will sound. Reduce load moment by booming up or retracting boom.

EMERGENCY OPERATING PROCEDURES

(Crane is equipped with 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 back, as necessary. Fittings have orifices to minimize oil loss.
3. While maintaining the boom at this angle, activate swing, telescope in the boom sections, 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.

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. Fully retract all boom sections.
3. Lower boom to maximum lowered position.
4. Ensure all operating controls are stowed in secure location with the key removed.
5. Close and lock, if applicable, covers, and doors.
6. Remove/Disconnect power source

HAND SIGNALS

Before operating the crane, the operator and signal person should be familiar with the following hand signals (see net page) to facilitate in the operation of the machine and to ensure the safety of all personnel.

Ensure that the signal person is in clear view of the crane operator, and a safe distance from the boom, hook block and load.



Use whipline — (Auxiliary hoist). Tap elbow with one hand, then use regular signals.



Raise boom — Arm extended, fingers closed, thumb pointing upward.



Lower boom — Arm extended, fingers closed, thumb pointing downward.



When both arms are free
Arm extended, fingers closed, thumb pointing upward, other arm bent slightly with forefinger pointing down and rotate hand in horizontal circles.



Raise the boom and lower the load

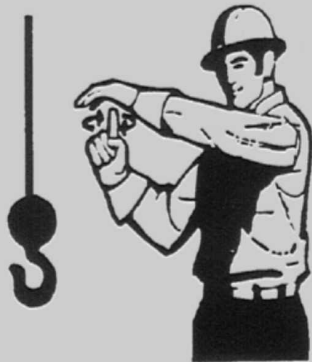
When only one arm is free
With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.



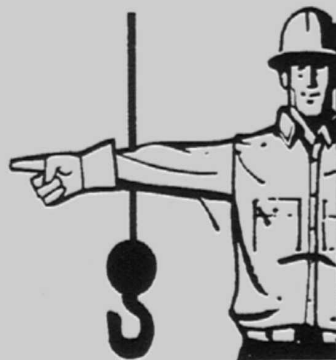
Lower the boom and raise the load

When both arms are free — Arm extended, fingers closed, thumb pointing downward, other arm vertical, forefinger pointing upward and rotate hand in horizontal circles.

When only one arm is free — With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.



Move slowly — Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)



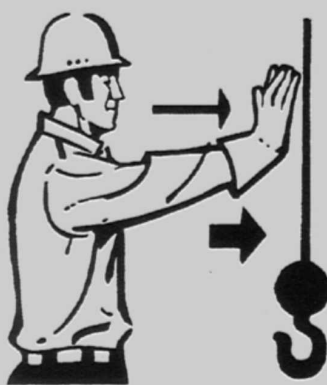
Swing — Arm extended, point with finger in direction of swing of boom.



Extend boom — (Telescoping booms). Both fists in front of body with thumbs pointing outward.



Retract boom — (Telescoping booms). Both fists in front of body with thumbs pointing toward each other.



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



Travel — (Both tracks). Use both fists in front of body, making a circular motion about each other, indicating direction of travel; forward or backward. (For crawler cranes only.)



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



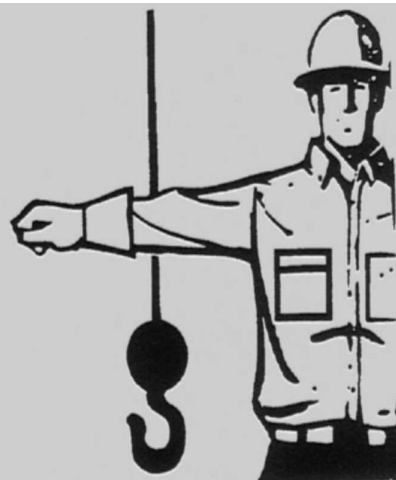
Hoist slowly to clear fouled line — Hands crossed in front, above shoulders, fingers relaxed.



Dog everything — Clasp hands in front of body.



Open clam shell bucket —
Arm extended, palm down,
open hand.



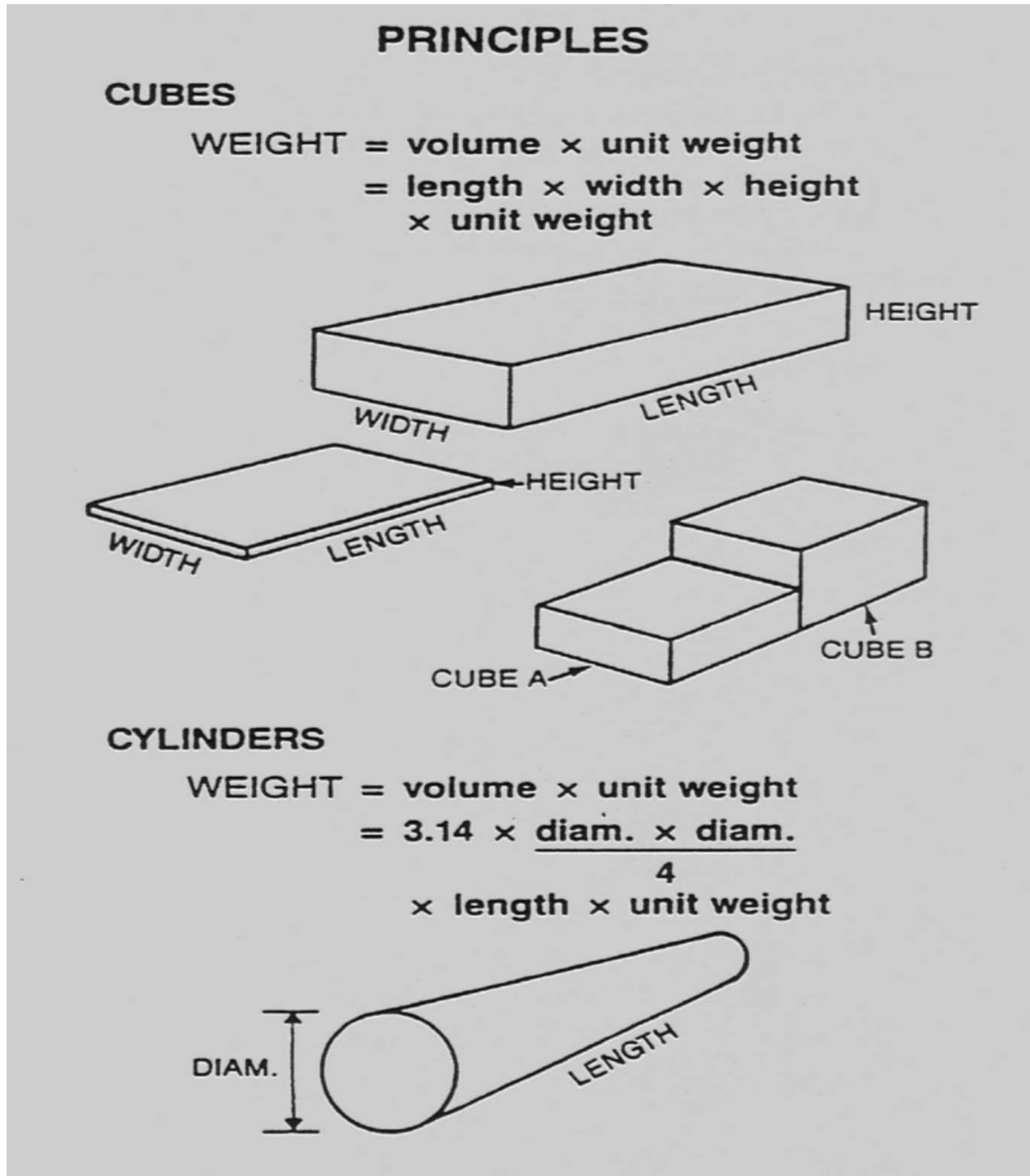
Close clam shell bucket —
Arm extended, palm down,
close hand.



Magnet is disconnected —
Crane operator spreads both
hands apart — palms up.

CALCULATING LOAD

WEIGHTS



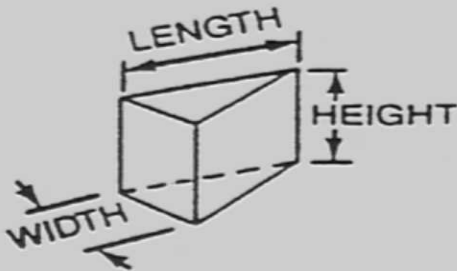
PRINCIPLES (cont.)

ROUND PLATES



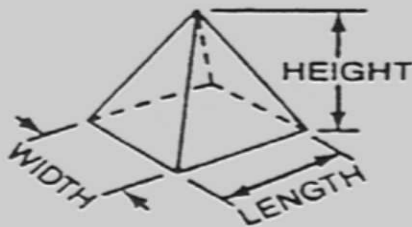
$$\begin{aligned} \text{WEIGHT} &= 3.14 \times \frac{\text{diam.} \times \text{diam.}}{4} \\ &\times \text{thickness} \times \text{unit weight} \end{aligned}$$

WEDGE



$$\begin{aligned} \text{WEIGHT} &= \frac{\text{width} \times \text{length}}{2} \\ &\times \text{height} \times \text{unit weight} \end{aligned}$$

PYRAMID



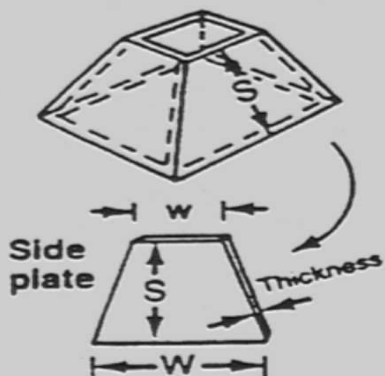
$$\begin{aligned} \text{WEIGHT solid} &= \text{width} \times \text{length} \\ &\times \frac{\text{height}}{3} \times \text{unit weight} \end{aligned}$$



$$\begin{aligned} \text{WEIGHT hollow (without a base)} &= (\text{A} \times \text{width} + \text{B} \times \text{length}) \\ &\times \text{thickness} \times \text{unit weight} \end{aligned}$$

PRINCIPLES (cont.)

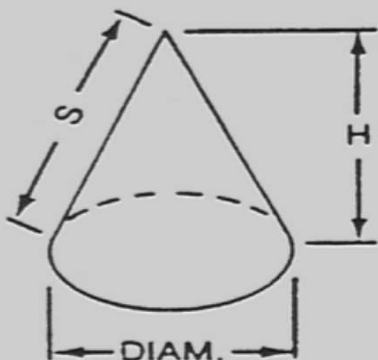
PYRAMID (cont.)



WEIGHT hollow (without a base)
= total volume of side
plates × unit weight

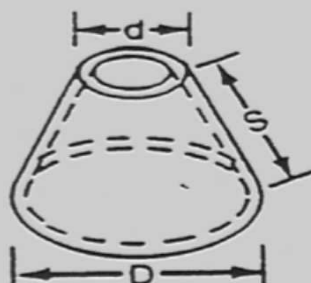
Volume of each side
plate =
$$\frac{W + w}{2} \times S \times \text{thickness}$$

CONE



WEIGHT solid
= $3.14 \times \frac{\text{diam.} \times \text{diam.}}{4}$
× $\frac{\text{height}}{3}$ × unit weight

WEIGHT hollow (without a base)
= $3.14 \times \frac{\text{diam.}}{2} \times S$
× unit weight



WEIGHT hollow (without a base)
= $3.14 \times \frac{(D + d)}{2} \times S$
× thickness × unit weight

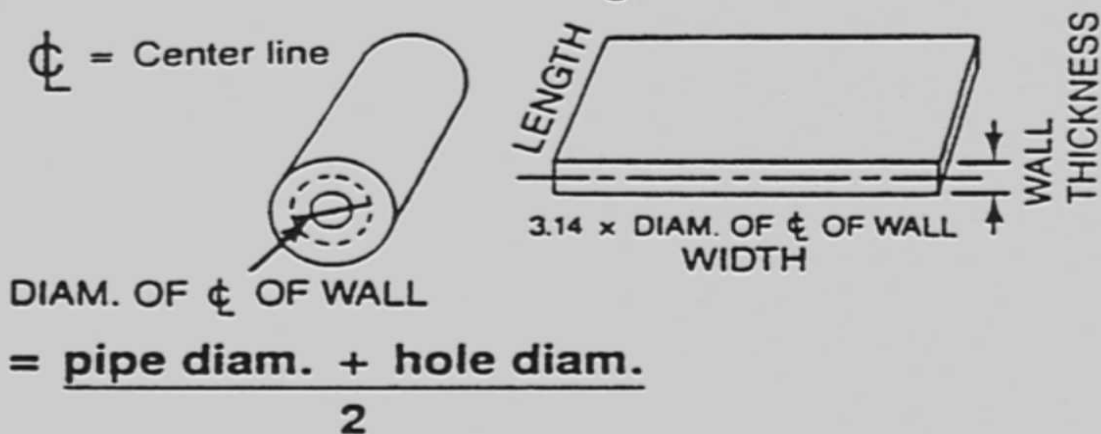
PRINCIPLES (cont.)

PIPE (cont.)

METHOD 3.

for heavy walled pipe such as concrete pipe

1. Split pipe and lay flat
2. Calculate width of slab
= $3.14 \times \text{diam. of } \phi \text{ of wall}$
3. **WEIGHT** = width \times length \times thickness
 \times unit weight



BALLS

WEIGHT solid ball

$$= \frac{3.14 \times \text{diam} \times \text{diam} \times \text{diam}}{6} \times \text{unit weight}$$



WEIGHT hollow ball

$$= 3.14 \times \text{diam} \times \text{diam} \times \text{thickness of wall} \times \text{unit weight.}$$

PRINCIPLES (cont.)

TANKS

For steel tanks

1. CALCULATE VOLUME OF ENDS

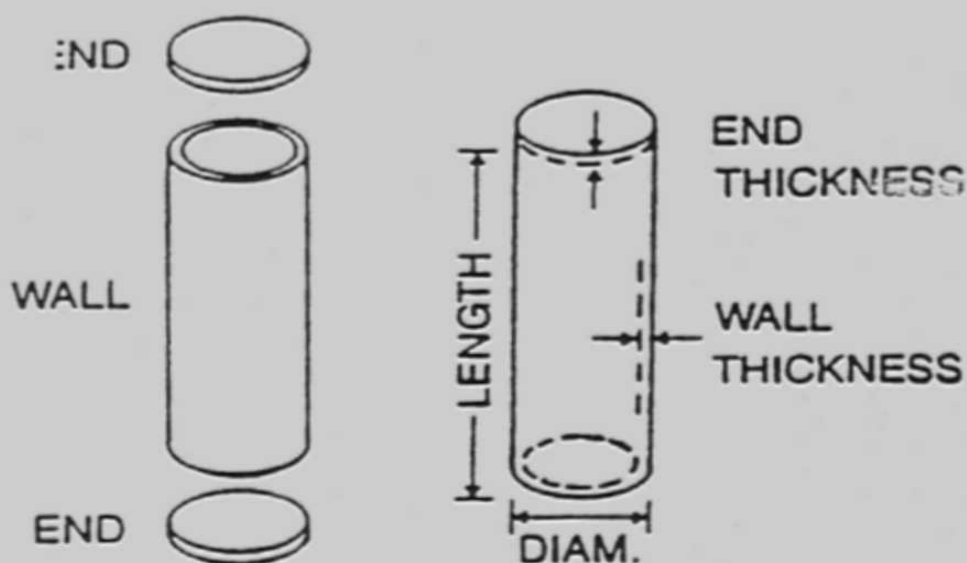
$$= 3.14 \times \frac{\text{diam} \times \text{diam} \times \text{thickness}}{4}$$

$$\times 2 \text{ ends}$$
2. CALCULATE VOLUME OF WALL

$$= 3.14 \times \text{diam.} \times \text{length} \times \text{thickness}$$
3. WEIGHT

$$= \text{volume of ends} + \text{wall}$$

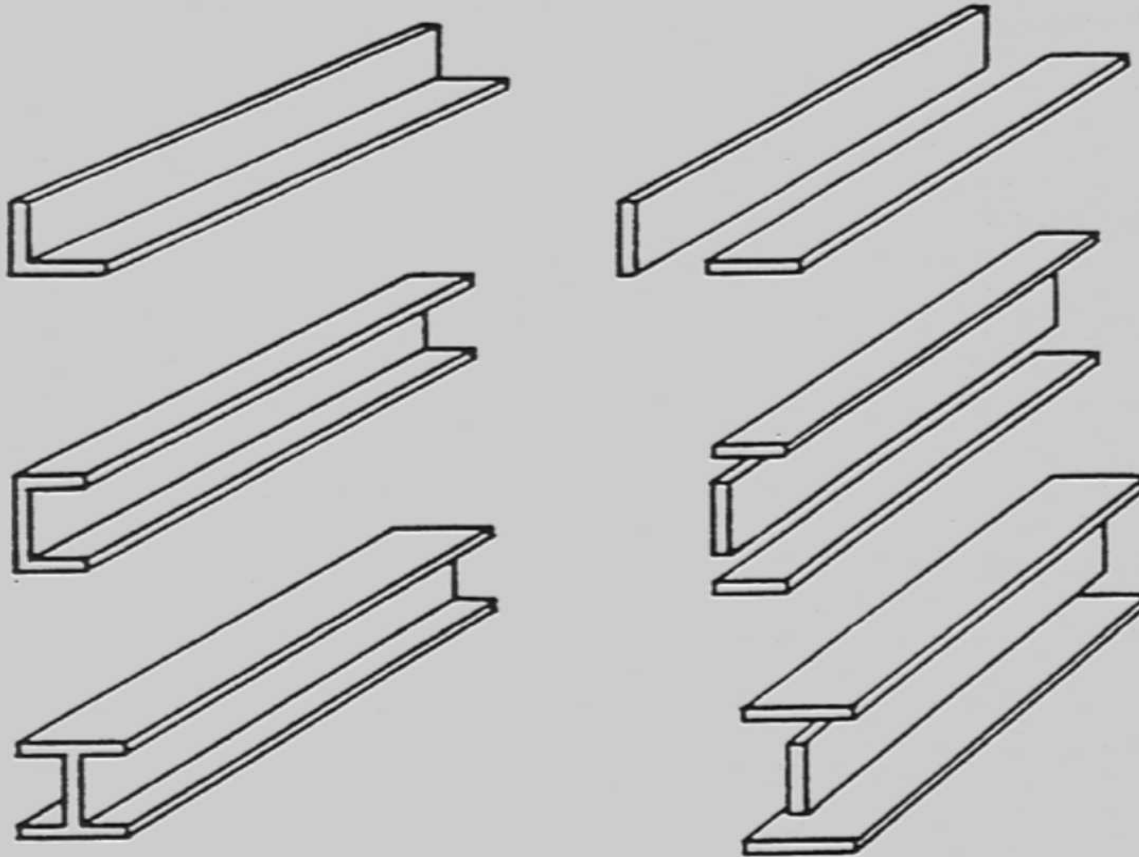
$$\times \text{unit weight}$$



PRINCIPLES (cont.)

STRUCTURAL SHAPES

**CALCULATE WEIGHT OF EACH PART
AND ADD THEM**



**OR
OBTAIN WEIGHT PER FOOT FOR ANGLES,
CHANNELS, BEAMS FROM
A STEEL HANDBOOK**

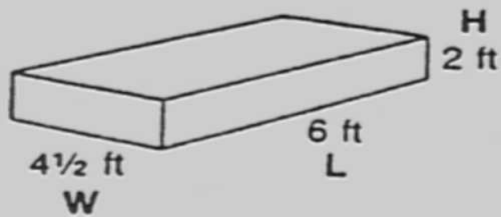
***For reinforcing rods*
CALCULATE AS A CYLINDER OR
SEE A STEEL HANDBOOK**

WEIGHTS OF MATERIALS

	lbs/cu.ft.	kg/cu.m.
Construction Materials		
Cement – Portland	94	1,505
Concrete – Stone	144	2,340
– Reinforced	150	2,400
Earth – Loose, Dry	76	1,220
– Wet, Packed	96	1,540
Gravel – Dry, Loose	110	1,760
– Wet, Packed	113	1,810
Granite	167	2,675
Limestone	165	2,645
Timber		
Cedar	22	360
Fir, Douglas	32	515
Oak	50	800
Pine	34	540
Metals		
Aluminum	165	2,640
Bronze	509	8,150
Cast Iron	442	7,080
Lead	710	11,370
Steel	490	7,850
Liquids		
Gasoline	42	675
Oils	58	930
Water	62.5	1,000
Miscellaneous		
Coal	56	900
Glass	162	2,600
Paper	58	930
Rubber	94	1,500
Asbestos	153	2,450

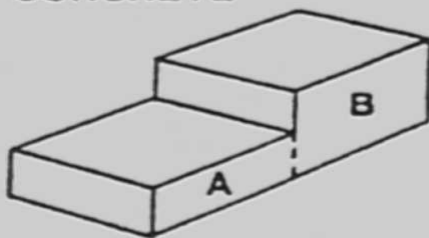
EXAMPLES

1. CUBES



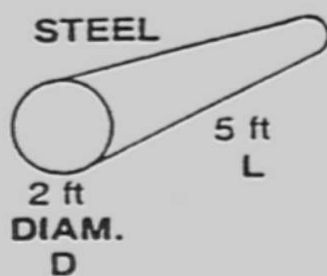
$$\begin{aligned}\text{WEIGHT} &= L \times W \times H \times \text{unit weight} \\ &= 6' \times 4\frac{1}{2}' \times 2' \times 150 \text{ lbs} \\ &= 8,100 \text{ lbs}\end{aligned}$$

**REINFORCED
CONCRETE**



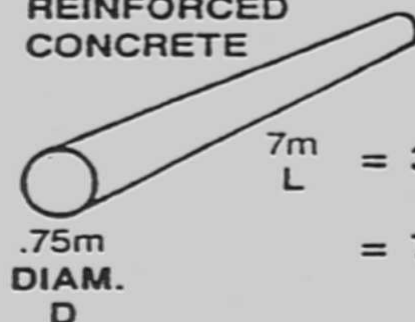
**Calculate each cube (A&B)
and add**

2. CYLINDERS



$$\begin{aligned}\text{WEIGHT} &= 3.14 \times \frac{D \times D}{4} \times L \times \text{unit weight} \\ &= 3.14 \times \frac{2' \times 2'}{4} \times 5' \times 490 \text{ lbs} \\ &= 7,693 \text{ lbs}\end{aligned}$$

**REINFORCED
CONCRETE**

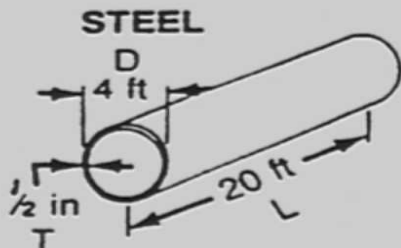


$$\begin{aligned}\text{WEIGHT} &= 3.14 \times \frac{D \times D}{4} \times L \times \text{unit weight} \\ &= 3.14 \times \frac{.75\text{m} \times .75\text{m}}{4} \times 7\text{m} \times 2,400\text{kg} \\ &= 7,420 \text{ kg}\end{aligned}$$

EXAMPLES (cont.)

3. PIPE

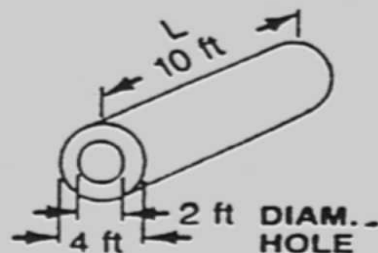
METHOD 1



WEIGHT

$$\begin{aligned}
 &= 3.14 \times D \times L \times T \times \text{unit weight} \\
 &= 3.14 \times 4 \text{ ft} \times 20 \text{ ft} \times \frac{1/2 \text{ ft}}{12} \\
 &\quad \times 490 \text{ lbs} \\
 &= 5,128 \text{ lbs}
 \end{aligned}$$

REINFORCED CONCRETE



D_p = PIPE DIAM.

D_h = HOLE DIAM.

METHOD 2

1. VOLUME OF PIPE (without hole)

$$\begin{aligned}
 &= 3.14 \times \frac{D_p \times D_p \times L}{4} \\
 &= 3.14 \times \frac{4 \text{ ft} \times 4 \text{ ft} \times 10 \text{ ft}}{4} \\
 &= 125.6 \text{ cu. ft}
 \end{aligned}$$

2. VOLUME OF HOLE

$$\begin{aligned}
 &= 3.14 \times \frac{D_h \times D_h \times L}{4} \\
 &= 3.14 \times \frac{2 \text{ ft} \times 2 \text{ ft} \times 10 \text{ ft}}{4} \\
 &= 31.4 \text{ cu. ft}
 \end{aligned}$$

3. VOLUME OF PIPE

$$\begin{aligned}
 &= 125.6 \text{ cu. ft} - 31.4 \text{ cu. ft} \\
 &= 94.2 \text{ cu. ft}
 \end{aligned}$$

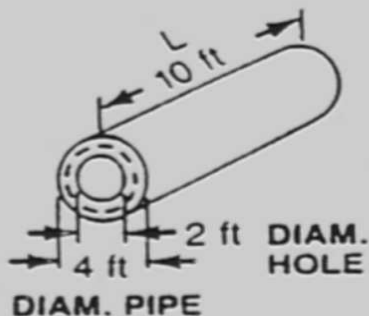
4. WEIGHT OF PIPE

$$\begin{aligned}
 &= 94.2 \text{ cu. ft} \times 150 \text{ lbs} \\
 &= 14,130 \text{ lbs}
 \end{aligned}$$

EXAMPLES (cont.)

3. PIPE (cont.)

REINFORCED
CONCRETE

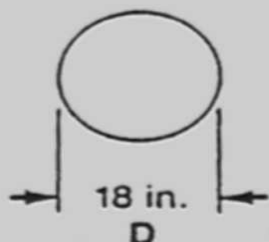


METHOD 3

1. SPLIT PIPE AND LAY FLAT
2. WIDTH OF SLAB
 $= 3.14 \times \text{ø of wall}$
 $= 3.14 \times 3 \text{ ft}$
3. WEIGHT
 $= 3.14 \times 3 \text{ ft} \times 10 \text{ ft} \times 1 \text{ ft}$
 $\times 150 \text{ lbs}$
 $= 14,130 \text{ lbs}$

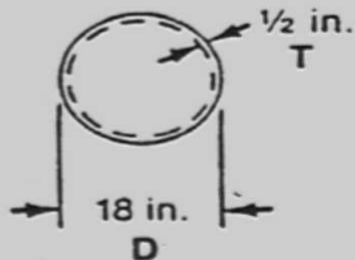
4. BALLS

STEEL (SOLID)



$$\begin{aligned} \text{WEIGHT} &= 3.14 \times \frac{D \times D \times D}{6} \times \text{unit weight} \\ &= 3.14 \times \frac{1.5 \text{ ft} \times 1.5 \text{ ft} \times 1.5 \text{ ft}}{6} \\ &\quad \times 490 \text{ lbs} \\ &= 865.4 \text{ lbs} \end{aligned}$$

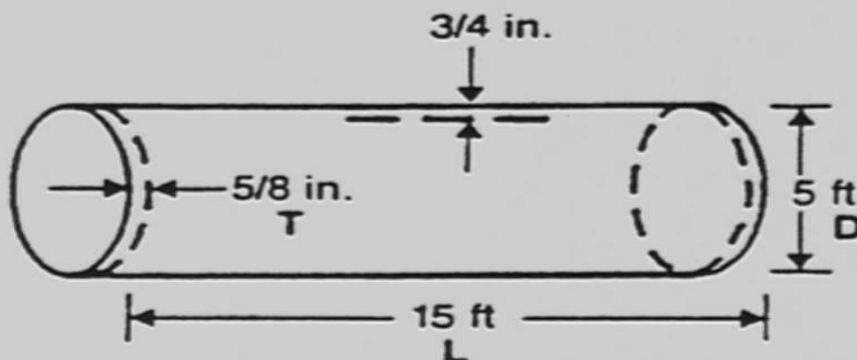
STEEL (HOLLOW)



$$\begin{aligned} \text{WEIGHT} &= 3.14 \times D \times D \times T \times \text{unit weight} \\ &= 3.14 \times 1.5 \text{ ft} \times 1.5 \text{ ft} \times \frac{1/2 \text{ ft}}{12} \\ &\quad \times 490 \text{ lbs} \\ &= 144 \text{ lbs} \end{aligned}$$

EXAMPLES (cont.)

5. TANKS



1. VOLUME OF ENDS

$$= 3.14 \times \frac{D \times D \times T}{4} \times 2 \text{ ends}$$

(T = thickness of ends)

$$= 3.14 \times \frac{5 \text{ ft} \times 5 \text{ ft}}{4} \times \frac{5/8 \text{ ft}}{12} \times 2$$

$$= 2.04 \text{ cu. ft}$$

2. VOLUME OF WALL

$$= 3.14 \times D \times L \times T$$

(T = thickness of wall)

$$= 3.14 \times 5 \text{ ft} \times 15 \text{ ft} \times \frac{3/4 \text{ ft}}{12}$$

$$= 14.72 \text{ cu. ft}$$

3. WEIGHT

$$= \text{volume of ends and wall} \times \text{unit weight}$$

$$= 2.04 \text{ cu. ft} + 14.72 \text{ cu. ft} \times 490 \text{ lbs}$$

$$= 8,212 \text{ lbs}$$

SECTION 4

TABLE OF CONTENTS

LUBRICATION	1
LUBRICATION POINTS.....	1
HYDRAULIC OIL RECOMMENDATIONS	2
Viscosity	2
Anti-wear Additives	3
LUBRICATION DIAGRAM	5



LUBRICATION

Following the designated lubrication procedures is important in ensuring maximum lifetime and utilization. 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 filled oil, the following types of oil are suitable under most operating conditions:

- a) Tractor Hydraulic Fluids of suitable viscosity.
- b) 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 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. 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 above 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 halogenated 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 shut-downs for maintenance. Efficient anti-wear oil protects the components against rusting, resists oxidation, and helps prevent wear.

LUBRICATION SCHEDULE

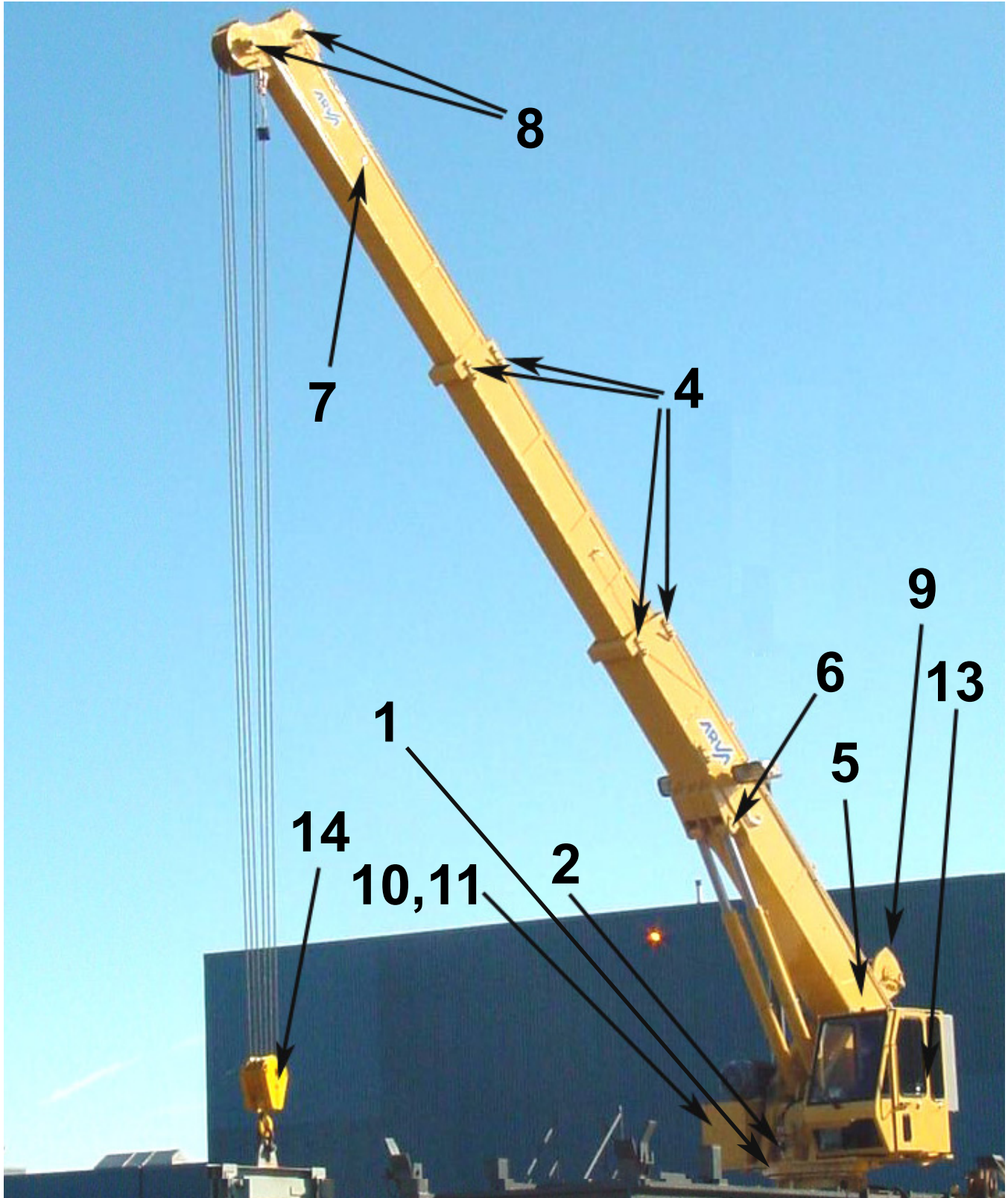
	<u>LOCATION</u>	<u>TYPE</u>	<u>ULTRAMAR*</u>	<u>QTY</u>	<u>FREQUENCY</u>		
					<u>LUBE (hrs)</u>	<u>Check (hrs)</u>	<u>Change (hrs)</u>
1	Swing Bearing	EP-Zero Grease	Ultra Lithium EP0	2 ltrs	50	100	1000
2	Swing Gear Planetary Drive	Gear Oil	EP-90		50	100	
	Bottom Bearing (zerk)	EP-Zero Grease	Ultra Lithium EP0		50		
3	Swing Gear Teeth	Open Gear Lube	Tex Clad 2*			50	
4	Boom Wear Pads (32 plcs)	EP-Lithium Grease	Ultra Lithium EP2	2 ltrs		200	1000
5	Boom Pivot Shaft	EP-Lithium Grease	Ultra Lithium EP2		50	200	
6	Lift Cylinder pins	EP-Lithium Grease	Ultra Lithium EP2		50	200	
7	Ext Cylinder Pins (3 plcs)	EP-Lithium Grease	Ultra Lithium EP2			200	
8	Sheave Pins	EP-Lithium Grease	Ultra Lithium EP2		50	200	
9	Hoist	Gear lube	Spartan 150 or Tex-aco 150/API GL-2/3			100	
10	Hydraulic Oil Reservoir	NUTO H46/ISO46	Hydraulic Oil	302 lts		Daily	
			Hyd Oil full system	416 lts			
11	Return Oil Filter	(Element -A115268)					500
12	Wire Rope	See Section 5 for recommendations					100
13	Hinges					Daily	
14	Hook Block	EP-Lithium Grease	Ultra Lithium EP2		50		

* Or factory approved equivalent such as Tribol Molub-Alloy 936 or Keystone Moly 29 open gear lube.

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 8 of this manual.

SYMBOL	DESCRIPTION
EP-MPG	Extreme Pressure Multipurpose Grease
WBG	Wheel Bearing Grease
EPGL	Extreme Pressure Gear Lubricant
EPGL(SCL)	Extreme Pressure Gear Lubricant Sulpho-Chloro-Lead
EO	Engine Oil
HYDO	Hydraulic Oil

LUBRICATION DIAGRAM



TROUBLESHOOTING & MAINTENANCE DATA

SECTION 5

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TROUBLESHOOTING & MAINTENANCE DATA

NOTE

THE 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 ITS 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.

1. Note the conditions such as temperature, ice build up, type of operation, etc.
2. Inspect the entire hydraulic system for leakage and ensure that the hydraulic reservoir is at the full mark.
3. Replace the return filter element.
4. Replace the suction strainer element.
5. Check hydraulic pressure at directional valves to ensure proper operating pressure. Refer to schematic for various system pressures.
6. Check the crane controls for possible defective control valve or valves.

FAULT ISOLATION

To isolate the defective component perform the following:

1. Find the system most closely resembling the problem encountered.
2. Note possible problem from the centre column on the troubleshooting charts.
3. Check hydraulic connections to suspect components for leakage.
4. 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 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.

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 Component Weights of Section 1 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 aluminum, 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 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 antifriction bearing will be shortened if not properly lubricated. Dirt 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. Dirty hydraulic systems are a major cause of component failures.

Keep the System Clean.

When removing component from a hydraulic system, cover all the 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.

1. Extension Cylinder - wear pad retaining structures, cylinder attaching points, and boom pivot shaft retaining structures.
2. Boom Lift Cylinder - end connections.
3. Outrigger Structures - near pivots, pads, arms, boxes and attachment structures.
4. Turret structure - near pivots, slew bearing bolts, cylinder thrust points and cylinder eyes.
5. Boom sections - near ends, pivots, and lower wear pads.
6. Counterweight support structure.
7. 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 PE-48M MARINE 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 structural 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 (kg-m), multiply the pounds/foot quantity by 0.138255

To convert pounds-inch of torque to kilograms-centimetre (kg-cm), 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

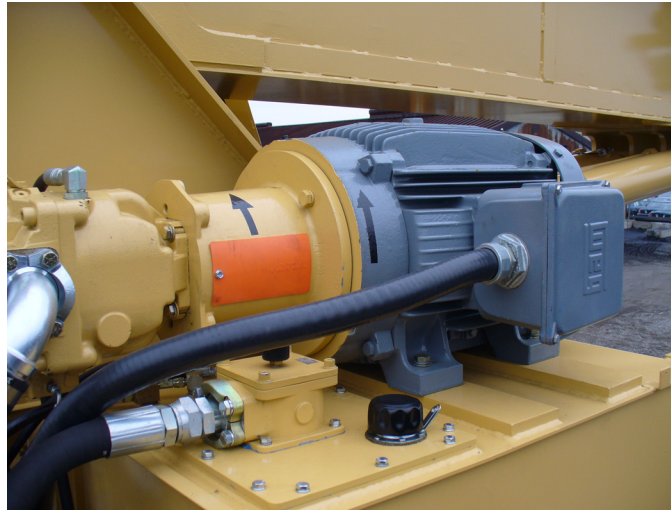


Figure 1

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 and good housekeeping. Contaminants can enter the system by the addition of unfiltered hydraulic oils, 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 dirt 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;
THIS 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 the 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 80 US gallons.
The approximate capacity of the total system is 110 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 SYSTEM TROUBLESHOOTING

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

TROUBLE	PROBABLE CAUSE	REMEDY
Slew very slow	Slew cylinder scored or motor, damaged	Replace if not operating
Slew does not stop turning	Valve not returning to neutral	Replace valve section
Boom does not extend/retract	Counterbalance valve	Replace valve
	Control valve	Replace valve if required
	Loss of load sense pressure if applicable	Repair or replace pump
Slow Boom extend/retract operation	Counterbalance valve	Replace valve
	System pressure	Main relief, circuit relief
	Cylinder internal leakage	Replace/repair cylinder
Lift or extend cylinder not holding	Lift cylinder internal leakage	Replace/repair cylinder
	Counterbalance valve	Replace/repair
Insufficient speed or power	Valve plate and cylinder block surface scored by abrasive in hydraulic fluid	Check for leakage at drain port. Replace hydraulic motor. Flush system with clean oil

HYDRAULIC TROUBLESHOOTING (cont'd)

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
External leakage from motor	Worn seal or gaskets	Install new seal or gaskets
Speed fluctuations with constant input flow	Irregular wear between valve plate and cylinder block	Replace hydraulic pump
	Speed reducer failed	Replace reducer
Slew does not turn	Control Valve	Check hydraulic fluid output. Replace if necessary

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 as part of the 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 converts mechanical energy to fluid energy for operation of the various hydraulic circuits employed by the machine. With no resistance encountered by the pump (all controls in neutral), pump discharge registers minimum pressure. When a circuit is activated, whereby a resistance to flow is created, pressure increase occurs instantly. As the pressure exceeds resistance to flow, fluid energy is available to perform work.

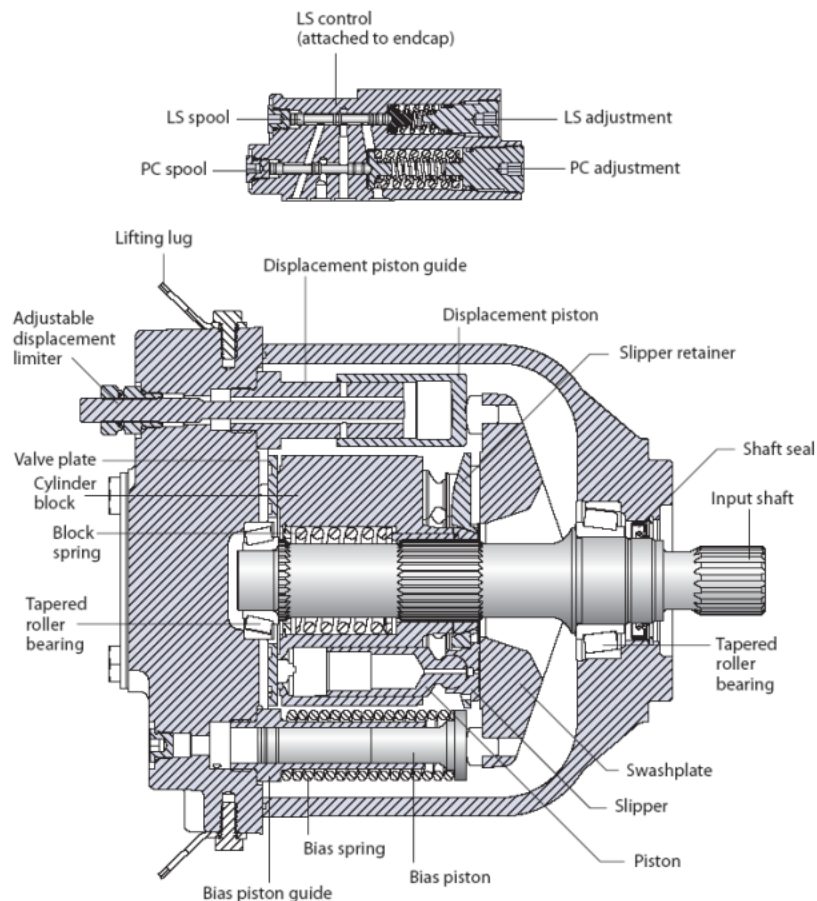


Figure 2

The hydraulic pump has a dual servo piston design with a cradle-type swashplate set in polymer-coated journal bearings. The bias piston increases swashplate angle. The displacement piston decreases swashplate 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 swashplate 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 viton 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.

Pump delivery is measured in gallons per minute (gpm) or litres per minute (lpm) at specified revolutions per minute.

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 it 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

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.
Pump noise. (Accompanied by oil foaming in reservoir)	Restricted or damaged control valve supply line.	Clean, repair or replace line as necessary.
	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

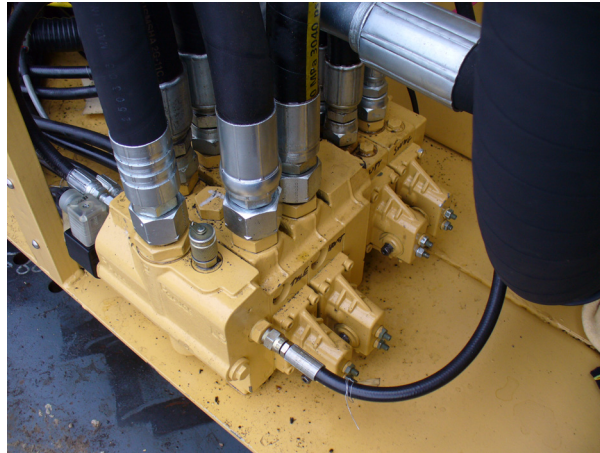


Figure 3

DESCRIPTION

The valve banks controlling crane functions are installed on the rear of the turret near the hydraulic tank.

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, dirt, 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 dirt 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 dirt, 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 Power Unit.
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 circuit does 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	3000-3050
Boom extend	2450-2500
Boom retract	2450-2500
Boom lift	2750-2800
Boom down	2450-2500
Rotate Valve (Swing)	850-910
Hoist Up	2950-3000
Hoist Down	2450-2500
Pump Setting (PC)	2900-2950

CAUTION

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

8. 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 dirt 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.

CONTROL VALVE TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Sticking Spool	Excessively high oil temperature	Eliminate any restriction in line or filtering system
	Dirt 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
Leaking Seals	Spring or valve cap binding. Valve not thoroughly warmed up.	Loosen cap, re-centre and re-tighten. Allow time for system warm up
	Paint on or under seal	Remove and clean as necessary
	Excessive back pressure	Open or enlarge line to reservoir
	Dirt 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	Dirt 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

CONTROL VALVE TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Load drops when spool moved from neutral	Dirt in check valve	Disassemble and clean check valve
	Scored check valve poppet or seat	Replace poppet or lap poppet to seat
Poor hydraulic system performance or failure	Damaged pump	Check pressure or replace pump
	Dirt 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

ROTATIONAL DRIVE



Figure 4 - Swing Stop Ramps

DESCRIPTION

The turret swing system provides a 360 degree continuous rotation. Slew in either direction is controlled by the left joystick.

The swing circuit consists of the directional control valve with relief valve, drive motors, internal swing brakes and gear reducers.

When the control lever is activated, flow is directed through the directional valve to the hydraulic motor which releases the brake and drives the gear reducer and swings the turret and boom.

A swing stop switch and ramps attached to the turret and pedestal function to prevent the operator from swinging into the ship's stacks. The switch can be bypassed to swing over the stacks by pushing the button located on the top of the left joystick controller. The operator must hold the button down continuously to swing within the area of the stacks.

NOTE

For more detailed information see the applicable service packages.

MAINTENANCE



Figure 5 - Rotational Drive

Hydraulic Motor Removal

1. Thoroughly clean off all outside dirt around fittings on motor. (This step is taken to prevent entry of dirt 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.

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.

ROTATION DRIVE TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Slow operation of function	Relief setting too low	Set relief valve for proper psi
	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 runs without turning	Broken Shaft	Replace shaft assembly. Check housing for wear and replace if necessary. Check for misalignment.

ROTATION DRIVE TROUBLESHOOTING Cont'd

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
	Dirt 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
Slow operation of function	Excessive pressure	Check relief valve setting for line restriction (clogged or under size line) Repair or replace pump
	Worn pump	
	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, us 5W20 oil
	Plugged filter	Replace filter or clean

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.

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 36.0:1.

NOTE

For more detailed information refer to the applicable service package.

MAINTENANCE

Removal

1. Stabilize the crane.
2. Tag, disconnect, and cap all hydraulic lines from the rotational drive.
3. See ROTATIONAL 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 carrier.
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 has 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 dirt out. An external grease fitting is installed to grease pinion bearing.

ROTATIONAL BEARING

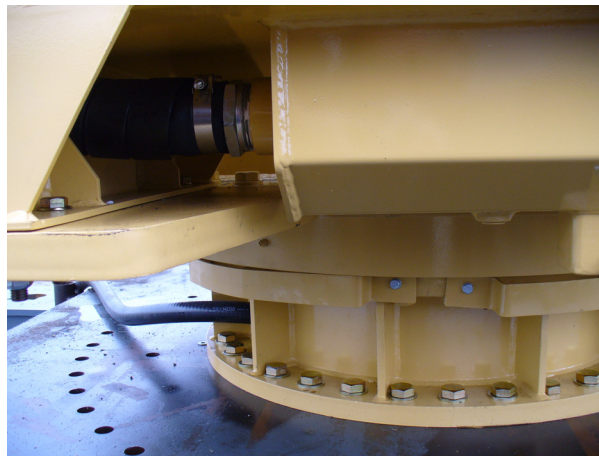


Figure 6

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 TURNABLE 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 re-torqued 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 thirty (36) 1.00-8NC x5" grade 8 bolts. The outer race of the bearing is secured to the turret by twenty six (26) 1.00-8NC grade 8 bolts.

Torque Values

Torque the bolts to according to the tables in section 6 of this manual.

Tools Required

Slew ring bolt socket, torque wrench and optional 4 to 1 multiplier.

Inner Race Torquing

1. Inner race bolts are to be torqued before placing turret onto frame.
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 pedestal from under the crane.
2. From under the pedestal, torque the bolts in a diametrically opposed sequence and to the same values as the inner race bolts.

Removal of Rotational 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 turret from top of rotation bearing.

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.

4. Remove the rotational drive assembly as described earlier in this section.
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 in the same position.

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.

NOTE

Installation orientation of crane must be in the travel 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 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).

ROTATION SYSTEM TROUBLESHOOTING

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
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

ROTATION SYSTEM TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
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

HOIST



Figure 7

DESCRIPTION

The hoist is a variable speed, planetary driven hoist with a dual brake system. A seat mounted joystick direct pilot pressure and 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 top of the boom base.

HOIST SPECIFICATIONS

Drum Dimensions: 10.625 inches diameter, 13.5 inches long.

Cable Capacity: For 9/16 inch diameter cable, 38,000 lbs. nominal breaking strength.

Maximum line pull: 6,000 lbs single line pull 145 ft/min.

NOTE

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

Removal

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. Remove the bolts and washers from the boom that secure the hoist.

-
5. 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 dirt and debris.
2. With the appropriate lifting device, position the hoist in place on the boom base.
3. To properly align the hoist with the boom:
 - a. Locate a line that is parallel to the drum axis when looking down from the top of the hoist.
 - b. Locate the centre of the top of the boom base section from both ends, and mark the centre point.
 - c. String chalk line over the two boom centre points and pull it tight so that it extends over the hoist axis line.
 - d. 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.
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BOOM



Figure 8

DESCRIPTION

The boom assembly is made up of three (3) major components, the fly section, mid section, and base section. The fly section extends and retracts inside of the mid section by means of an extension cylinder. The mid extends and retracts inside the base section by means of an extension cylinder. The hydraulic supply to the upper extension cylinder is provided using a type of hose reel.

Extension of the boom is achieved by operating the control lever in the cab or by use of the manual control valves on the side of the crane turret.

Wear pads of nylatron are positioned at crucial points on the fly, mid and base sections to reduce friction between sliding parts

The boom assembly supports other equipment such as the, lights and load sensor devices.

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. With boom in the horizontal rest position, extend fly section far enough to expose the extension cylinder access holes.
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 the crane off.

6. Disconnect electrical cables and separate between the boom and turntable.
7. Support the sheave end of the fly section with rigging appropriate for the weight of the boom. Raise the fly slightly to relieve the pressure on the lift cylinder.

WARNING**ENSURE BLOCKING AND LIFTING DEVICES ARE CAPABLE OF SUPPORTING THE BOOM ASSEMBLY**

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 dirt 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 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. Install the retaining pin and bolt to secure the shaft.
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 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.

BOOM DISASSEMBLY

This procedure describes separating boom components and sections after the complete boom assembly is removed from the turret. Refer to Figure 5.1 of this section or Parts Section of this manual for parts illustrations. Boom assembly weighs approximately 14,000 lbs.

1. It is recommended that a hydraulic power unit and overhead lifting device be used for disassembly.
2. Boom should be extended so that fly cylinder pin is exposed for removal (approximately 4 ft per section).
3. Position boom horizontally and securely. Boom assembly weighs 14,000 pounds.
4. Disconnect hydraulic hoses at back of boom freeing hose extension system.
5. Remove front lower wear pad keeper plates (2) on base and mid sections.
6. Remove front upper boom restraint plates (4) from front top of base and mid sections.
7. Lift fly and mid sections taking weight off of lower front wear pad.
8. Remove lower extension cylinder pin at boom base Use $\frac{3}{4}$ -NC bolt to assist in pulling.
9. Unbolt hose extension system cable anchors (2) located on each side of mid section.
10. Remove ten (10) front side wear pad assemblies on base and mid sections.

CAUTION!

Take care that assembly does not tip downward and fall, possibly injuring personnel
--

11. With lifting device remove mid and fly section assembly and secure.
12. Extend upper cylinder to maximum with hydraulic power. Ensure that assembly will not tip.
13. Remove upper cylinder fly section pin.
14. With lifting device remove fly section from mid section and secure.
15. Remove upper cylinder mid section pin (at rear of mid section). Attach lifting device before removing pin to stabilize cylinder.
16. With lifting device remove upper cylinder moving toward front of mid section. Secure cylinder.

17. With lifting device stabilize lower cylinder.
18. Remove lower cylinder trunnion caps (2).
19. Remove lower cylinder by moving rearward out of mid section.

BOOM ASSEMBLY

1. Assembly can be performed by following the disassembly steps in reverse order.
Hydraulic power and lifting device are required.

NOTE

Inner rear sides, top and bottom wear pads are to be shimmed (supplied with new pads) to within 1/16" clearance.

2. Align boom sections with shims

NOTE

Follow lubrication requirements when assembling boom. See lubrication section of this manual.

Functional check

1. Activate the hydraulic system by starting the crane.
2. Elevate the boom to approximately fifty degrees from horizontal and extend the boom to its full length.
3. Check for downward creep that could signal leaks or faulty cylinder seals.
4. Retract, extend, raise, and lower the boom several times to check for smooth operation.
5. Check the operation of all electrical functions that were disconnected during boom maintenance.

Alignment and Inspection

Visually inspect the extend boom at 50 hour intervals for cracks, warping, and other damage that could be caused by misuse. Check boom sheaves periodically for shaft wear and freedom of movement.

NOTE

Consult the Maintenance Schedule for detailed planned maintenance.

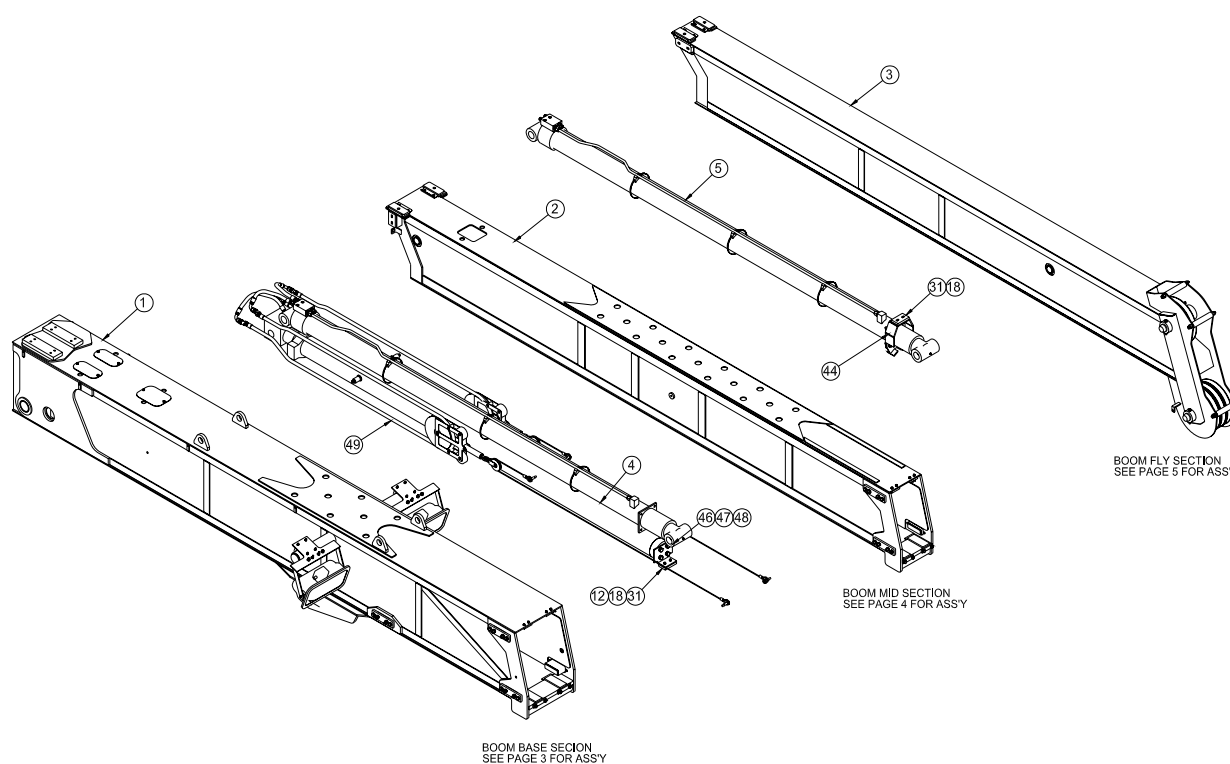


Figure 9

TELESCOPE CIRCUIT TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Boom will not extend or retract	Hydraulic oil level low	Replenish to proper level.
	Clogged, broken, or loose hydraulic lines or fittings.	Clean, tighten, or replace lines or fittings.
	Damaged control valve	Repair or replace valve
	Telescope cylinder damaged	Repair or replace telescope cylinder
	Telescope cylinder locked.	Repair or replace telescope cylinder
Boom Extends and/or retracts erratically	Hydraulic oil level low	Replenish oil to proper level
	Clogged, broken, or loose hydraulic lines or fittings	Clean, tighten, or replace lines or fittings
	Damaged relief valve	Repair or replace valve.
	Damaged control valve	Repair or replace valve
	Damaged telescope cylinder.	Repair or replace telescope cylinder

LIFT CIRCUIT



Figure 10

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 in the cab 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 main 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

WARNING
ENSURE THE LIFTING AND SUPPORTING DEVICES ARE ADEQUATE

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

1. Ensure the boom is fully supported for removal of the lift cylinders.
2. Attach a lifting device capable of lifting the cylinders.
3. Remove the bolts, washers, and pins that retain the cylinder pins.
4. Block the cylinder up and pry out the rod ends.
5. Retract the cylinders fully.
6. Tag and disconnect hoses from the cylinders. Cap hose ends and plug valve ports.
7. Take up any slack in the cylinder lifting device, then remove the cap and the cylinder pins.
8. 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 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	Cycle (elevate and lower) boom
	Control valve linkage out of adjustment	Adjust linkage to obtain full spool travel
	Air in holding valve	Bleed holding valve
	Holding valve damaged	Repair or replace valve
	Improperly adjusted holding valve	Adjust holding valve
	Damaged hydraulic pump section	Repair or replace pump section
Boom lowers erratically	Low hydraulic oil	Replenish oil to proper level
	Low engine rpm	Increase and maintain engine rpm
	Damaged relief valve	Repair or replace valve
Boom raises slowly	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
	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
Boom lowers slowly	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
	Excessive load	Reduce load as required
Boom will not raise	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 pmp drive coupling	Replace drive coupling
	Broken control valve spool	Replace control valve

ELEVATION SYSTEMS TROUBLESHOOTING (cont'd)

TROUBLE	PROBABLE CAUSE	REMEDY
Boom will not lower	Low hydraulic oil	Replenish oil to proper level
	Relief valve damaged	Repair or replace valve
	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

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 the cylinder. 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 evedent 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 via an electric cable, located on the side of the turret.

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

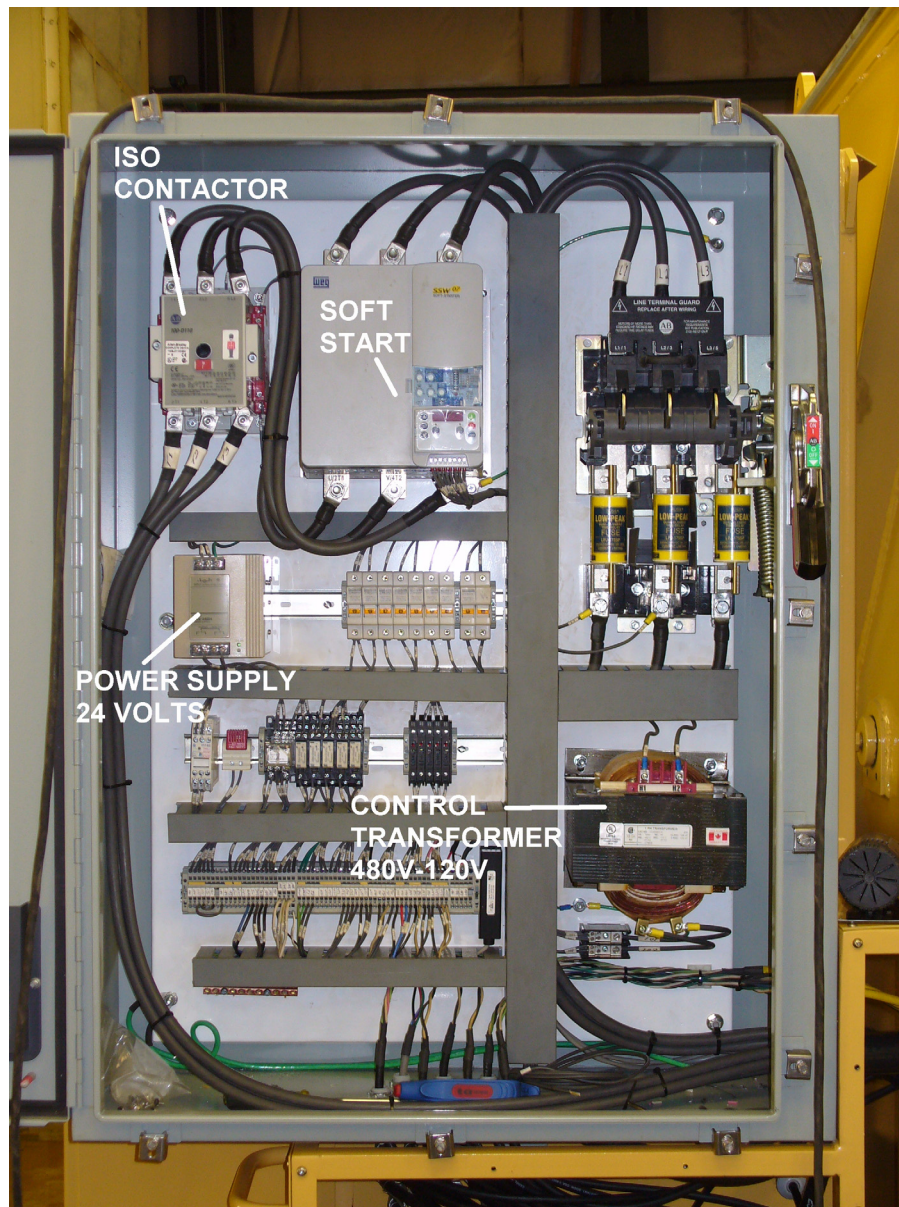
Check all indicating instruments and lights for proper operation. Tighten all loose connections and replace damaged instruments and lights.

Electrical Box

The electrical box located on one side of the turret, 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 on the crane adapter plate within the confines of the service platform

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



Electrical Panel

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 them ensure that 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 can 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

9/16 inch dia., 6x26 IWRC, 450 ft long, with 38,000 lbs nominal breaking strength rotation resistant RRL (right regular lay).

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 the entire 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.

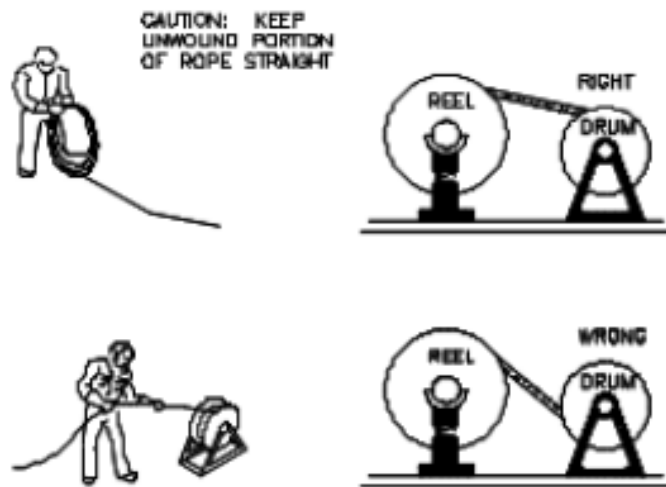


Figure 11

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.

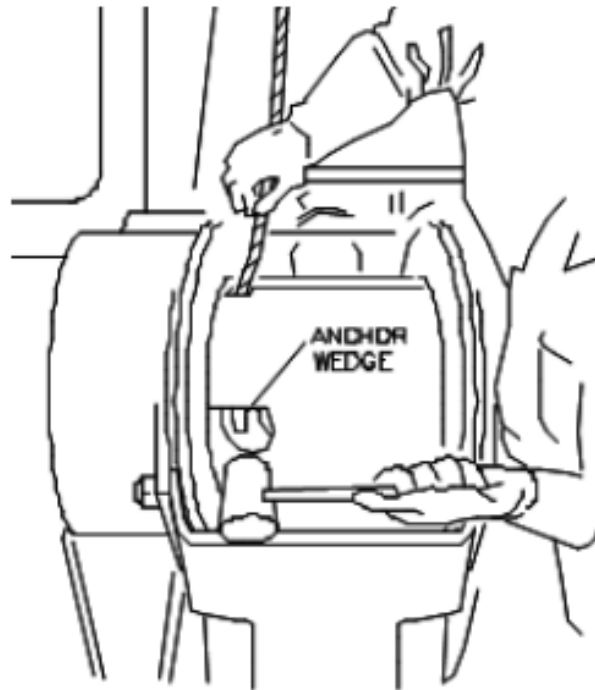


Figure 12

6. Evidence of noticeable reduction in original rope diameter after allowance for normal stretch and diameter reduction of a newly rigged rope has been made.
7. 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.

Non-preformed wire rope, less than 7/16 inch diameter; Place two clamps on each side of cut mark and proceed with cutting.

Non-preformed wire rope, 7/8 inch diameter or greater: Place three clamps on each side of cut mark and proceed with cutting.

<p style="text-align: center;">NOTE</p> <p>END OF ROPE SHOULD BE EVEN WITH BOTTOM OF ANCHOR WEDGE.</p>
--

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

<p style="text-align: center;">NOTE</p> <p>IF WEDGE DOES NOT SEAT SECURELY IN SLOT, CAREFULLY TAP TOP OF WEDGE WITH Mallet.</p>

3. 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.
4. 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.

<p style="text-align: center;">CAUTION</p> <p>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.</p>
--

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 'B'.

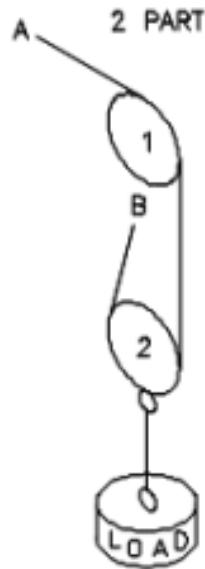


Figure 13

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 petrolatum, 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	_____
_____	Check Engine Fluid Levels: Oil, Radiator	_____
_____	Lubricate All joints as required in section 4	_____
_____	Check Transmission Fluid Level (Trans. Temp 180-200°F)	_____
_____		_____

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 Lever joints with SAE30 Oil	_____
_____	Lubricate – Lift Cylinder Rod Pins	_____
_____	Lubricate – Slew Ring Bearing	_____
_____	Check Battery Cell Fluid Level	_____
_____	Check for Leaks at differential: Input seal housing	_____
_____	Check Bolt Torque: Differential Carrier to Axle housing bolts	_____

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 Point Sheave	_____
_____	Lubricate – Boom Slider Wear Pads	_____
_____	Lubricate – Boom Extend Cylinder Trunnions	_____
_____	Lubricate – Boom Pivot Pin	_____
_____	Check Condition of Hoses & Tubing	_____
_____	Check Torques – Swing Reduction Bolts (see chart end of sec)	_____
_____	Lubricate – Swing Gear Teeth	_____

COMMENTS _____

5. 'D' MAINTENANCE CHECKS - 250 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 Engine Oil, Drain (Recommended) & filter change_____

Check – Swing Gear Box Oil Level

COMMENTS _____

[illegible]

6.`E' MAINTENANCE CHECKS - 500 HOURS OR QUARTERLY SERVICE

Maintenance Person_____

Date Performed_____

Machine Model No._____

Machine Serial No._____

CHKD	MAINTENANCE POINTS	PERFORMED BY
_____	Repeat `A', `B', `C' and `D' Maintenance Checks	_____
_____	Visually Check Slew Ring Seals	_____
_____	Lubricate – Swing Gear, & Gear Reducer	_____
_____	Inspect Tie Rod Ends and Axle king Pins for Wear	_____

COMMENTS _____



7. 'F' MAINTENANCE CHECKS - 1000 HOURS OR SEMI-ANNUAL 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	_____
_____	Inspect – Boom Wear Pads, replace if necessary	_____

COMMENTS _____

8. 'G' MAINTENANCE CHECKS - 2000 HOURS OR 1 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	_____
_____	Change differential and planetary reduction oil front & rear axle	_____
_____	Change – Transmission Oil	_____
_____	Inspect Brake Lining	_____
_____	Replace – Boom Wear Pads	_____
_____	Replace – Radiator Coolant Antifreeze	_____

COMMENTS _____ Repeat Annually _____

9. 'H' 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' & 'G' Maintenance Checks _____

_____ Replace – Hydraulic Hoses _____

_____ Replace Seals in All Cylinders _____

_____ Replace Seals in Hydraulic Valves _____

COMMENTS _____

10. 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.

11. 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.

12. 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.

13. INSPECTIONS

13.1. 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.

13.2. 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.

13.3.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.

13.4.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.

13.5.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.

13.6.SHIMS

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

13.7.BEARINGS

13.7.1.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.

13.7.2. 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.

13.7.3. Heating Bearings

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

13.7.4. 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.

13.7.5. 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.

13.7.6.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.

13.8.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.

13.9.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.

13.10.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.

13.10.1.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 aid in assembly.

13.10.2. 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.

13.10.3. 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.

14. 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.

15.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.

16..WELDING REPAIR PROCEDURE

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

Boom & Frame	50,000 psi yield
Outrigger	100,000 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 Outrigger beam structures.

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.

17. 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.

18. 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.

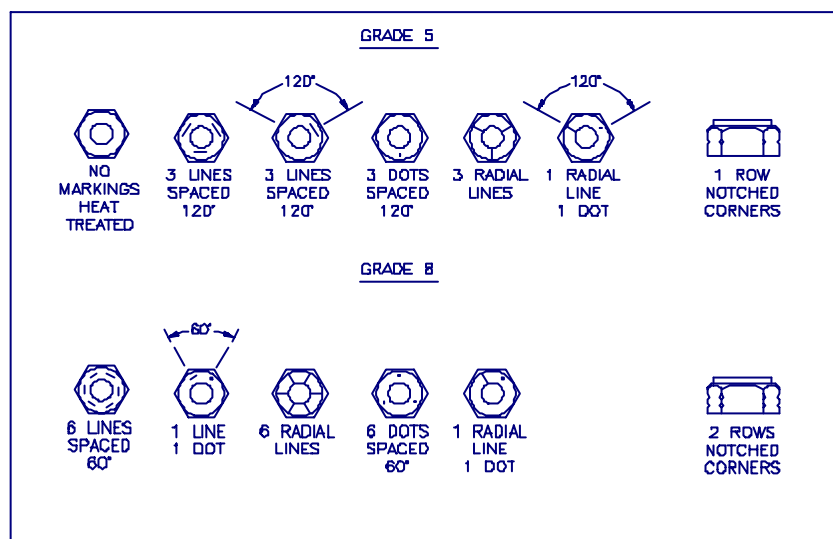
Special attention should be given to the existence of lubricant, plating or other factors that might require variation from standard torque values.

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.

19.NUT IDENTIFICATION














20. METRIC TORQUE VALUES

Fine or Course Thread Fastener	Grade Designation	M4	M5	M6	M7	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27
		TORQUE (FOOT-POUNDS)													
	8.8	2	4	7	11	18	32	58	94	144	190	260	368	470	707
	10.9	2.9	6	10	16	25	47	83	133	196	269	366	520	664	996
	12.9	3.6	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.)

21.S.A.E. TORQUE VALUES (LUBRICATED)

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	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											
	S.A.E. 7 STEEL		MED. CARB. ALLOY, QCHD TMPRD RL THR'D	39	62	95	135	188	315	495	743	1634		2620
	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											
	N.A.S. 144 AIRCRAFT STD. MS20000 MIL. STD.			45	73	109	158	216	356	566	868	1908		3052

Torque values as shown are for nut-bolt combinations that have been plated or have had lubrication applied. (Maximum torque values are listed).

22.S.A.E. TORQUE VALUES (DRY)

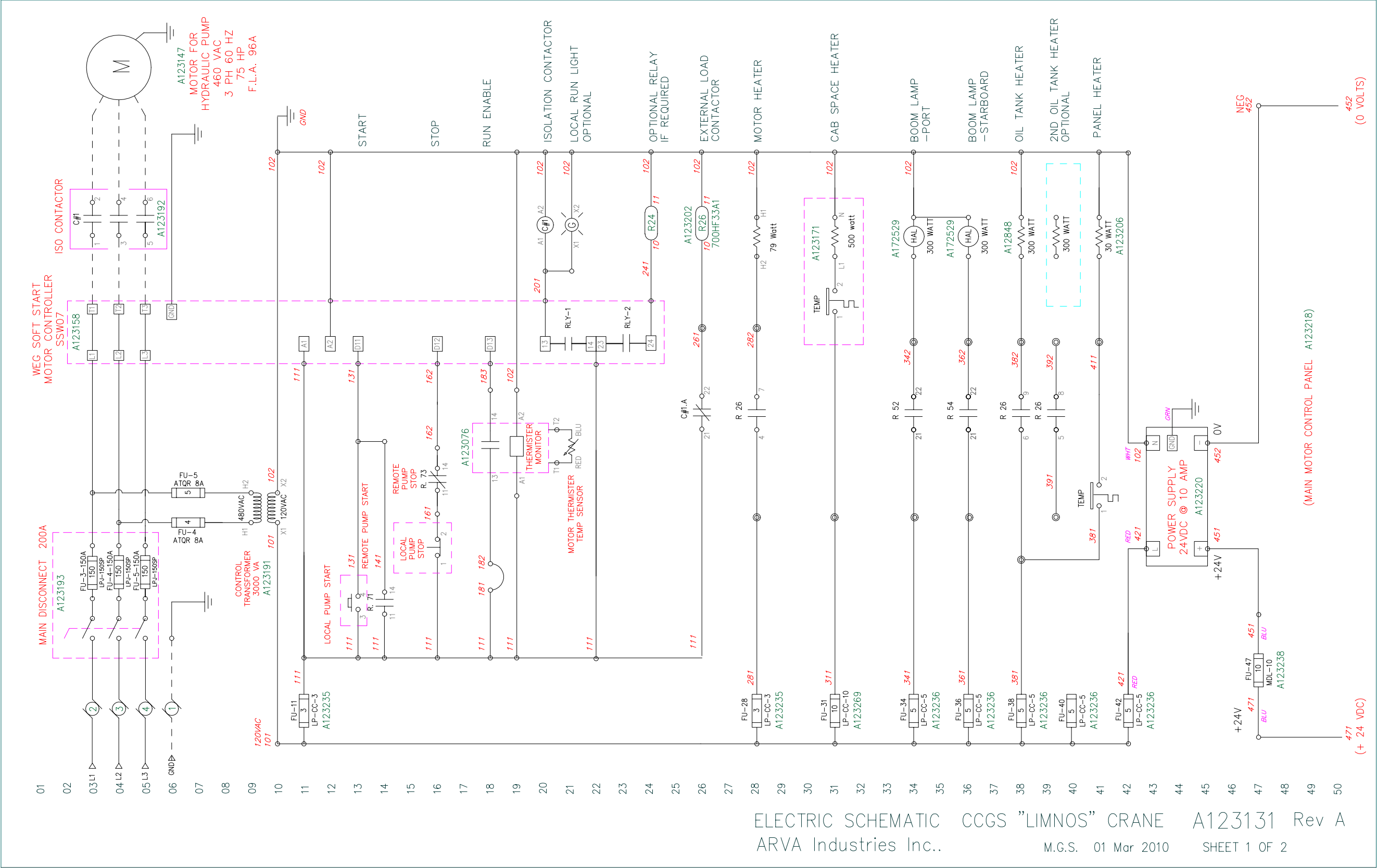
Fine or Course Thread Fastener	Grade Designation	Tensile Strength Minimum	Material	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/4	1-3/8	1-1/2
				TORQUE (FOOT-POUNDS)										
	S.A.E. 2 A.S.T.M. A 307 STEEL	64,000 PSI	LOW CARBON STEEL	19	30	45	66	93	150	202	300	659		1057
	S.A.E. 3 STEEL	100,000 PSI	MEDIUM CARBON 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. CARBON QUINCHED TEMPERED	34	54	81	119	167	269	427	644	1392		2234
	S.A.E. 6 STEEL	133,000 PSI	MED. CARB. STEEL QUINCHED TEMPERED											
	S.A.E. 7 STEEL		MED. CARB. ALLOY, QUINCHED TEMPERED REL. THREADED	43	69	106	150	209	350	550	825	1815		2913
	S.A.E. 8 STEEL	150,000 PSI	MED. CARB. ALLOY, QUINCHED TEMPERED	46	75	115	165	225	370	591	893	1964	2633	3150
	SQC. HEAD CAPSCREW ALSO N.A.S. AIRCRAFT STD.	160,000 PSI	HIGH CARB. ALLOY QUINCHED TEMPERED											
	N.A.S. 144 AIRCRAFT STD. MS20000 MIL. STD.			50	81	121	176	240	395	629	964	2120		3402

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	A123131
Hydraulic Schematic	A115183

SECTION 7
ELECTRICAL SCHEMATIC (SHEET 1 OF 2)



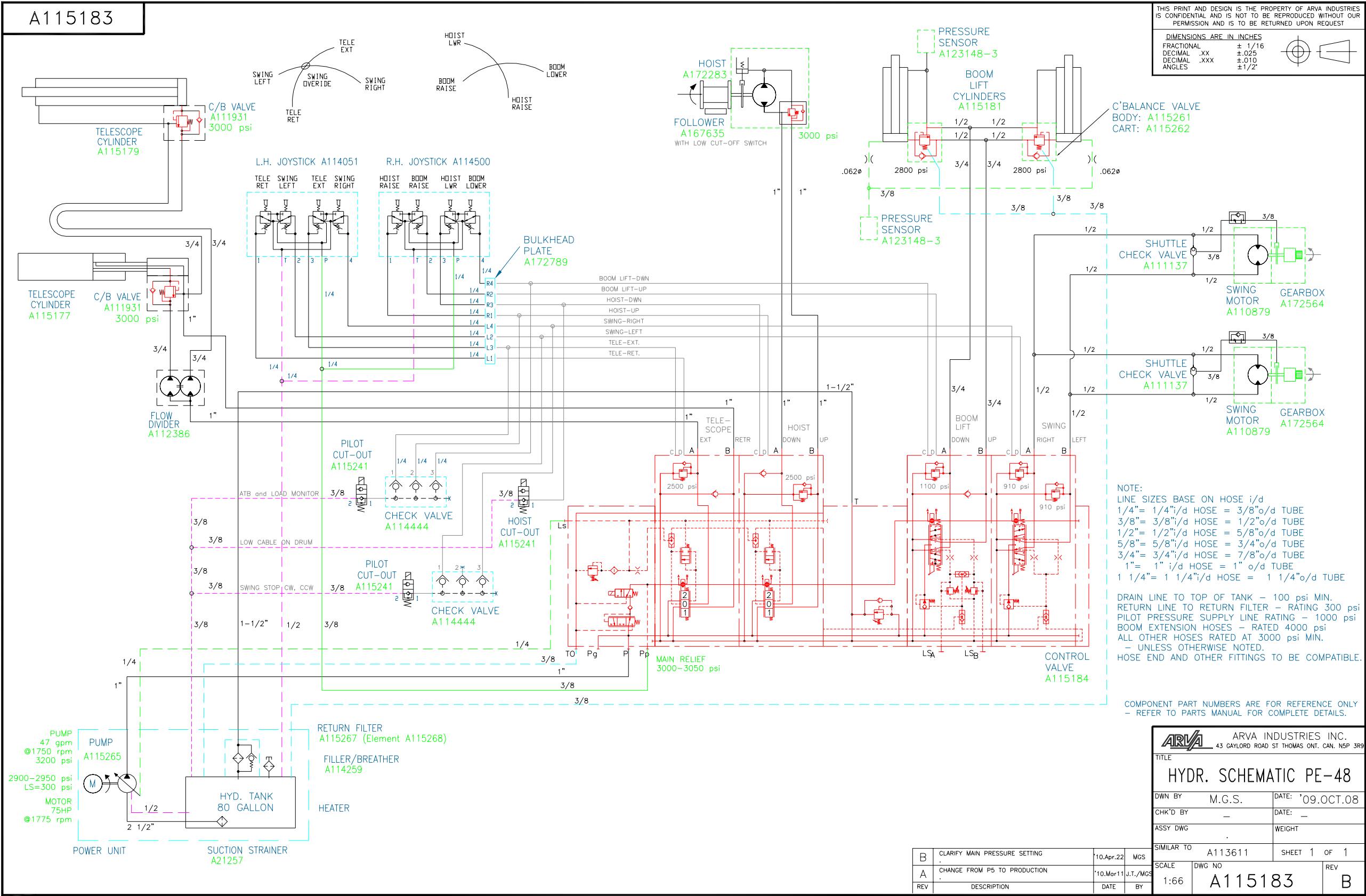
ELECTRIC SCHEMATIC CCGS "LIMNOS" CRANE A123131 Rev A
ARVA Industries Inc.. M.G.S. 01 Mar 2010 SHEET 1 OF 2

SECTION 7



SECTION 7

HYDRAULIC SCHEMATIC (SHEET 1 OF 1)



PARTS DIAGRAM INDEX

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CYLINDER, EXTEND, LOWER	A115177	1-1aa
EXTEND CYLINDER ASSEMBLY, UPPER	A115180	1-1b
CYLINDER, EXTEND, UPPER	A115179	1-1ba
WEAR PAD SIDE ASSEMBLY - BASE	A162108	1-1c
WEAR PAD, SIDE ASSEMBLY - MID	A167509	1-1d
WEAR PAD ASSEMBLY - BACK LOWER	A162028	1-1e
WEAR PAD ASSEMBLY, FLY SIDE	A167699	1-1f
HOSE EXTENSION INSTALLATION	A172175	1-1g
HOSE REEL ASSEMBLY	A171162	1-1ga
DRAWBAR SPRING ASSEMBLY	A167837	1-1gaa
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PARTS DIAGRAM INDEX

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WINCH INSTALLATION	A172164	6
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CUT OUT VALVE ASSEMBLY, WINCH	A115291	11-4
PAINT & DECAL INSTALLATION	A172174	12
FLUID SPEC, PE-48M CRANE	A173025	13
MANUAL, OPERATOR, MAINTENANCE & PARTS	A172908	14

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;

**ARVA INDUSTRIES INC.
43 GAYLORD ROAD
ST. THOMAS, ONTARIO
N5P 3R9**

**TELEPHONE (519) 637-1855
FACSIMILE (519) 637-1848**
e-mail: sales@arvaindustries.com
web site: www.arvaindustries.com

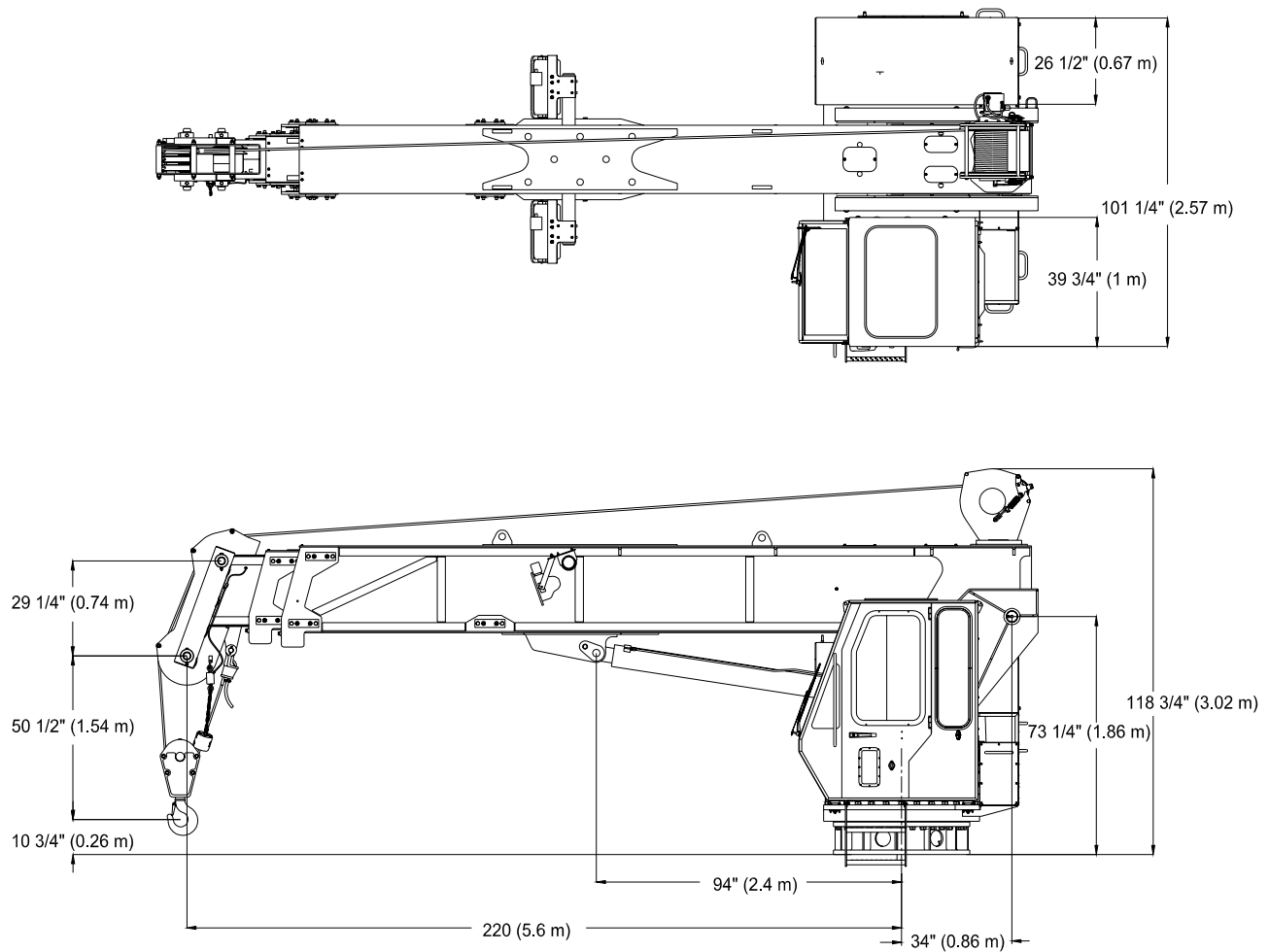


FIGURE GA

CRANE - LIMNOS, COAST GUARD

(SHEET 1 OF 3)

Figure GA

A171660

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172160	1	Boom Installation	Ref Fig 1
2	A172161	1	Turret Assembly	Ref Fig 2
3	A172936	1	Swing Stop Installation	Ref Fig 3
4	A172162	1	Cab Installation	Ref Fig 4
5	A172163	1	Power Unit Installation	Ref Fig 5
6	A172164	1	Winch Installation	Ref Fig 6
7	A172841	1	Reeving Installation	Ref Fig 7
8	A172166	1	Load System Installation	Ref Fig 8
9	A172842	1	Anti-Two Block Installation	Ref Fig 9
10	A123130	1	Electrical Installation	Ref Fig 10
11	A115187	1	Hydraulic Installation	Ref Fig 11
12	A172174	1	Paint & Decal Installation	Ref Fig 12
13	A173025	1	Fluid Spec, PE-48M Crane	Ref Fig 13
14	A172908	1	Manual, Operator, Maintenance & Parts	Ref Fig 14

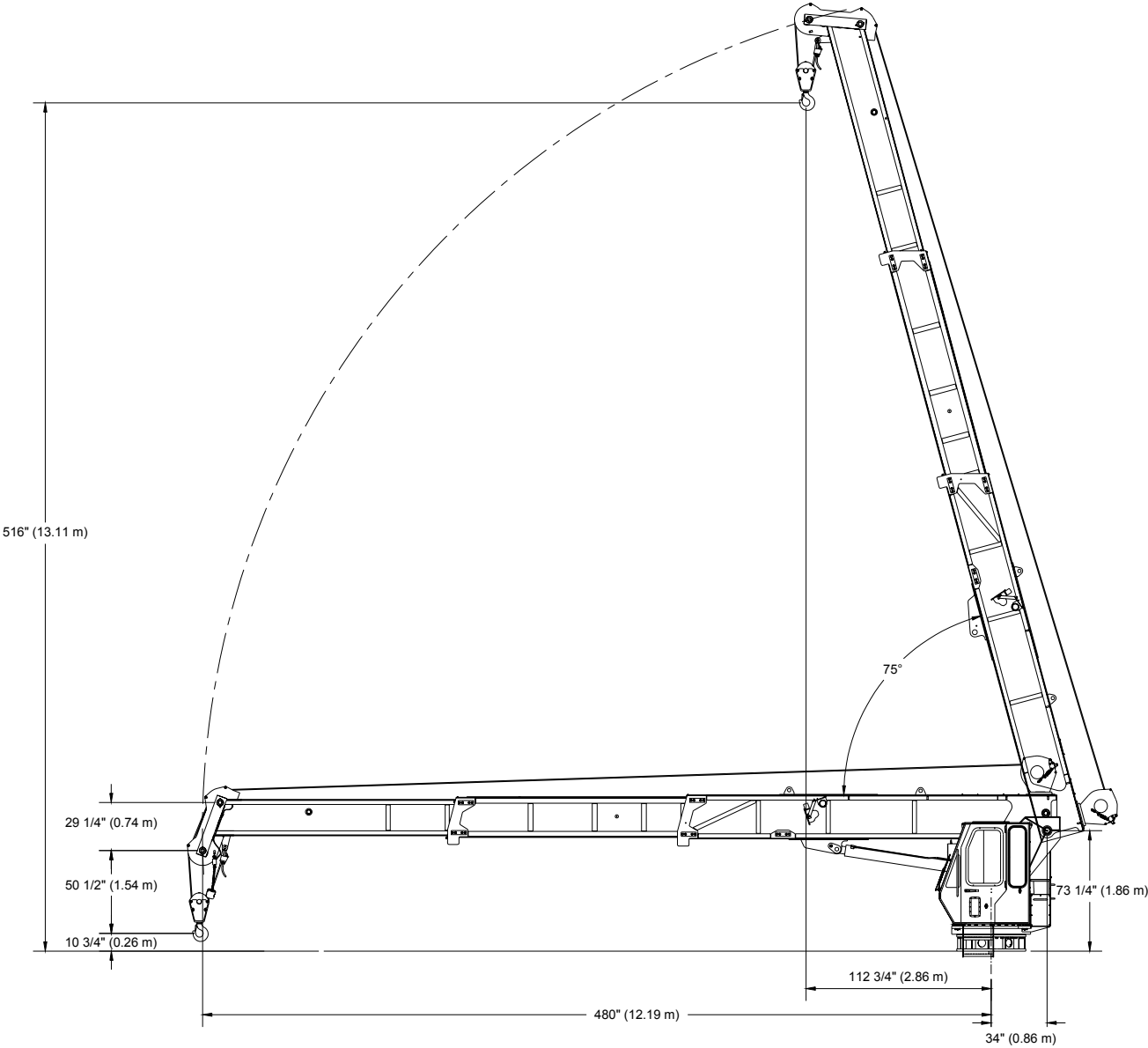


FIGURE GB

CRANE - LIMNOS, COAST GUARD

(SHEET 2 OF 3)

Figure GB

A171660

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172160	REF	Boom Installation	Ref Fig 1
2	A172161	REF	Turret Assembly	Ref Fig 2
3	A172936	REF	Swing Stop Installation	Ref Fig 3
4	A172162	REF	Cab Installation	Ref Fig 4
5	A172163	REF	Power Unit Installation	Ref Fig 5
6	A172164	REF	Winch Installation	Ref Fig 6
7	A172841	REF	Reeving Installation	Ref Fig 7
8	A172166	REF	Load System Installation	Ref Fig 8
9	A172842	REF	Anti-Two Block Installation	Ref Fig 9
10	A123130	REF	Electrical Installation	Ref Fig 10
11	A115187	REF	Hydraulic Installation	Ref Fig 11
12	A172174	REF	Paint & Decal Installation	Ref Fig 12
13	A173025	REF	Fluid Spec, PE-48M Crane	Ref Fig 13
14	A172908	REF	Manual, Operator, Maintenance & Parts	Ref Fig 14

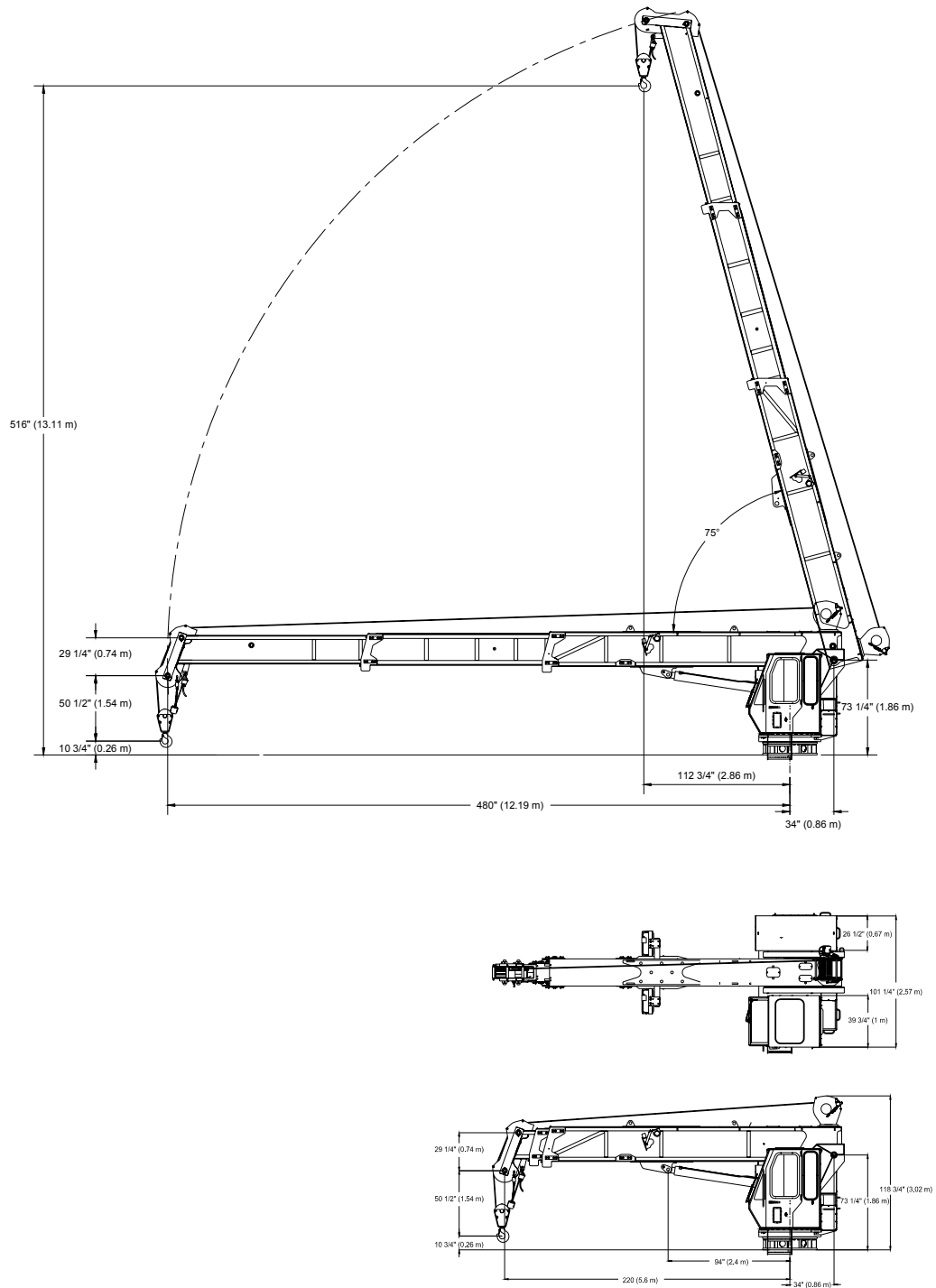


FIGURE GC

CRANE - LIMNOS, COAST GUARD

(SHEET 3 OF 3)

Figure GC

A171660

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172160	REF	Boom Installation	Ref Fig 1
2	A172161	REF	Turret Assembly	Ref Fig 2
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11	A115187	REF	Hydraulic Installation	Ref Fig 11
12	A172174	REF	Paint & Decal Installation	Ref Fig 12
13	A173025	REF	Fluid Spec, PE-48M Crane	Ref Fig 13
14	A172908	REF	Manual, Operator, Maintenance & Parts	Ref Fig 14

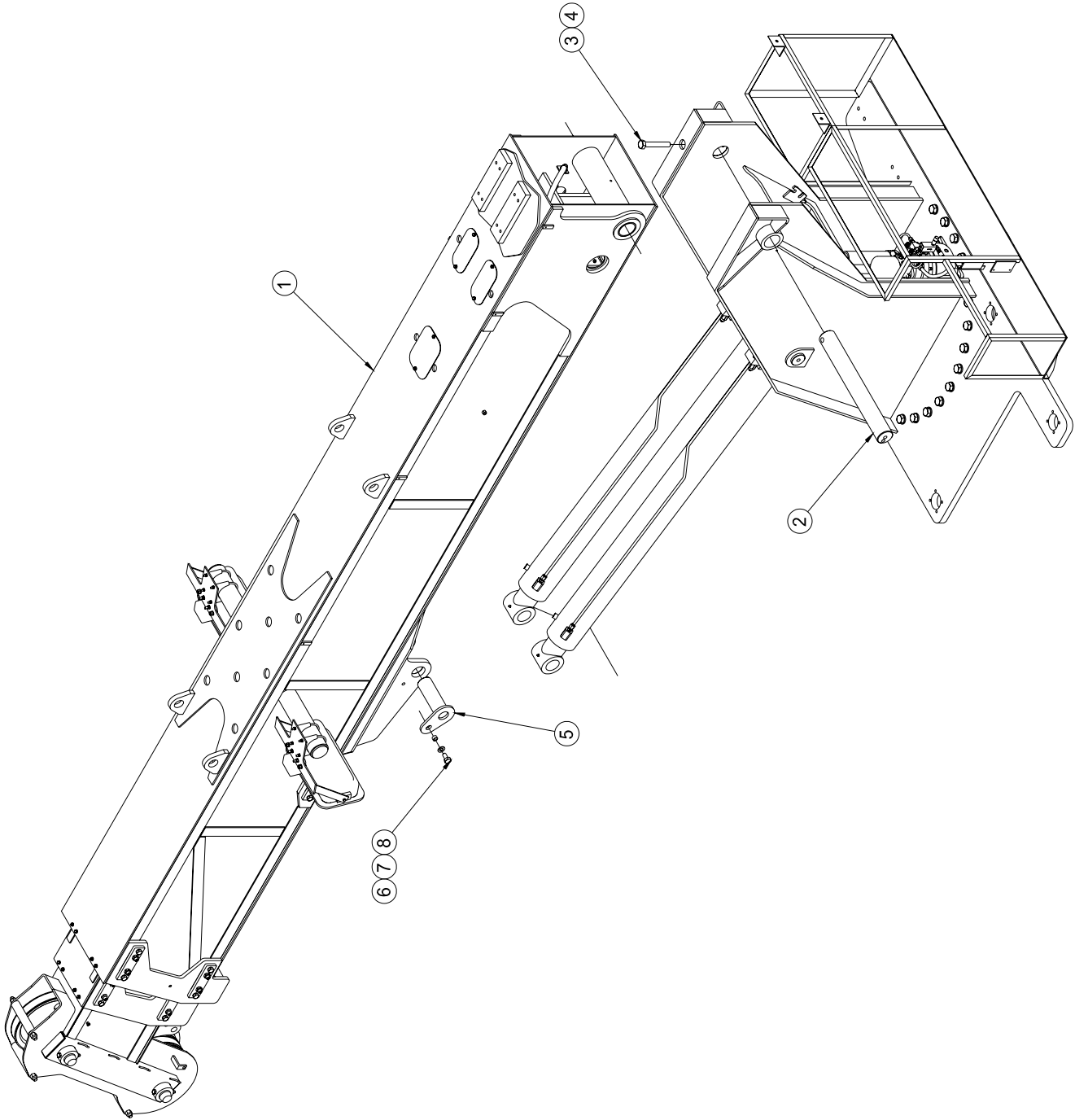


FIGURE 1

BOOM INSTALLATION

Figure 1

A172160

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172170	1	Boom Assembly
2	A167639	1	Pin,Pivot
3	A100985	1	Bolt, 1-8Nc X 6-1/2" Gr 8 (Hex)
4	A102533	1	Nut, 1-8Nc (Hex) Gr8
5	A167638	2	Pin Weldment - Lift Cylinder
6	A162319	2	Tube Spacer,1"Dia
7	A103007	2	Washer, 3/4" (Flat)
8	A100717	2	Bolt, 3/4-10Nc X 1-1/2" Gr 8 (Hex)

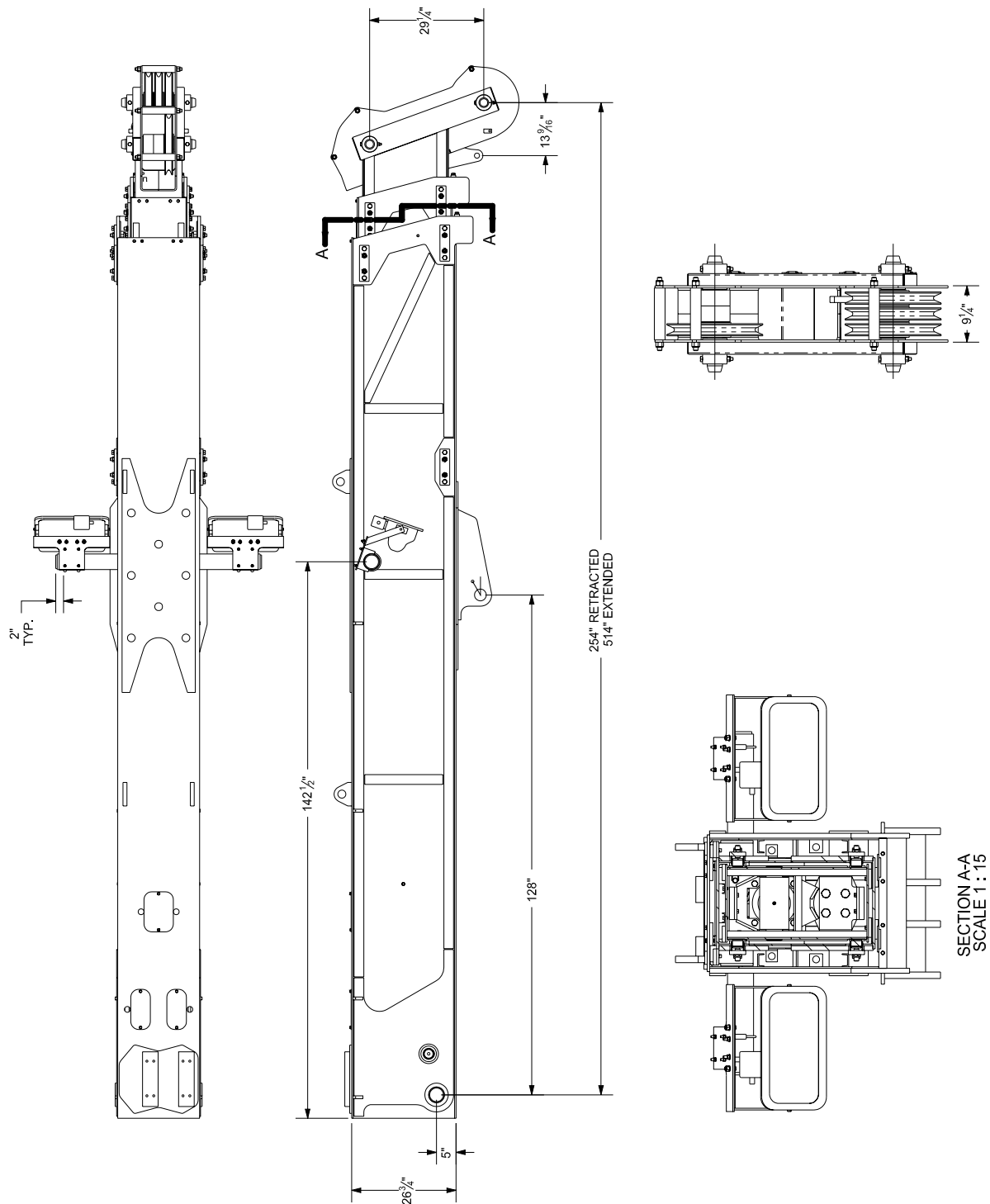


FIGURE 1-1A

BOOM ASSEMBLY

(SHEET 1 OF 2)

Figure 1-1A

A172170

Drawing Rev C

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172281	1	Boom Base Machining	
2	A172172	1	Boom Mid Weldment	
3	A172282	1	Boom Fly Machining	
4	A115178	1	Extend Cylinder Assembly, Lower	Ref Fig 1-1a
5	A115180	1	Extend Cylinder Assembly, Upper	Ref Fig 1-1b
6	A161871	1	Pin, Cylinder-Lower, Base	
7	A150924	6	Retaining-Ring, 2-1/2" Regular	
8	A162108	6	Wear Pad Side Assembly - Base	Ref Fig 1-1c
9	A162084	4	Wear Pad, Front Lower	
10	A162082	2	Pad Rtr-Base	
11	A167510	2	Spacer-Base	
12	A103202H	16	Washer-Lock, 3/8"	
13	A167516	2	Plate-Cover	
14	A167517	1	Plate-Cover,	
15	A103204	8	Washer-Lock, 1/2" (High Alloy)	
16	A103206	20	Washer-Lock, 5/8" (High Alloy)	
17	A100200H	14	Bolt, 3/8-16Nc X 1/2" Gr 5 (Hex)	
18	A100204H	24	Bolt, 3/8-16Nc X 3/4" Gr 5 (Hex)	
19	A100212H	4	Bolt, 3/8-16Nc X 1-1/4" Gr 5 (Hex)	
20	A100413H	8	Bolt, 1/2-13 Nc X 1-1/4" Gr 8 (Hex)	
21	A100472H	4	Bolt, 1/2-13Nc X 5" Gr 5 (Hex)	
22	A100617	20	Bolt, 5/8-11Nc X 1-1/2" Gr 8 (Hex)	
23	A167509	4	Wear Pad, Side Assembly - Mid	Ref Fig 1-1d
24	A161870	1	Pin, Cylinder - Upper, Mid	
25	A167508	2	Spacer-Base	
26	A162083	2	Pad-Retainer	
27	A162028	4	Wear Pad Assembly - Back Lower	Ref Fig 1-1e
28	A162030	2	Cylinder. Retainer Plate	
29	A101634	4	Bolt, 3/4-10Nc X 3" (Soc)	
30	A102070	4	Bolt, 3/8 X 1/2" X 5/16-18Nc (Shoulder)	
31	A162100	4	Wear Pad - Cylinder	
32	A162003	4	Plate-Retainer	
33	A162027	4	Wear Pad, Back Upper	
34	A161859	1	Pin, Cylinder - Upper Fly	
35	A167699	2	Wear Pad Assembly, Fly Side	Ref Fig 1-1f
36	RM01211-12	3	Rod, 3/4-10Nc X 12" Gr 5 (Threaded)	
37	A102725	6	Nut-Nylock, 3/4-10Nc Gr8 (Hex)	
38	A102713H	4	Nut-Nylock, 1/2-13Nc Gr8	
39	A167514	2	Pin-Sheave	
40	A167798	4	Sheave Assembly 3/4-16 Dia	

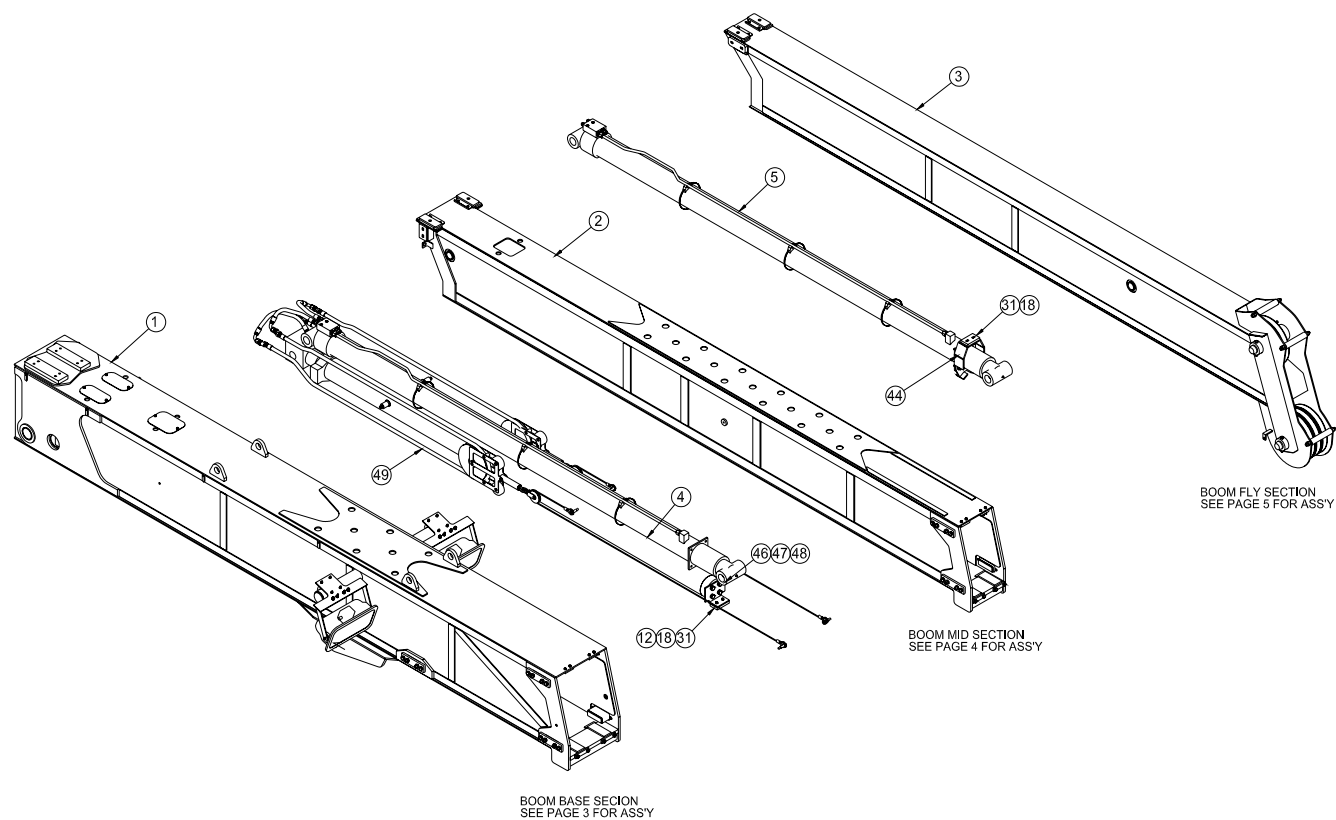


FIGURE 1-1B

BOOM ASSEMBLY

(SHEET 2 OF 2)

Figure 1-1B

A172170

Drawing Rev C

ITEM	PART NO.	QTY.	DESCRIPTION
41	A167552	4	Shim-Sheave,
42	A167515	2	Spacer-Sheave
43	A167513	3	Pipe Spacer Weldment
44	A162102	1	Wear Pad Bracket Weldment - Upper Cylinder
45	A102712H	4	Nut-Nylock, 1/2-13Nc Gr5
46	A162104	1	Wear Pad Bracket - Lower Cylinder
47	A103207H	4	Washer-Lock, 3/4"
48	A100717	4	Bolt, 3/4-10Nc X 1-1/2" Gr 8 (Hex)
49	A172175	1	Hose Extension Installation
50	A172533	2	Flood Light Bracket Assembly

Ref Fig 1-1g

Ref Fig 1-1h

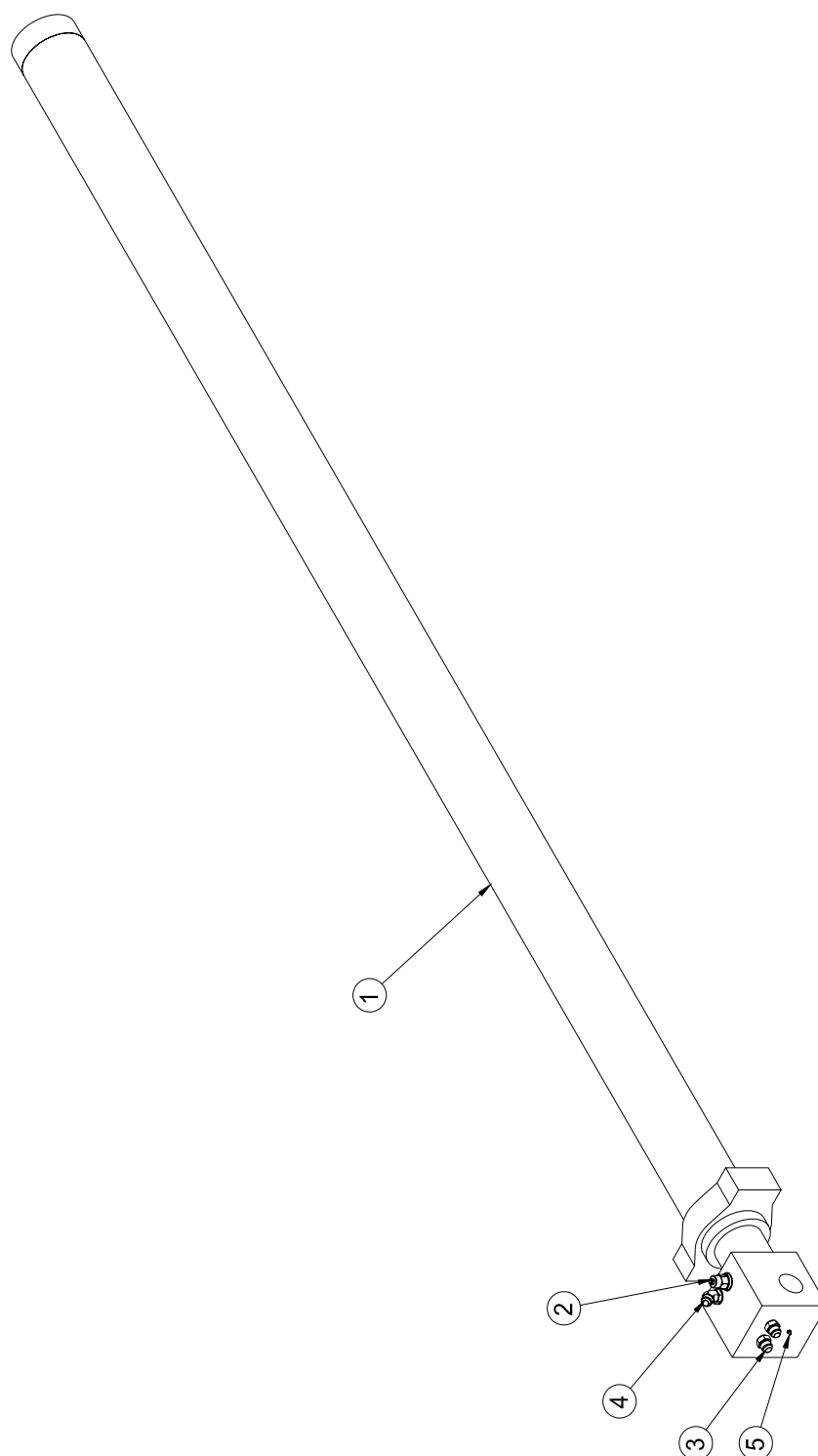


FIGURE 1-1a

EXTEND CYLINDER ASSEMBLY, LOWER

Figure 1-1a

A115178

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A115177	1	Cylinder, Extend, Lower	Ref Fig 1-1aa
2	A111931	1	Valve, Cartridge	
3	A13850	2	Adapt, 12Sae - 12Jicm	
4	A17466	1	Adapt-45, 12Saem - 12Jicm	
5	J00007	1	Fitting, Grease 1/8-27Npt	

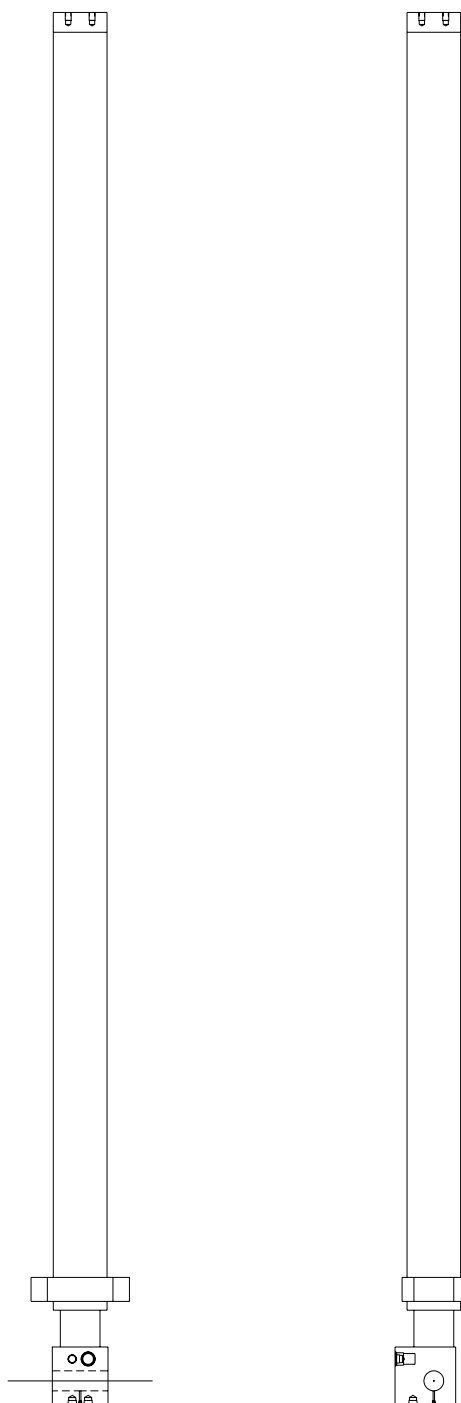


FIGURE 1-1aa

EXTEND CYLINDER

Figure 1-1aa

A115177

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115339	1	Seal Kit
Seal Kit Consists of:			
		1	Piston Seal
		2	Wear Ring
		1	O-Ring
		1	O-Ring
		1	Back-Up Ring
		1	Rod Seal
		1	Wear Ring
		1	Wiper

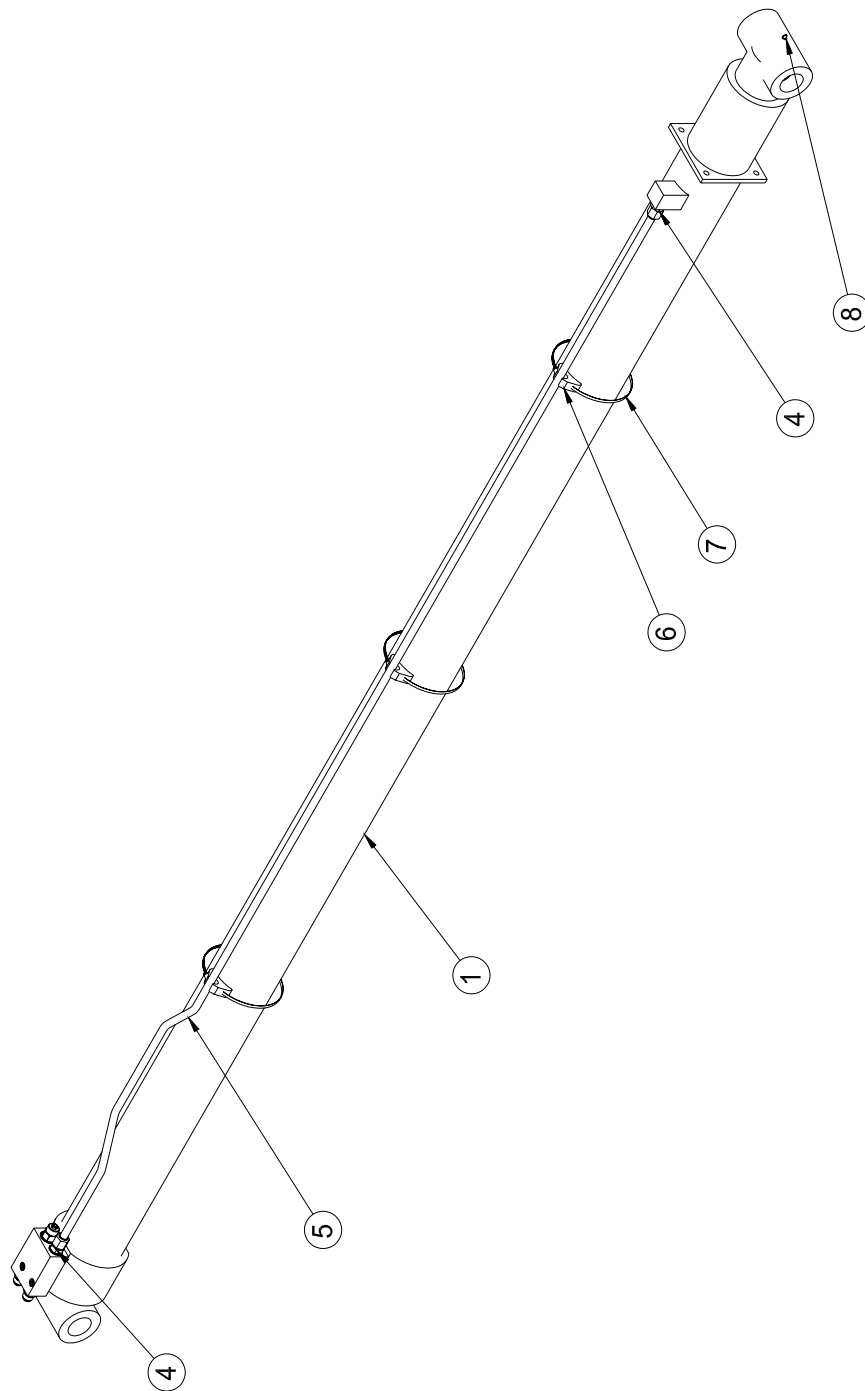


FIGURE 1-1b

EXTEND CYLINDER ASSEMBLY, UPPER

Figure 1-1b

A115180

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A115179	1	Cylinder, Extend, Upper	Ref Fig 1-1ba
2	A111930	1	Valve	
3	A101428	2	Bolt, 1/2-13Nc X 2-3/4" (Soc)	
4	A13850	4	Adapt, 12Sae - 12Jicm	
5	A115189	1	Hydraulic Tube Assembly 3/4"	
6	A195655	3	Clamp, Saddle	
7	A167842	3	Clamp, Gear Type 8" Hose	
8	J00007	2	Fitting, Grease 1/8-27Npt	

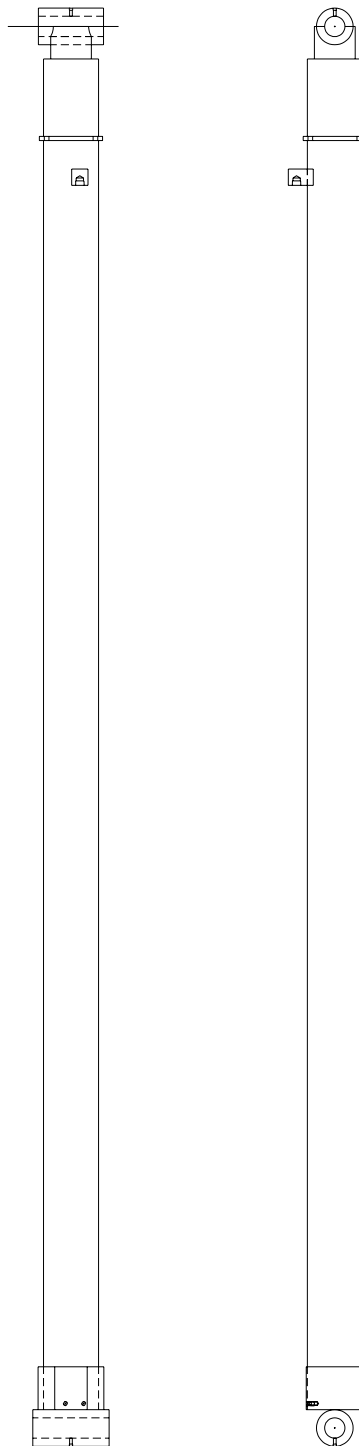


FIGURE 1-1ba

EXTEND CYLINDER

Figure 1-1ba

A115179

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115338	1	Seal Kit
Seal Kit Consists of:			
		1	Piston Seal
		2	Wear Ring
		1	O-Ring
		1	O-Ring
		1	Back-Up Ring
		1	Rod Seal
		1	Wear Ring
		1	Wiper

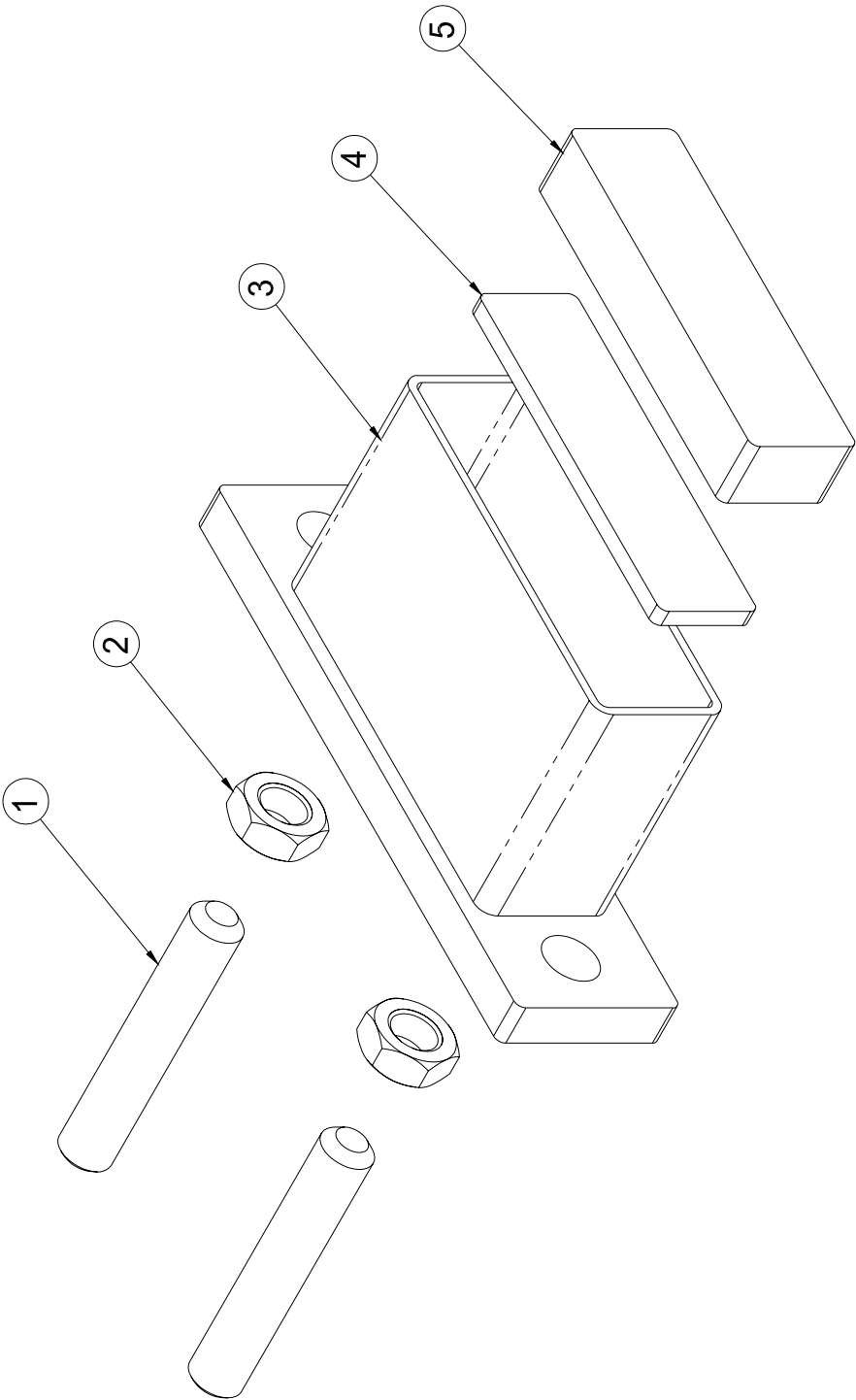


FIGURE 1-1c

WEAR PAD SIDE ASSEMBLY - BASE

Figure 1-1c

A162108

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A102228	2	Screw, 3/4-10Nc X 4-1/4 (Set Soc Hex)
2	A102814	2	Nut, 3/4-10Nc (Jam Rh)
3	A162106	1	Wear Pad Holder - Base
4	A162110	1	Plate
5	A162109	1	Wear Pad

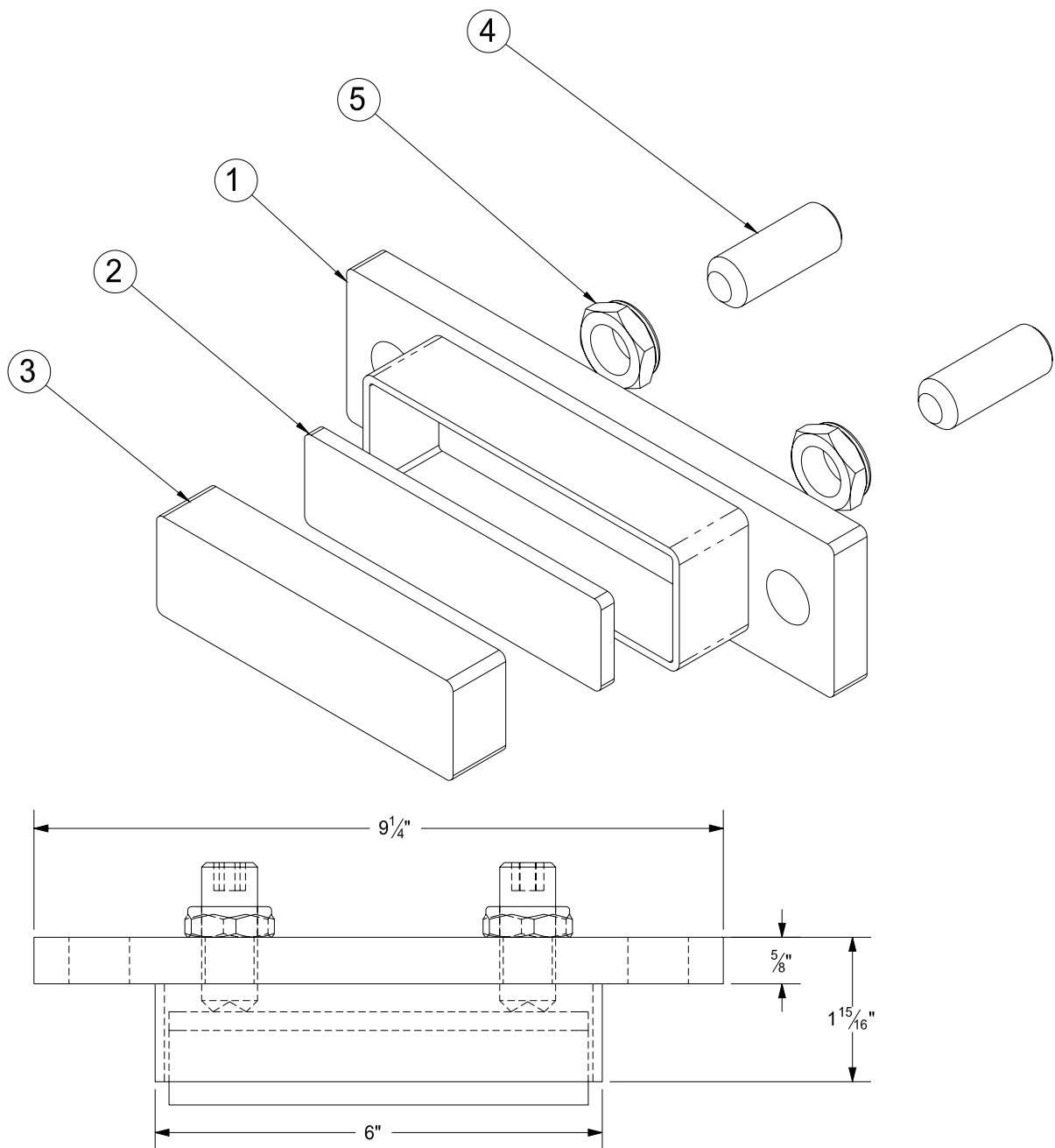


FIGURE 1-1d

WEAR PAD, SIDE ASSEMBLY**Figure 1-1d****A167509****Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A162109	1	Wear Pad
2	A162110	1	Plate
3	A167530	1	Wear Pad Holder Weldment- Mid
4	A102724	2	Nut-Nylock, 3/4-10Nc Gr5
5	A102211	2	Screw, 3/4-10Nc X 2" (Set Soc Hd Hex)
6	A100716	2	Bolt, 3/4-10Nc X 1-1/2" Gr 5 (Hex)
7	A103206H	2	Washer-Lock, 5/8" (Flat Hard)

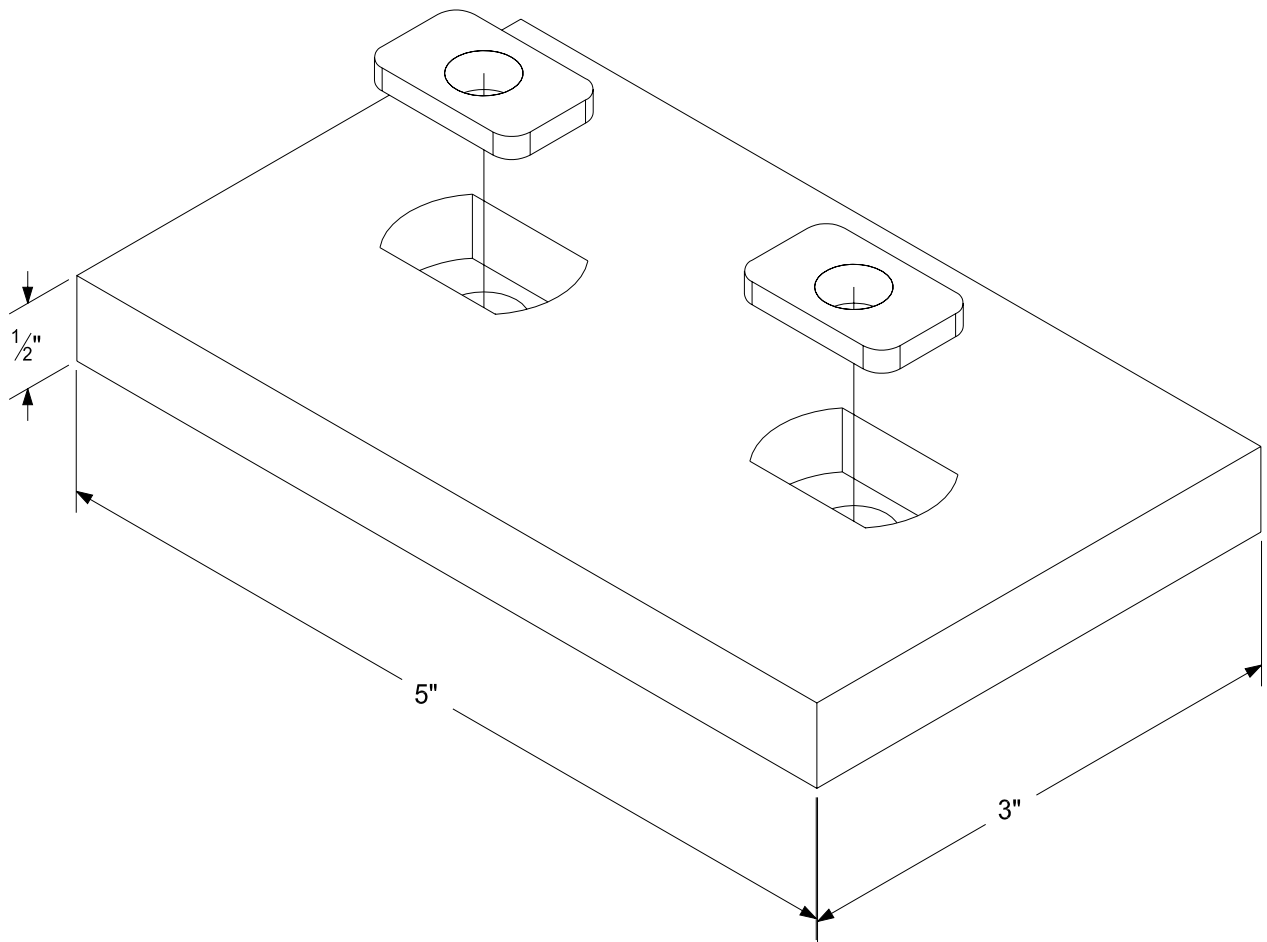


FIGURE 1-1e

Figure 1-1e **A162028** **Drawing Rev -**

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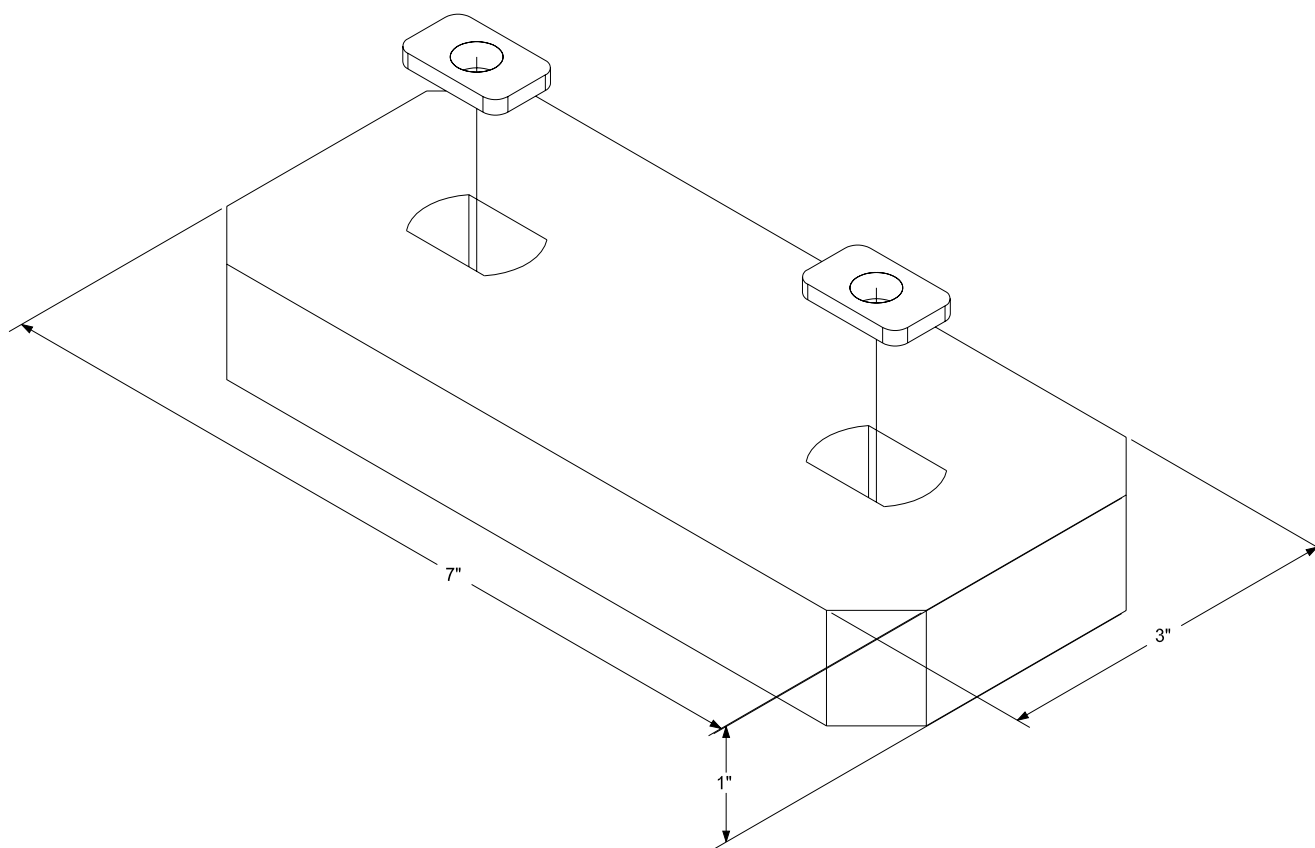


FIGURE 1-1f

WEAR PAD ASSEMBLY, FLY SIDE

Figure 1-1f

A167699

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A102848	2	Nut, 3/8-16Nc X1" (Tab Weld)
2	A167700	1	Wear Pad

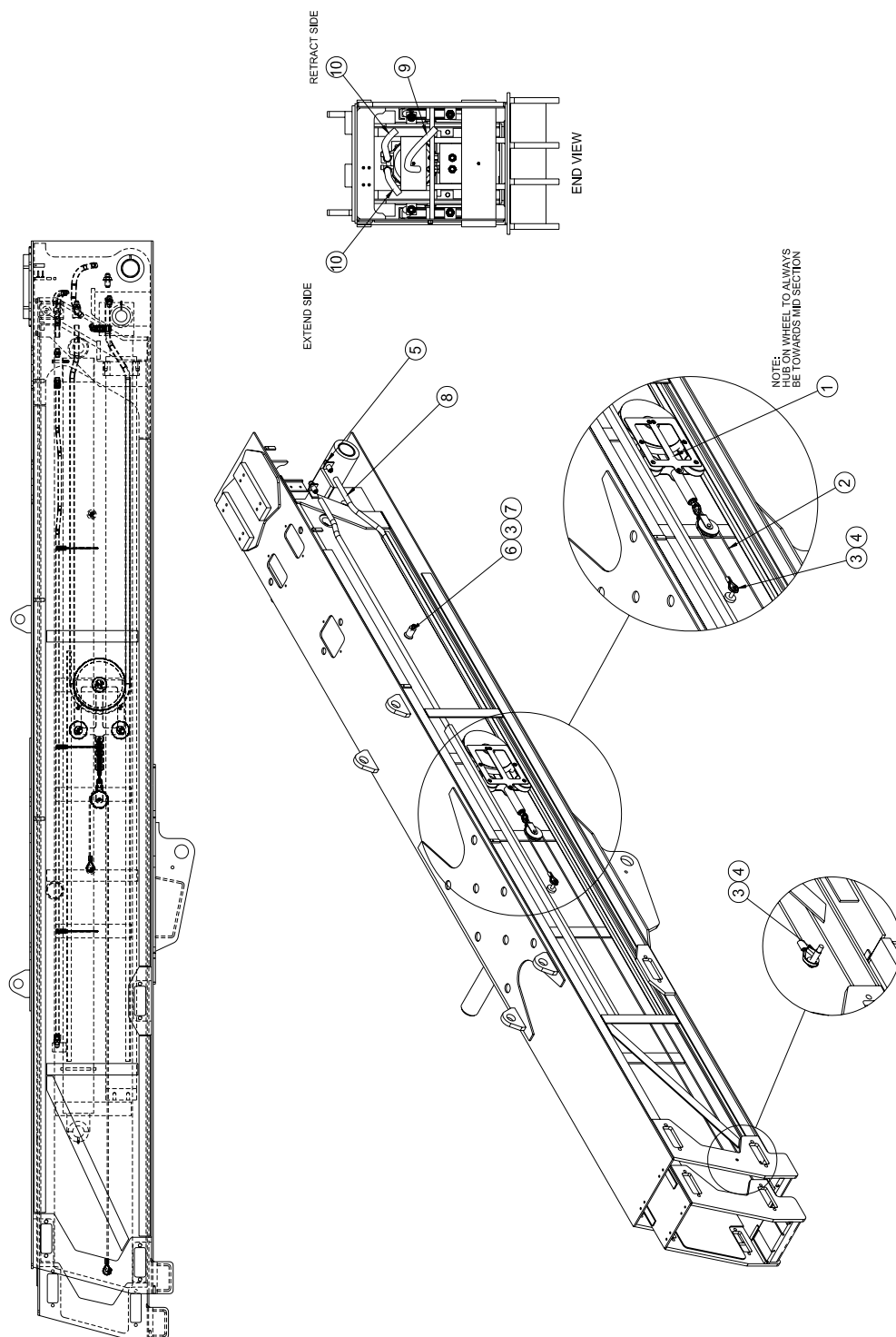


FIGURE 1-1g

HOSE EXTENSION INSTALLATION

Figure 1-1g

A172175

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171162	2	Hose Reel Assembly
2	A172352	2	Cable Assembly - 1/4"
3	A102065	6	Bolt, 5/8 X 1-3/4" (Shoulder)
4	A103060	4	Washer, 1/2" 1-3/8 Od (Plain Large)
5	A13902	4	Adapt, 12Jic - 12Jic (Bulkhead)
6	H00900-182	2	Hose Assembly - 3/4"
7	A164224	2	Roller
8	A102713H	2	Nut-Nylock, 1/2-13Nc Gr8
9	H00902-26	1	Hose-Assembly - 3/4"
10	H00902-24	2	Hose-Assembly - 3/4"

Ref Fig 1-1ga

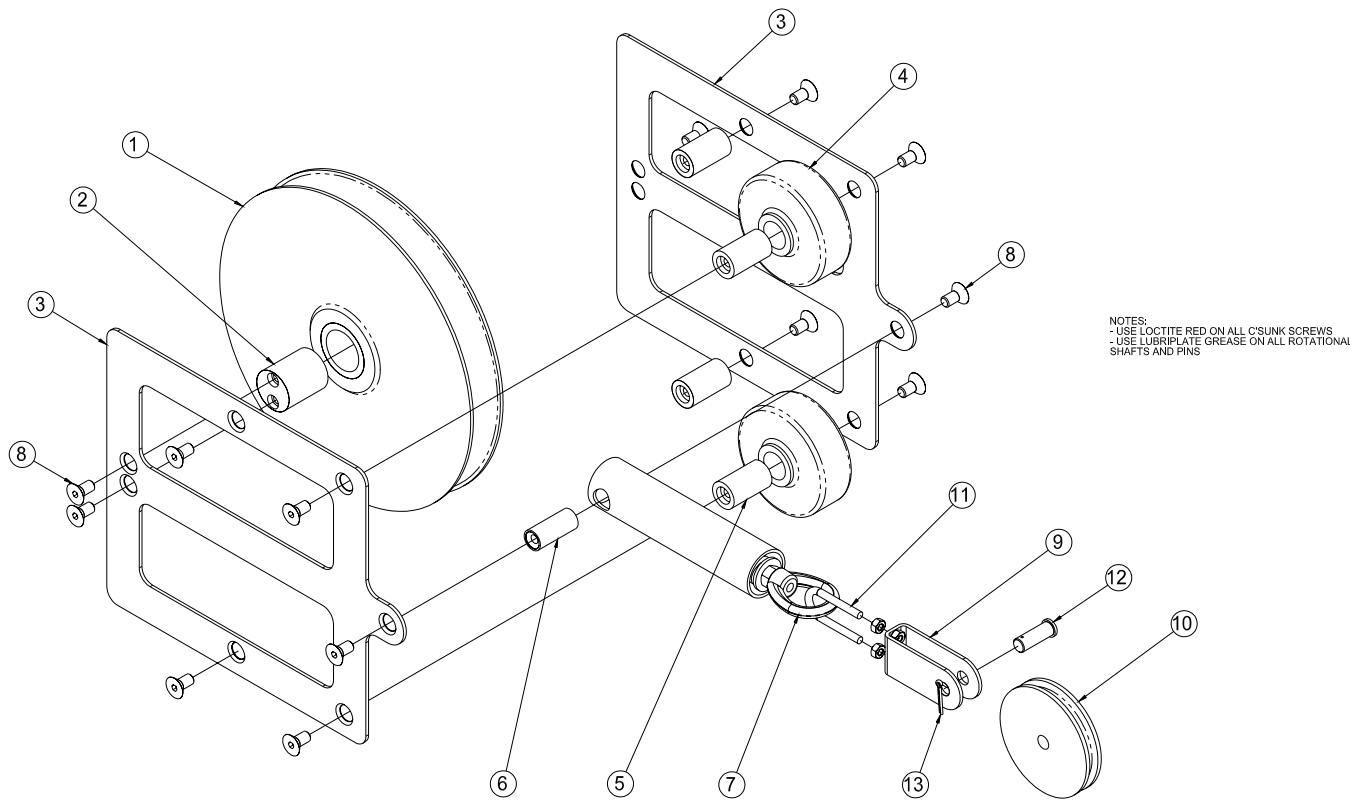


FIGURE 1-1gaA

HOSE REEL ASSEMBLY

(SHEET 1 OF 2)

Figure 1-1ga

A171162

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171056	1	Sheave Modified
2	A171058	1	Shaft
3	A171057	2	Frame Plate
4	A159331	2	Roller
5	A159333	4	Shaft
6	A168086	1	Pin-Tapped
7	A167837	1	Drawbar Spring Assembly
8	A102258	14	Screw, 3/8-16Nc X 3/4 (Mach Flat Hd Slot
9	A159335	1	Frame"U"
10	A159336	1	Pulley
11	A102032	1	Bolt, 1/4-20Nc X 1" Crs (U)
12	A102500H	4	Nut, 1/4-20 Unc (Hex) Gr 5
13	A109506	1	Pin-Clevis
14	M00039	1	Pin-Cotter

Ref Fig 1-1gaa

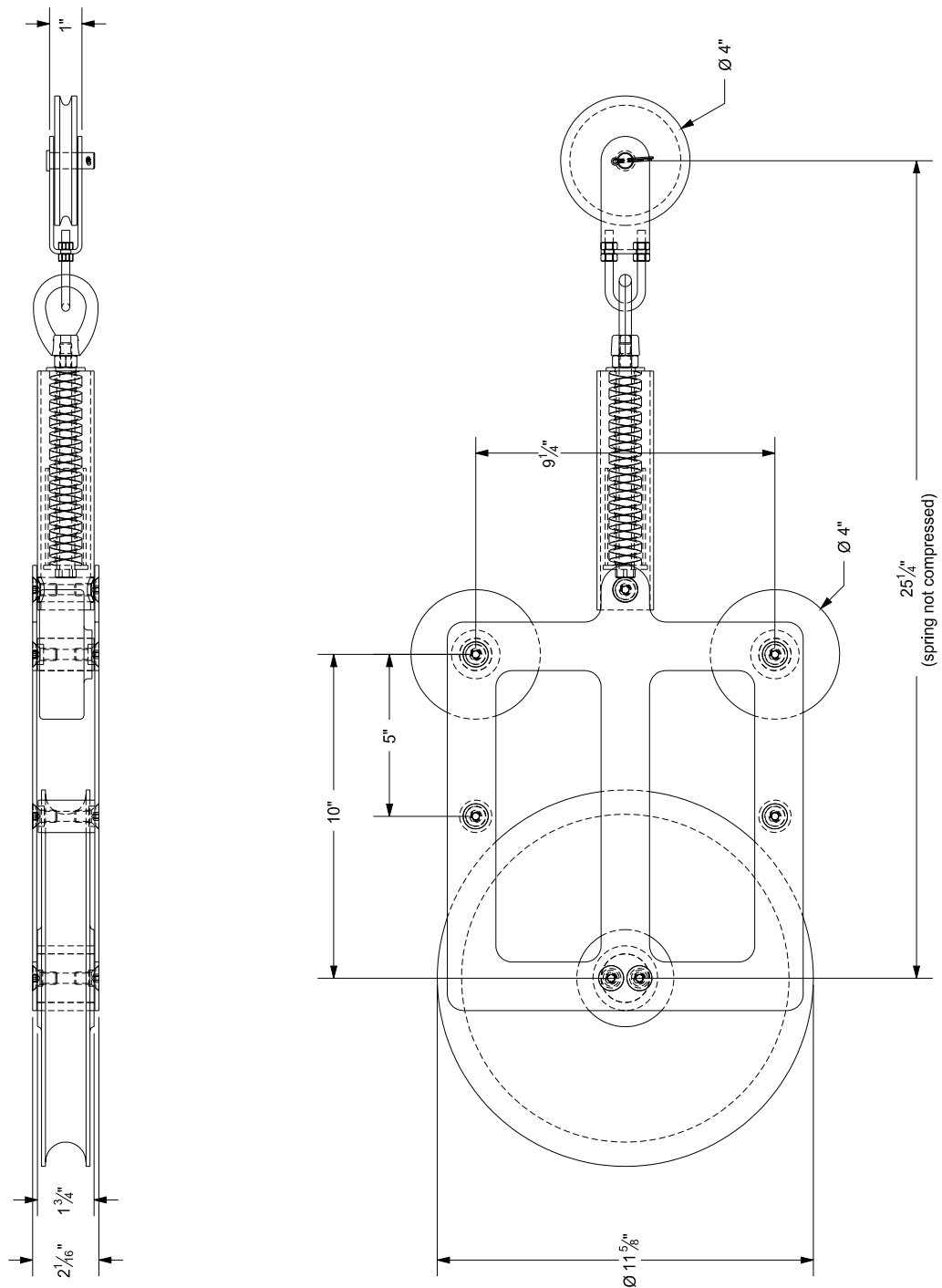


FIGURE 1-1gaB

HOSE REEL ASSEMBLY

(SHEET 2 OF 2)

Figure 1-1gaB

A171162

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A171056	REF	Sheave Modified
2	A171058	REF	Shaft
3	A171057	REF	Frame Plate
4	A159331	REF	Roller
5	A159333	REF	Shaft
6	A168086	REF	Pin-Tapped
7	A167837	REF	Drawbar Spring Assembly
8	A102258	REF	Screw, 3/8-16Nc X 3/4 (Mach Flat Hd Slot
9	A159335	REF	Frame"U"
10	A159336	REF	Pulley
11	A102032	REF	Bolt, 1/4-20Nc X 1" Crs (U)
12	A102500H	REF	Nut, 1/4-20 Unc (Hex) Gr 5
13	A109506	REF	Pin-Clevis
14	M00039	REF	Pin-Cotter

Ref Fig 1-1gaa

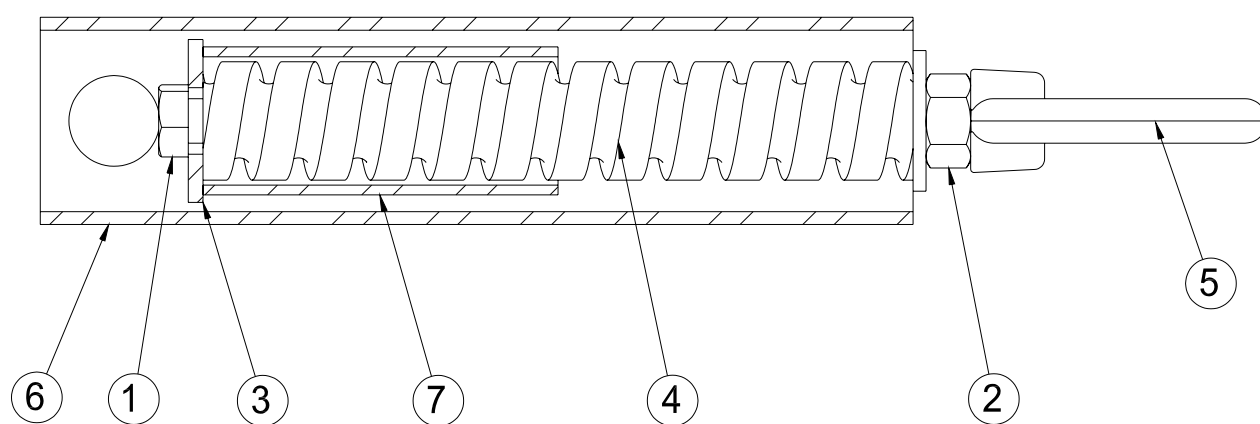


FIGURE 1-1gaa

DRAWBAR SPRING ASSEMBLY

Figure 1-1gaa

A167837

Drawing Rev D

ITEM	PART NO.	QTY.	DESCRIPTION
1	A100289H	1	Bolt, 3/8-16Nc X 7" Gr 8 (Hex)
2	A102505H	1	Nut, 3/8-16Nc (Hex) Gr8
3	A103004	1	Washer, 1/2" (Flat)
4	A167832	1	Spring Die 1X 6 Blue/Black
5	A168077	2	Eye Nut, Drop Forged, 5/16"
6	A167875	1	Tube Weldment - Drawbar
7	A167872	1	Tube-Stop Hydraulic

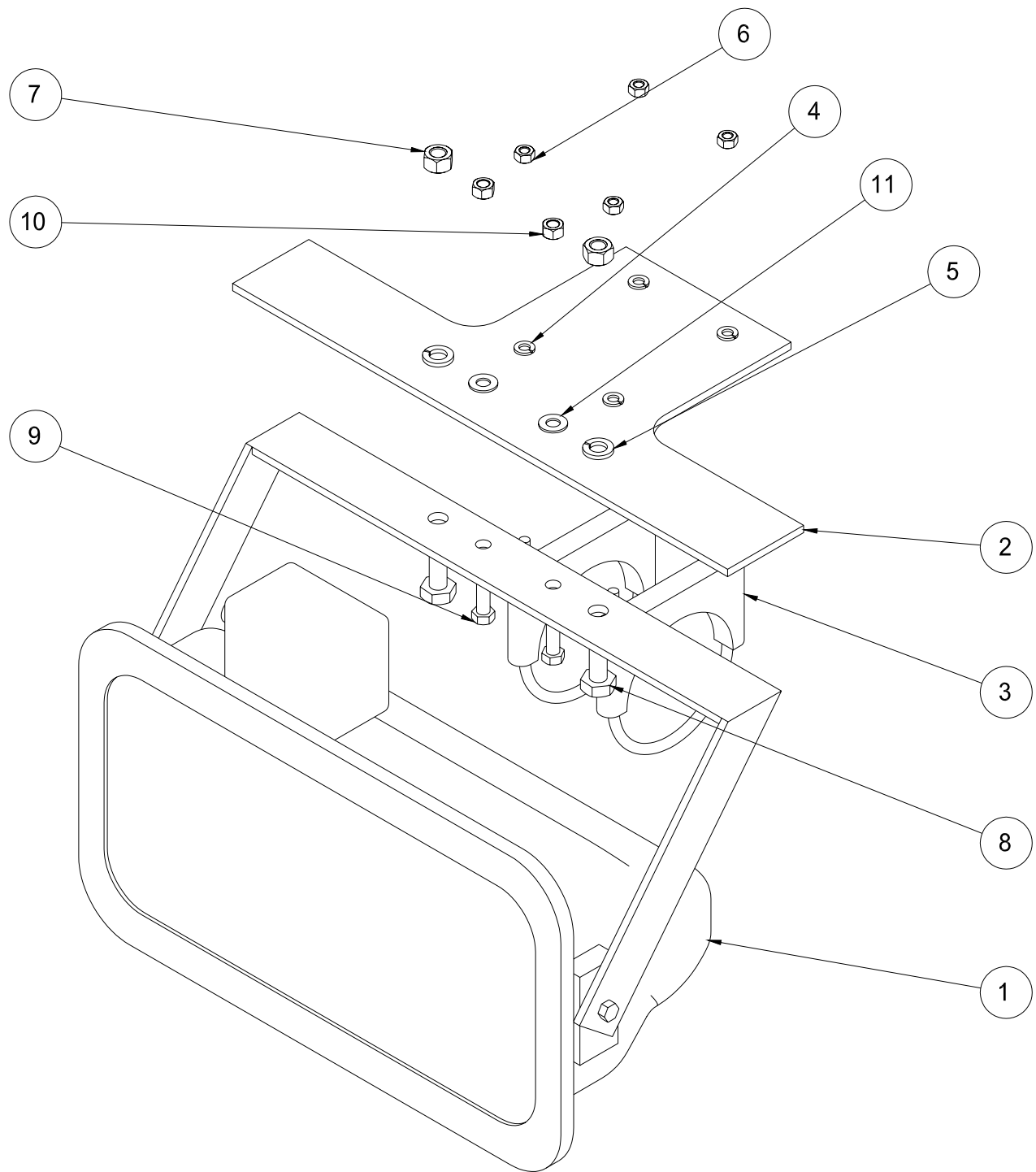


FIGURE 1-1h

FLOOD LIGHT BRACKET ASSEMBLY

Figure 1-1h

A172533

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172529	1	Floodlight, Halogen, 1000W
2	A172534	1	Plate, Floodlight Bracket Base
3	A153615	2	Clamp, Saddle, 4"
4	A103201H	4	Washer-Lock, 5/16"
5	A103204	2	Washer-Lock, 1/2" (High Alloy)
6	A102536H	4	Nut, 5/16-18Nc (Hex) Gr5
7	A102512H	2	Nut, 1/2-13Nc (Hex) Gr5
8	A100413H	2	Bolt, 1/2-13 Nc X 1-1/4" Gr 8 (Hex)
9	A100216H	2	Bolt, 3/8-16Nc X 1-1/2" Gr 5 (Hex)
10	A102506H	2	Nut, 3/8-24Nf (Hex) Gr5 (Fac)
11	A103022H	2	Washer, 3/8" (Flat Hard Gr8)
12	A172529-2	1	Bulb, Qtz Halogen, 300 W 119mm, 130V

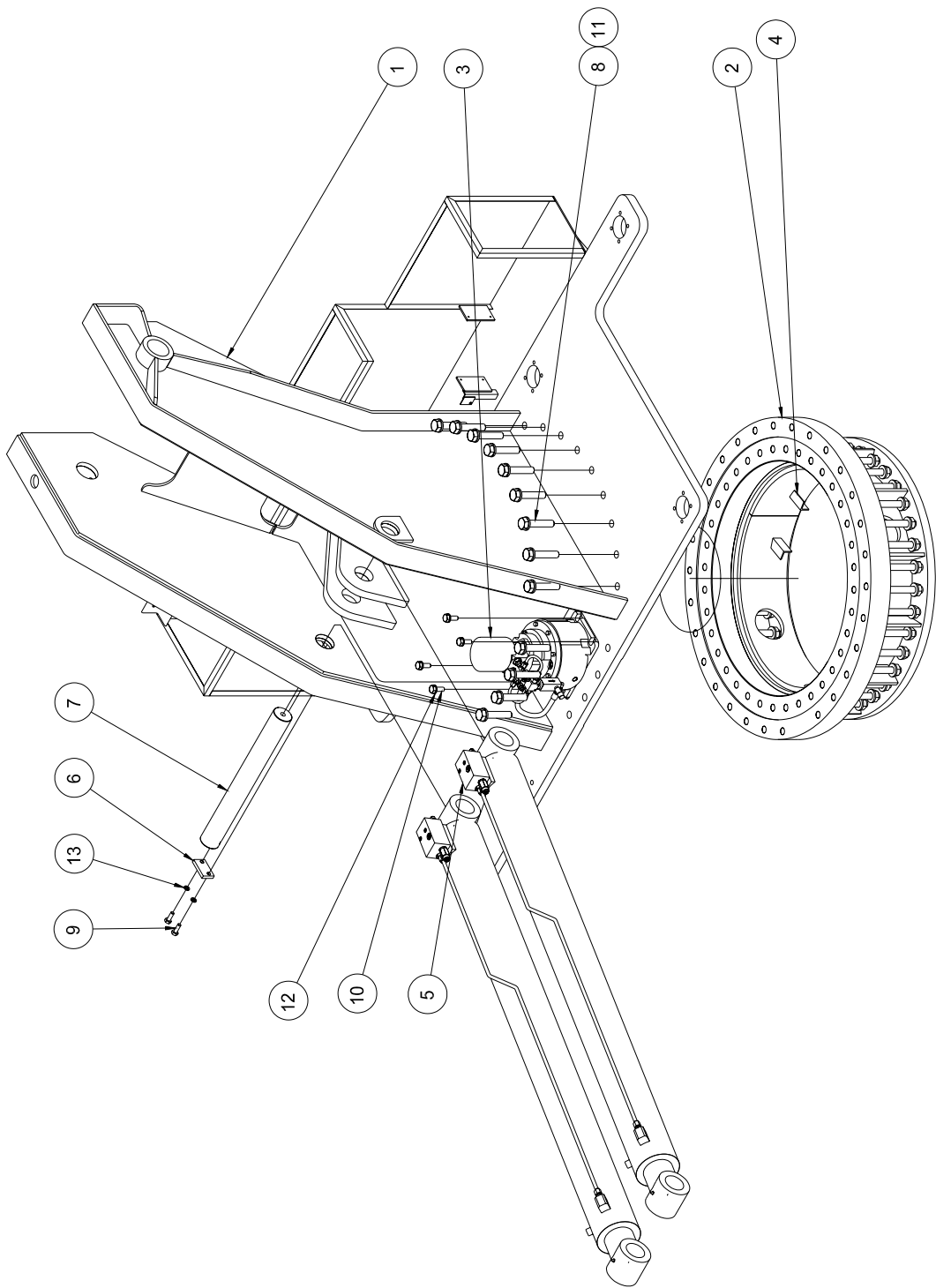


FIGURE 2

TURRET ASSEMBLY

Figure 2
A172161
Drawing Rev C

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172817	1	Turret Final Weldment
2	A172055	1	Bearing, Rotation, Series 3000
3	A172839	2	Slew Drive Assembly
4	A172692	1	Pedestal, Machining
5	A115182	2	Boom Lift Cylinder Assembly
6	A158645	1	Plate-Lock
7	A172713	1	Pin-Lift Cylinder
8	A100973	62	Bolt, 1-8Nc X 5" Gr 8 (Hex)
9	A100417H	2	Bolt, 1/2-13Nc X 1-1/2" Gr 8 (Hex)
10	A100621	8	Bolt, 5/8-11Nc X 1-3/4" Gr 8 (Hex)
11	FS00130	62	Washer, 1" High Strength, Thick, Sae
12	A103026	8	Washer, 5/8" (Flat Hard)
13	A103204	2	Washer-Lock, 1/2" (High Alloy)
14	A172894	1	Electric Swivel Assembly

Ref Fig 2-1

Ref Fig 2-2

Ref Fig 2-3

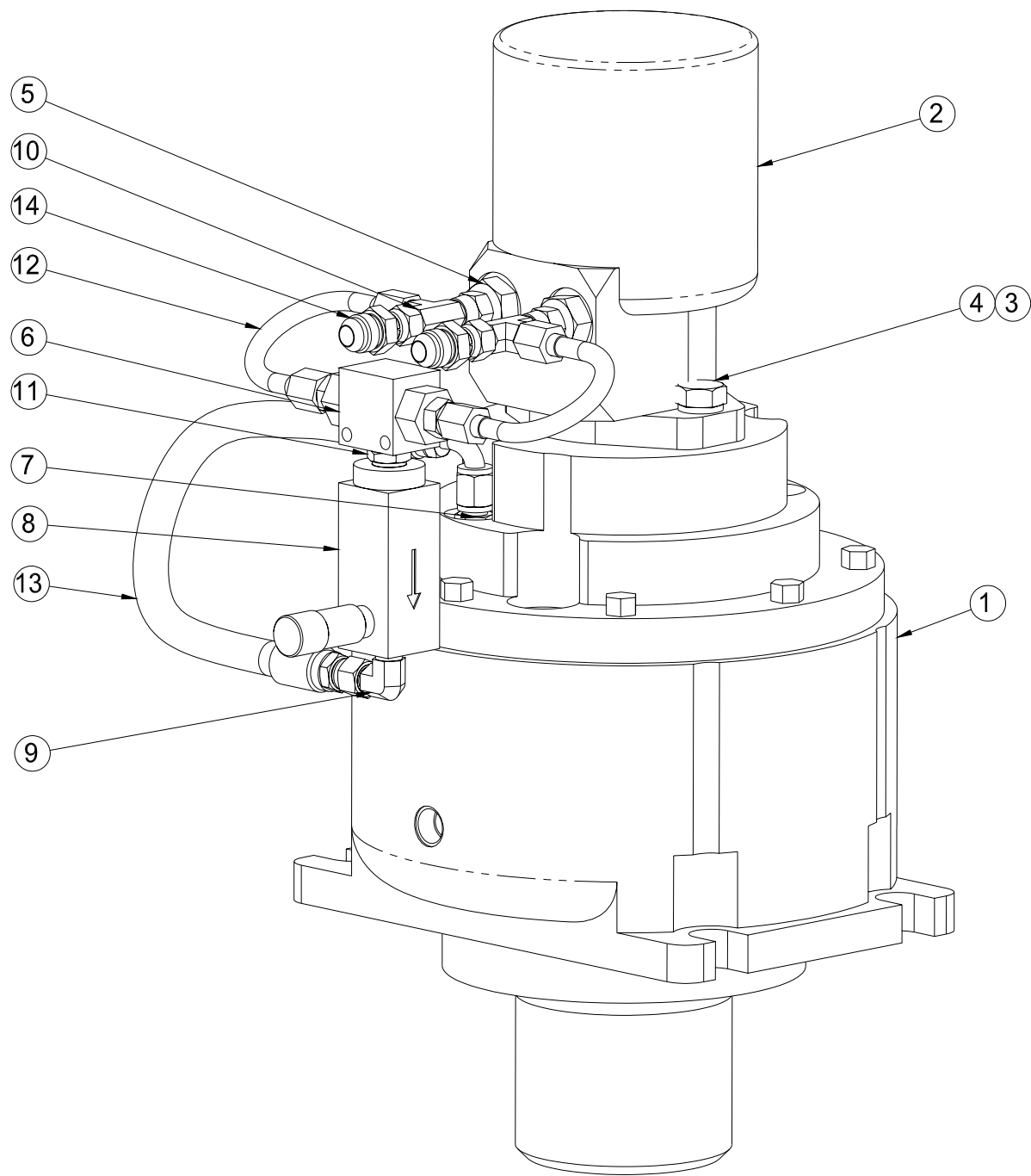


FIGURE 2-1

SLEW DRIVE ASSEMBLY

Figure 2-1

A172839

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172564	1	Gear Box, Swing Drive
2	A110879	1	Hydraulic Motor, 8.0 Cir
3	A103204	2	Washer-Lock, 1/2" (High Alloy)
4	A100421H	2	Bolt, 1/2-13Nc X 1-3/4" Gr 8 (Hex)
5	A16166	2	Adapt, 10Sae - 6Jicm
6	A111137	1	Valve, Shuttle 6Sae (Gresen)
7	A13240	3	Adapt, 6Sae - 6Jicm
8	A115274	1	Valve, Flow Control, 3/8"
9	A13905	1	Adapt-90, 3/8Nptm - 6Jicm
10	A13893	2	Adapt-Tee, 6Jicf/S - 6Jicm (Run)
11	A115288	1	Adapt, 3/8Nptm - 6Sae
12	A115289	2	Hyd. Tube Assembly - 3/8"
13	H00853-15	1	Hose Assembly - 3/8"
14	A115297	2	Adapt, 6Jicf - 8Jicm (A113180)

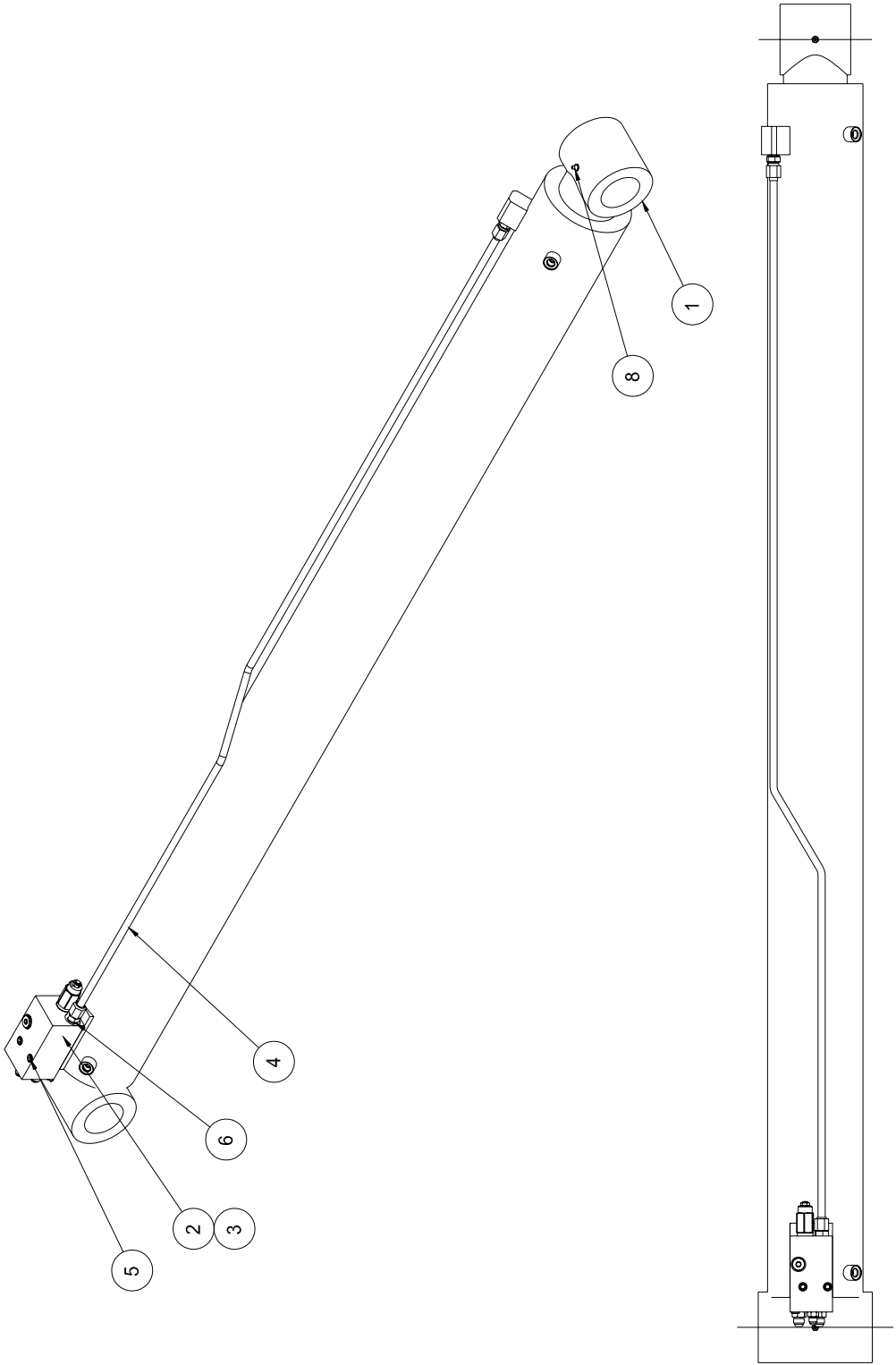


FIGURE 2-2

BOOM LIFT CYLINDER ASSEMBLY

Figure 2-2

A115182

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A115181	1	Cylinder, Boom Lift	Ref Fig 2-2a
2	A115261	1	Manifold	
3	A115262	1	Cartridge	
4	A115277	1	Hydraulic Tube Assembly - 1/2"	
5	A101310	2	Bolt, 3/8-16Nc X 3" (Soc)	
6	A13886	4	Adapt, 8Sae - 8Jicm	
7	J00007	2	Fitting, Grease 1/8-27Npt	

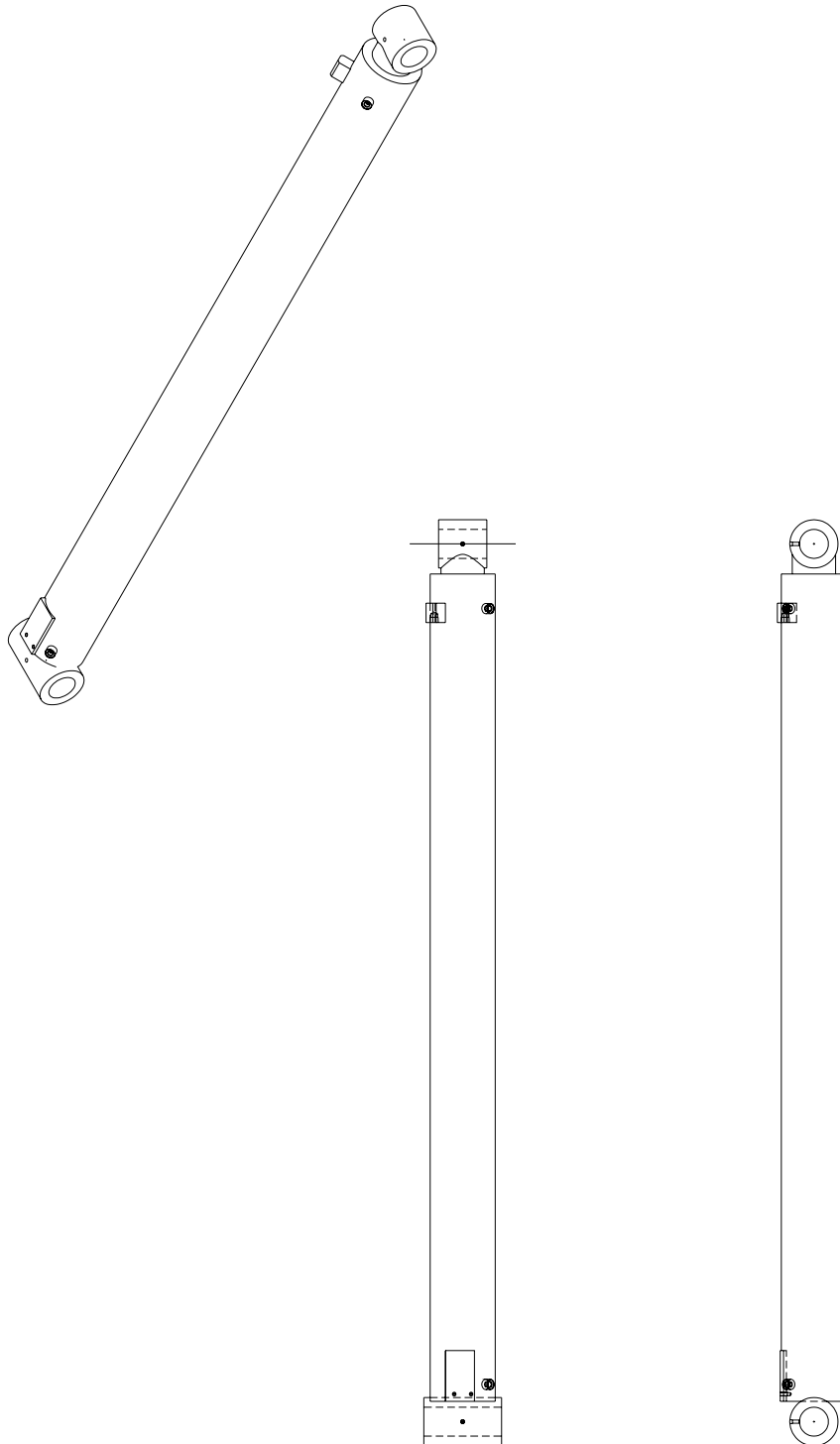


FIGURE 2-2a

LIFT CYLINDER

Figure 1-1ba

A115181

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115337	1	Seal Kit
Seal Kit Consists of:			
		1	Piston Seal
		2	Wear Ring
		1	O-Ring
		1	O-Ring
		1	Back-Up Ring
		1	Rod Seal
		1	Wear Ring
		1	Wiper

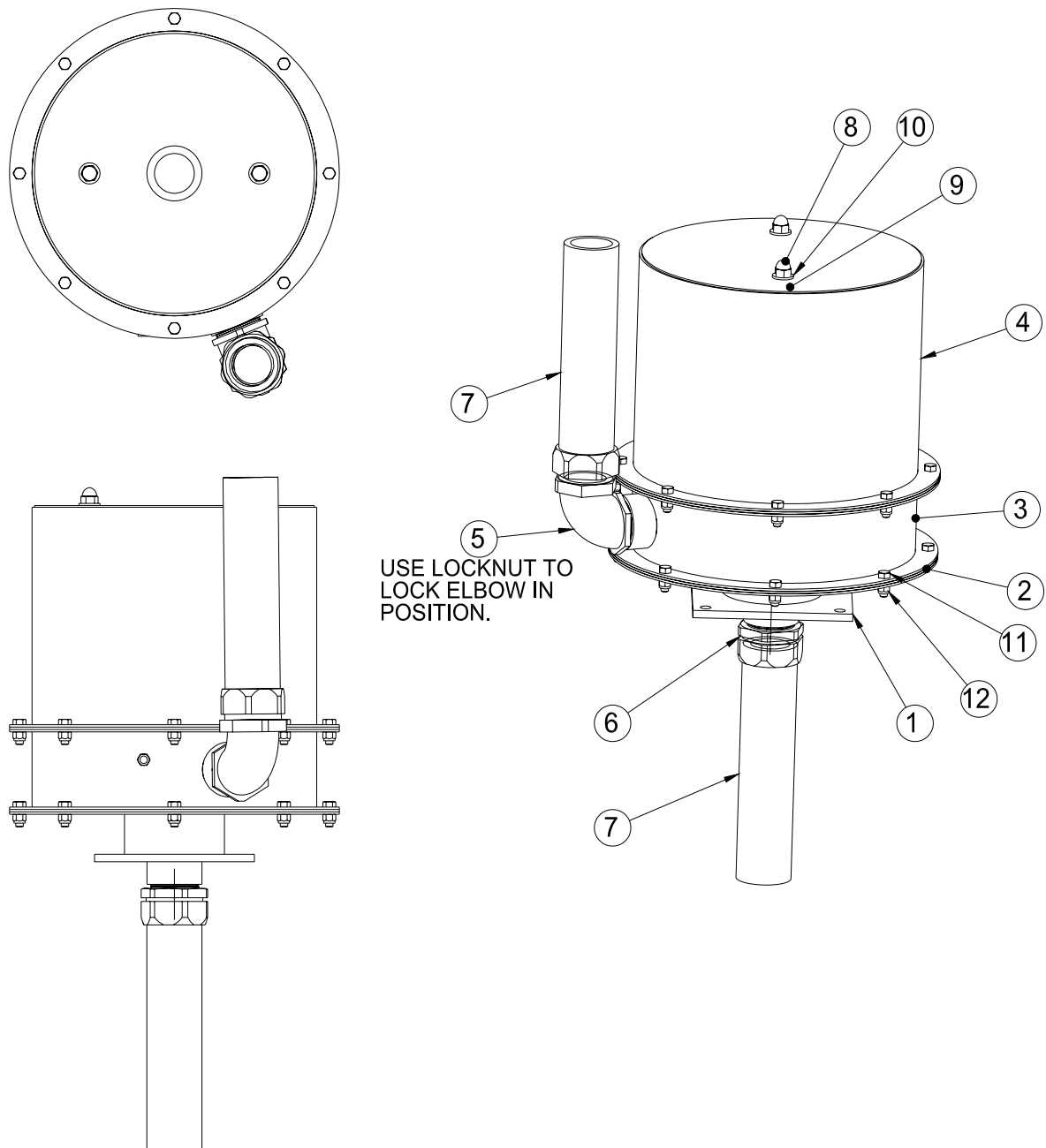


FIGURE 2-3

ELECTRIC SWIVEL ASSEMBLY

Figure 2-3

A172894

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123155	1	Swivel Assy, Electric
2	A172893	2	Gasket, Rubber
3	A172887A	1	Spacer Weldment, Electric Swivel
4	A172890A	1	Top Weldment, Electric Swivel
5	A122441	1	L/T Connector, 2" 90°
6	A122418	1	L/T Connector, 2"
7	RM01339	160	Conduit, 2" Flexible (Liquid-Tite)
8	FS00232	2	Nut-Cap, 1/2-13 Nc, ss
9	A102512H	2	Nut, 1/2-13Nc (Hex) Gr5
10	FS00233	2	Washer-Flat, 1/2" Sealing
11	A100208H	16	Bolt, 3/8-16Nc X 1" Gr 5 (Hex)
12	A102704H	18	Nut-Nylock, 3/8-16Nc Gr5 (Fac)
13	A123263	3	Lug, 1 Awg 2 Hole 1/4 Stud Panduit
14	A123262	1	Sleeve, Insuliner
15	A123264	1	Lug, 6Awg 2 Hole 1/4 Stud Panduit
16	RM00538-96	4	Cable, 16-2C 600V 105C
17	RM02732-96	2	Wire, 14 Ga 600V
18	RM00383-96	3	Wire, 1 Ga 2KV
19	RM02700-96	1	Wire, 6 Ga Green
20	A123265	2	Bushing, 2 - 1-1/2 Reducer

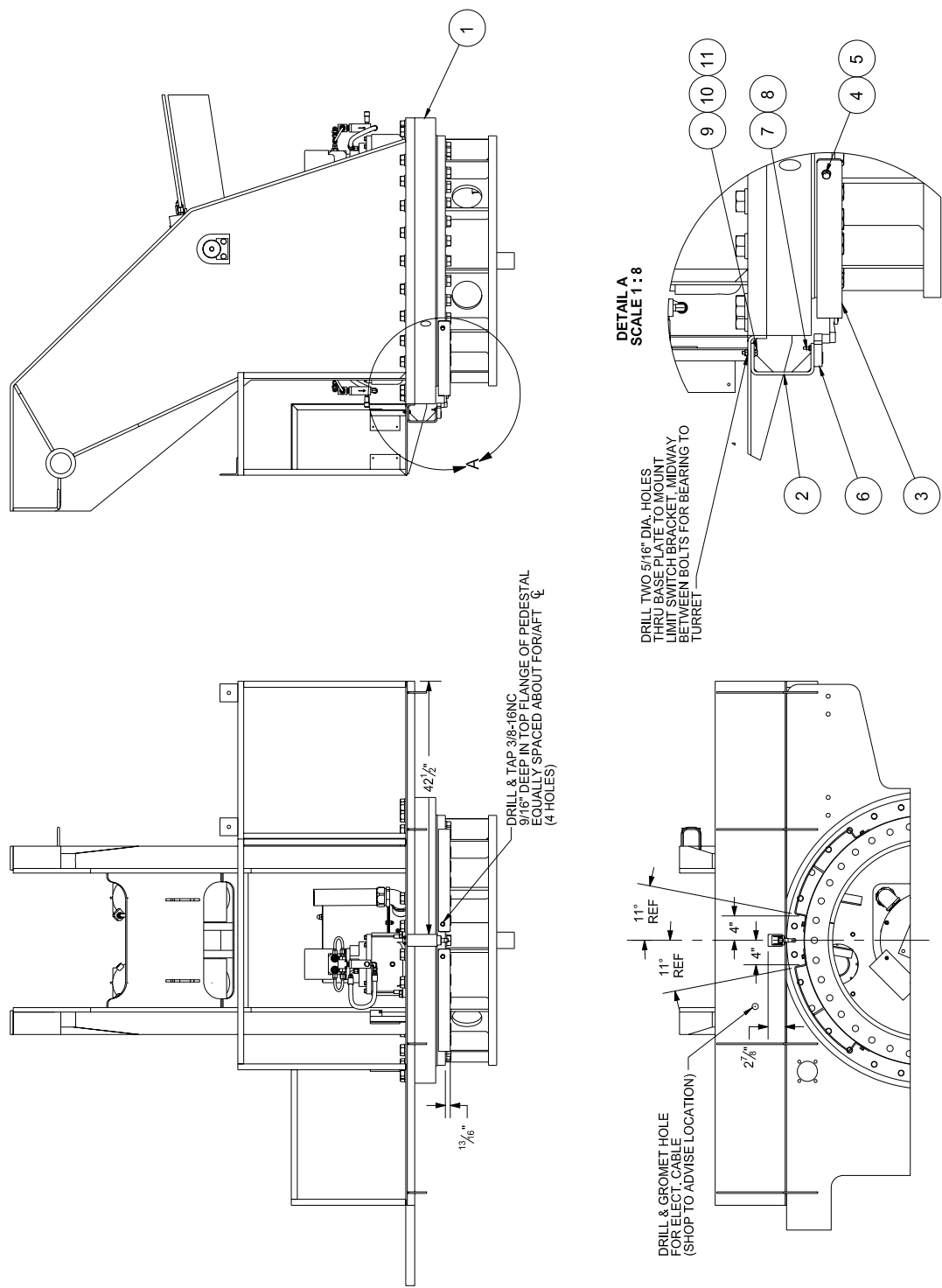


FIGURE 3

SWING STOP INSTALLATION

Figure 3

A172936

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172932	1	Limit Switch Bracket Weldment
2	A172934	2	Limit Switch Plate Weldment
3	A100204H	4	Bolt, 3/8-16Nc X 3/4" Gr 5 (Hex)
4	A103202H	4	Washer-Lock, 3/8"
5	A172778	1	Switch, Limit Lever
6	A101751	2	Bolt, 10-24Nc X 1-1/4" (Soc Hd Cap)
7	A102742	2	Nut-Nylock, 10-24 Nc
8	A100008H	2	Bolt, 1/4-20Nc X 1" Gr 5 (Hex)
9	A103000	2	Washer, 1/4 (Flat)
10	A102500H	2	Nut, 1/4-20 Unc (Hex) Gr 5

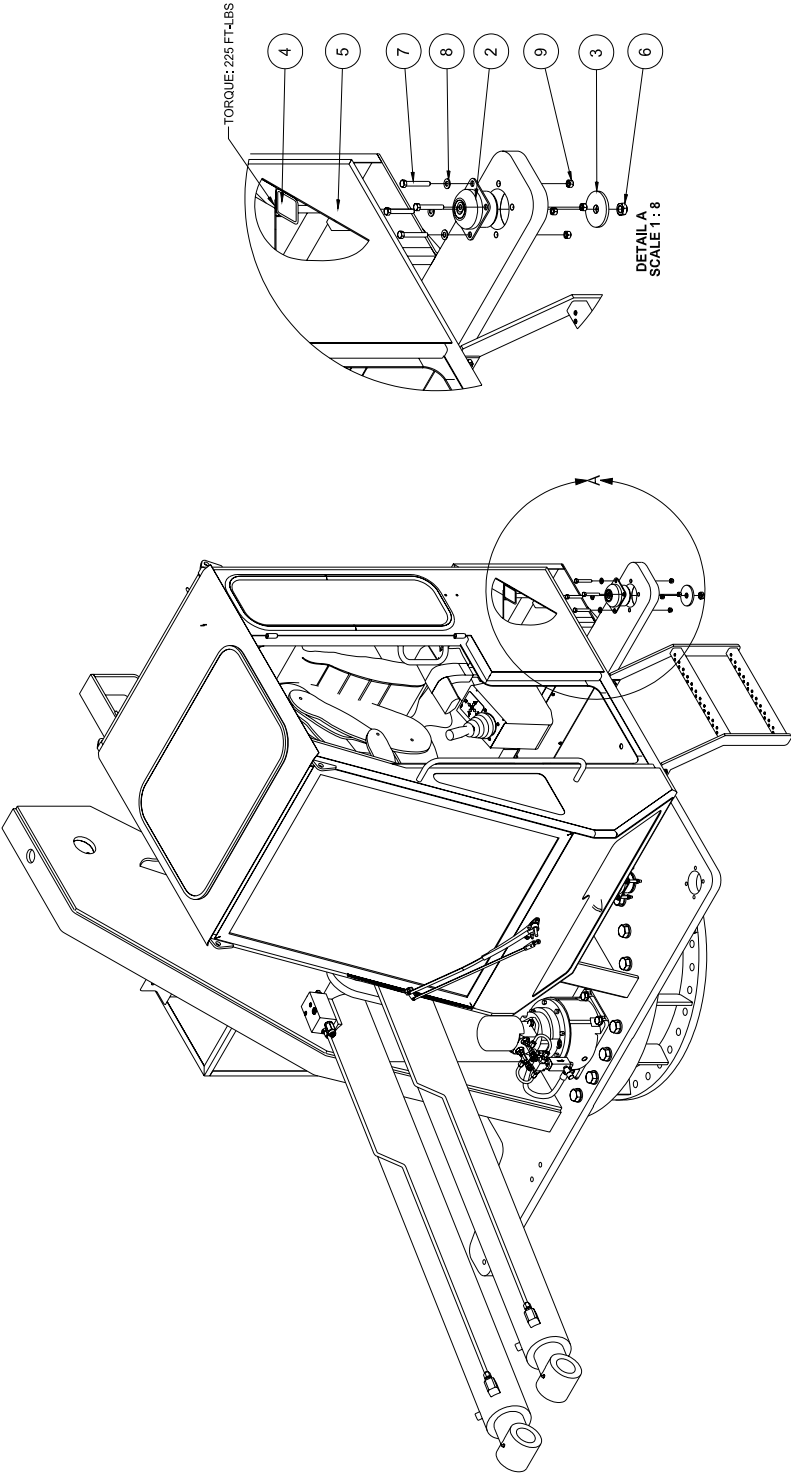


FIGURE 4

CAB INSTALLATION

Figure 4 **A172162** **Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172511	1	Cab Assembly
2	A162616	3	Mount, Conical Motor Durometer 40
3	A166083	3	Washer 3" Od
4	A100665	3	Bolt, 5/8-11Nc X 4-1/2" Gr 8 (Hex)
5	A103026	3	Washer, 5/8" (Flat Hard)
6	A102825	3	Nut, 5/8-11Nc Gr5 (Jam)
7	A100232H	12	Bolt, 3/8-16Nc X 2-1/2" Gr 5 (Hexcap)
8	A103022H	12	Washer, 3/8" (Flat Hard Gr8)
9	A102504H	12	Nut, 3/8-16Nc (Hex) Gr5

Ref Fig 4-1

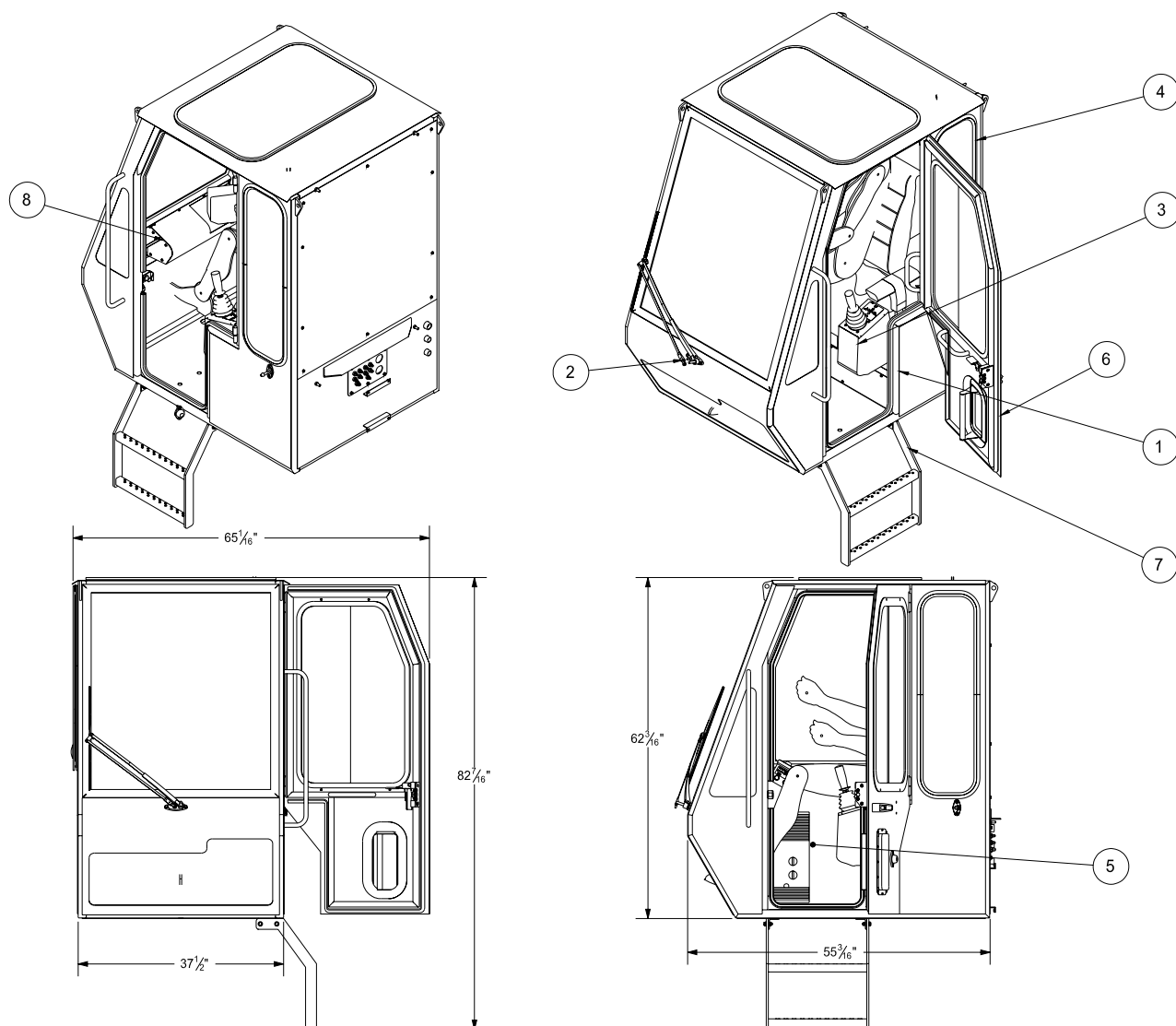


FIGURE 4-1

CAB ASSEMBLY

Figure 4-1		A172511		Drawing Rev -	
ITEM	PART NO.	QTY.	DESCRIPTION		
1	A172400	1	Cab Weldment		
2	A172515	1	Wiper & Accessories Installation	Ref Fig 4-1a	
3	A172514	1	Seat Installation	Ref Fig 4-1b	
4	A172513	1	Window Installation	Ref Fig 4-1c	
5	A172512	1	Insulation Installation	Ref Fig 4-1d	
6	A172750	1	Door Installation	Ref Fig 4-1e	
7	A172772	1	Dash Panel Installation	Ref Fig 4-1f	
8	A172829	1	Ladder Installation	Ref Fig 4-1g	

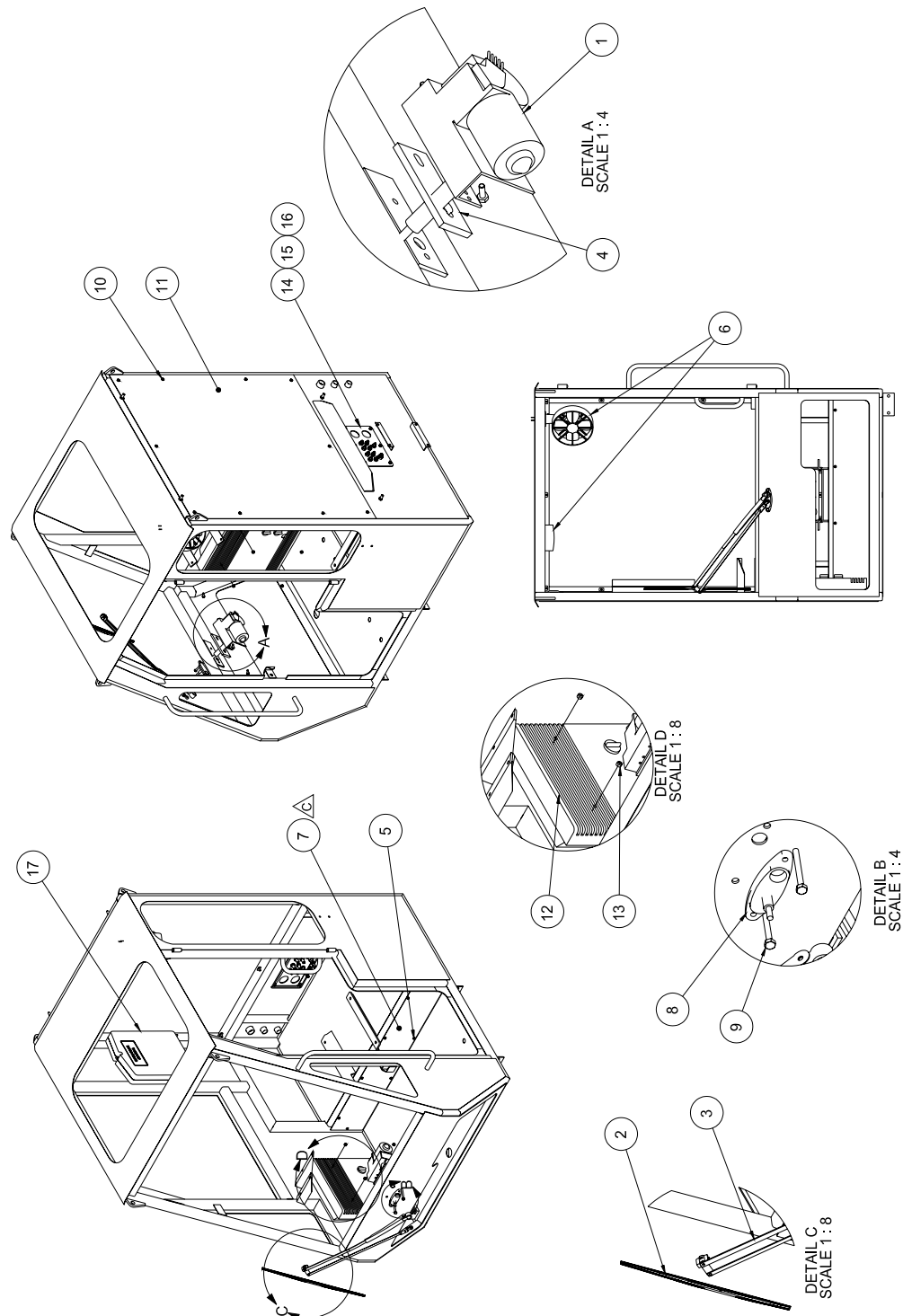
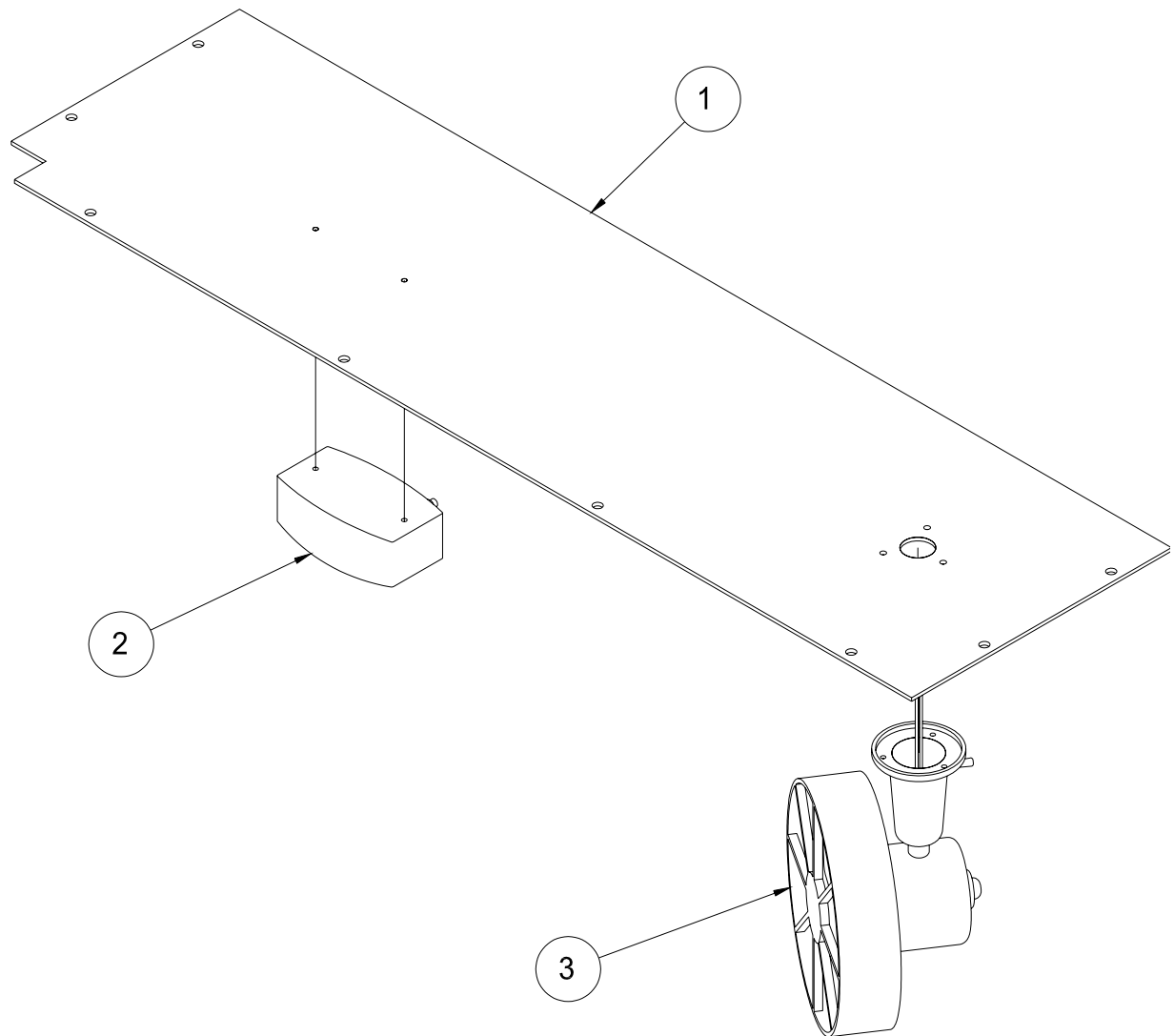


FIGURE 4-1a

WIPER & ACCESSORIES INSTALLATION

Figure 4-1a
A172515
Drawing Rev D

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A196251	1	Motor-Wiper Assembly	
2	A196299	1	Blade-Wiper, 20" Flex	
3	A169382	1	Arm, Wiper Panto 22"	
4	A169861	1	Spacer Plate, Front Wiper	
5	A102298	15	Screw, 1/4Nc X 1/2 Bhscs, Zinc Coated	
6	A172569	1	Roof Panel Assembly	Ref Fig 4-1aa
7	A172563	1	Plate, Lowerr	
8	A172561	1	Plate, Backr	
9	A196252	1	Kit, Pantograph Adapterr	
10	A100034H	2	Bolt, 1/4-28Nf X 2-1/2" Gr 5 (Hex)	
11	A100004H	10	Bolt, 1/4-20Nc X 3/4" Gr 5 (Hex)	
12	A123171	1	Heater, Cab, 120V	
13	A102700	4	Nut-Lock, 1/4-20Nc Gr5	
14	A172789	1	Bulkhead Plate Assembly	Ref Fig 4-1ab
15	A103200H	6	Washer-Lock, 1/4" (Plated)	
16	A100000H	6	Bolt, 1/4-20Nc X 1/2" (Hex)	
17	A167628	1	Manual Box Assembly	Ref Fig 4-1ac



NOTE:
MOUNTING HARDWARE SUPPLIED WITH COMPONENTS

FIGURE 4-1aa



Figure 4-1aa A172569 Drawing Rev -

8.59

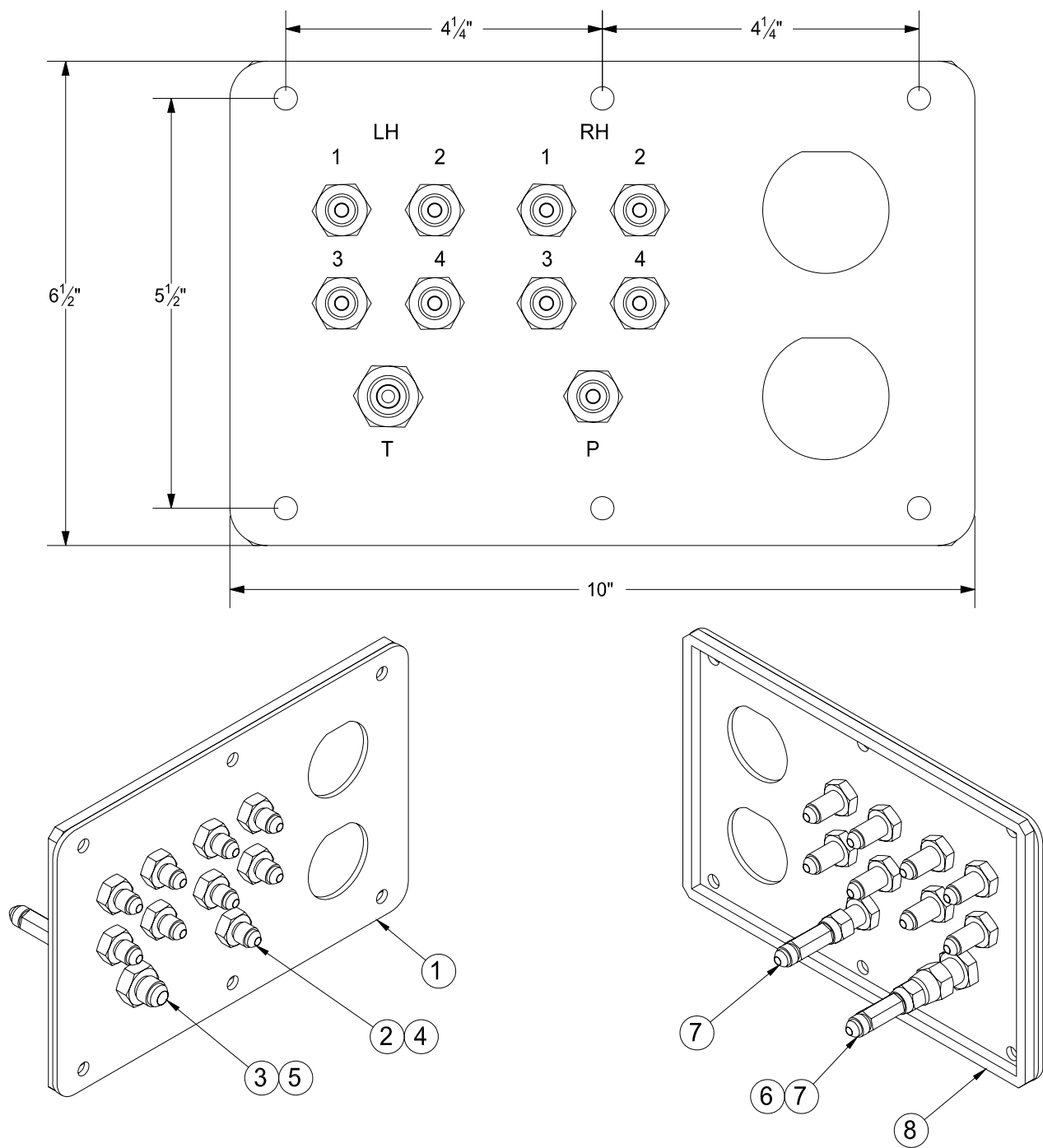


FIGURE 4-1ab

BULKHEAD PLATE ASSEMBLY

Figure 4-1ab

A172789

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172524	1	Bulkhead Plate, 44W
2	A17467	9	Adapt, 4Jic (Bulkhead)
3	A13903	1	Adapt, 6Jicm - 6Jicm (Bulkhead C/W Nut)
4	A113826	9	Nut, 4 (Bulkhead)
5	A113828	1	Nut, 6 (Bulkhead)
6	H00356	1	Adapt, 6Jicf/S-4Jicm (Reducer)
7	A13880	2	Adapt-Tee, 4Jicf/S - 4Jic - 4Jic (Run)
8	RM02565	32	Tape, 1/4 X 1/4" Sealing Neoprene

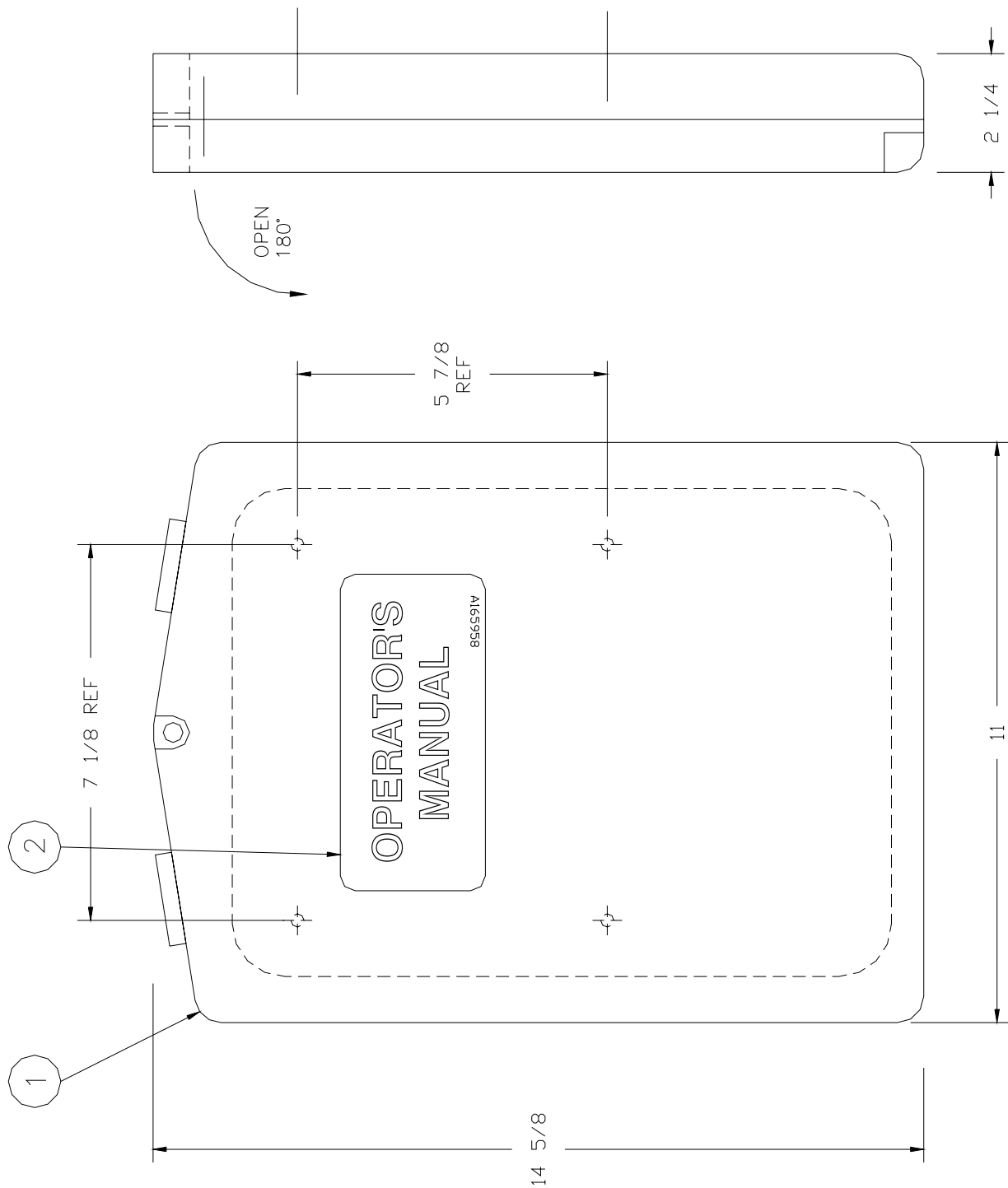


FIGURE 4-1ac



Figure 4-1ac

Drawing Rev -

A172908

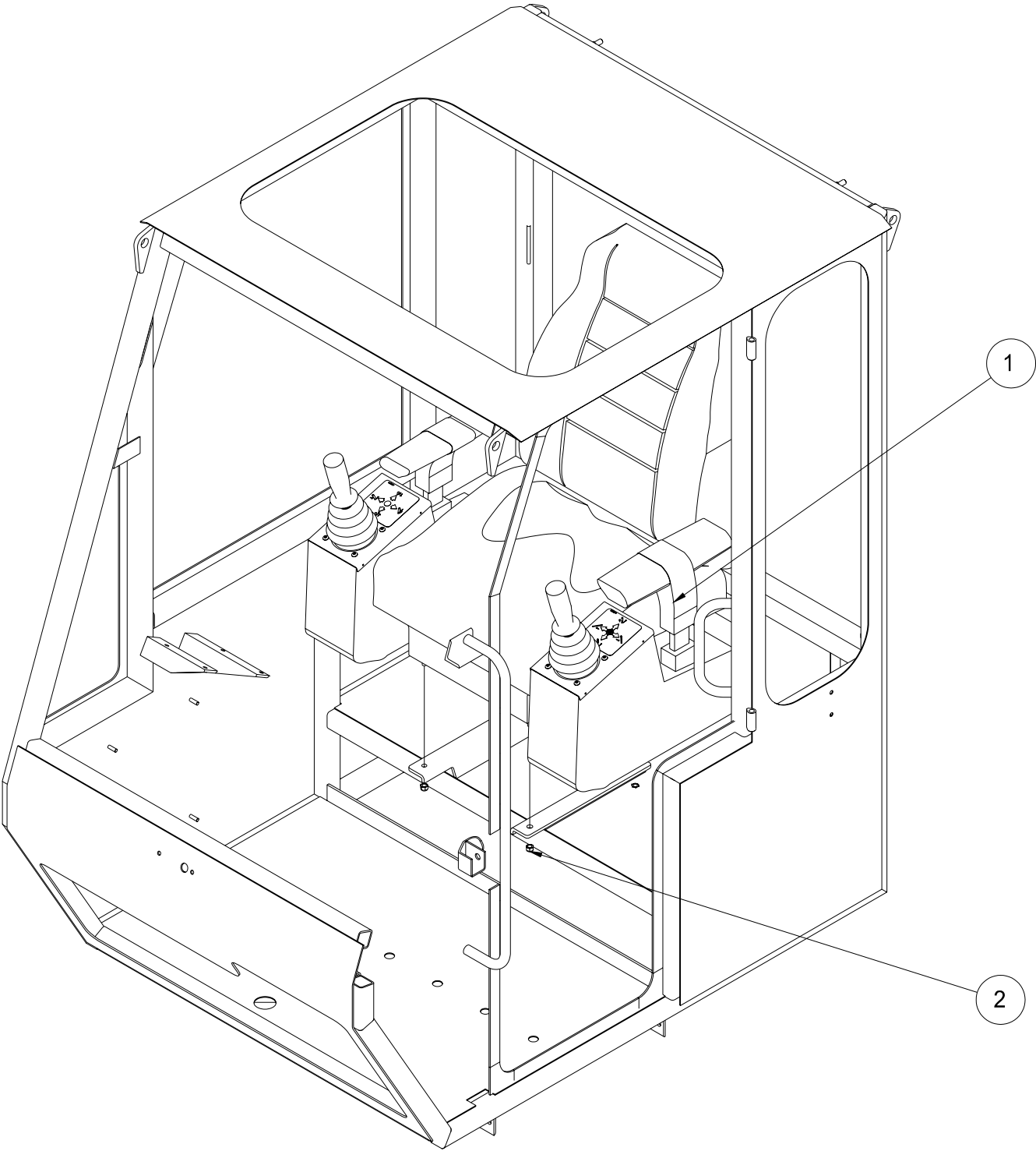


FIGURE 4-1b

Figure 4-1b

Drawing Rev -

A172908

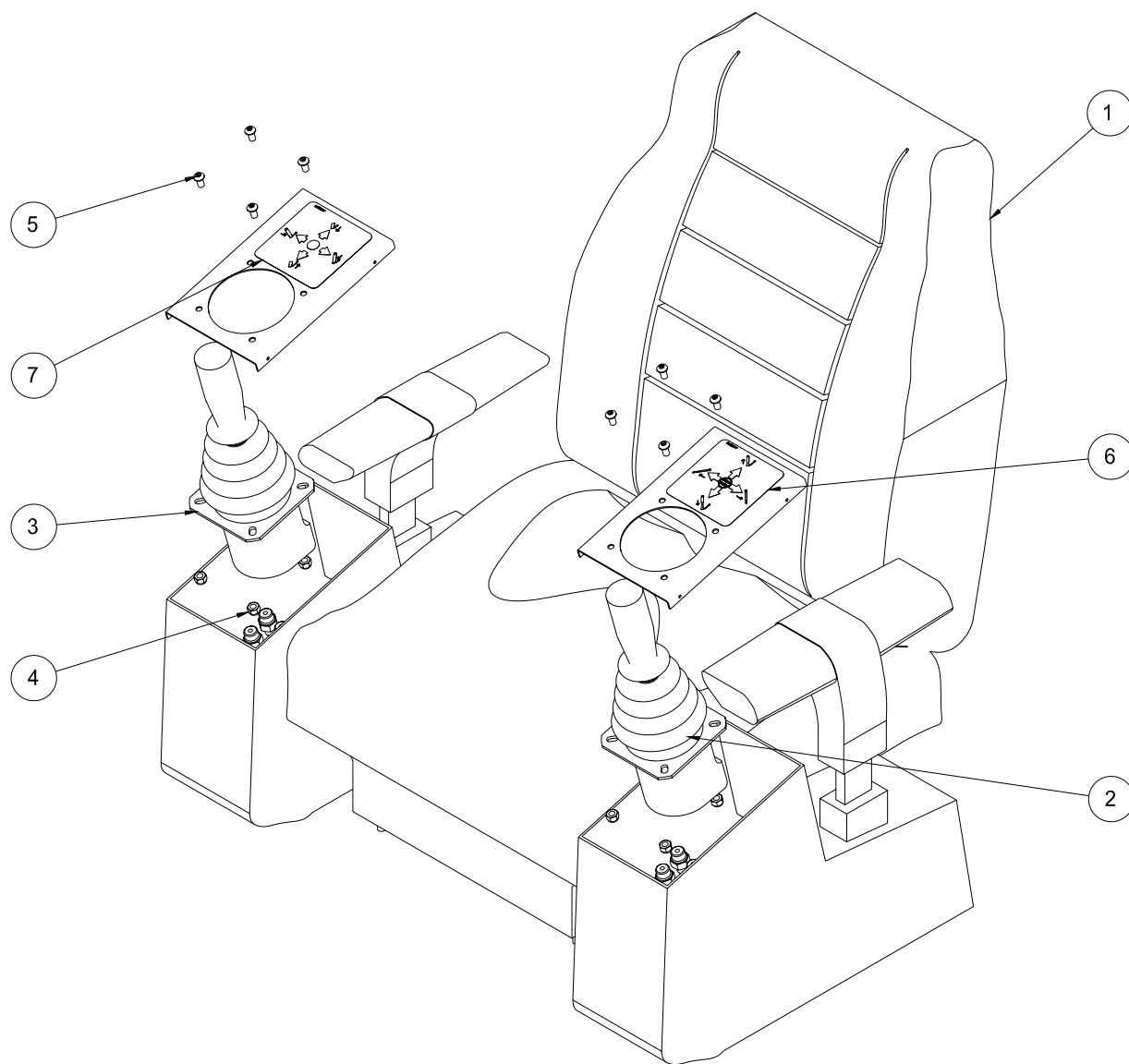


FIGURE 4-1ba

SEAT ASSEMBLY

Figure 4-1ba

A172565

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172566	1	Seat Modification	
2	A114537	1	Joystick Control Assembly	Ref Fig 4-1baa
3	A114184	1	Hyd. Remote Control Assembly	Ref Fig 4-1bab
4	A102700	8	Nut-Lock, 1/4-20Nc Gr5	
5	A102298	8	Screw, 1/4Nc X 1/2 Bhscs, Zinc Coated	
6	A172592	1	Decal, Tele And Swing	
7	A172591	1	Decal, Lift And Hoist	

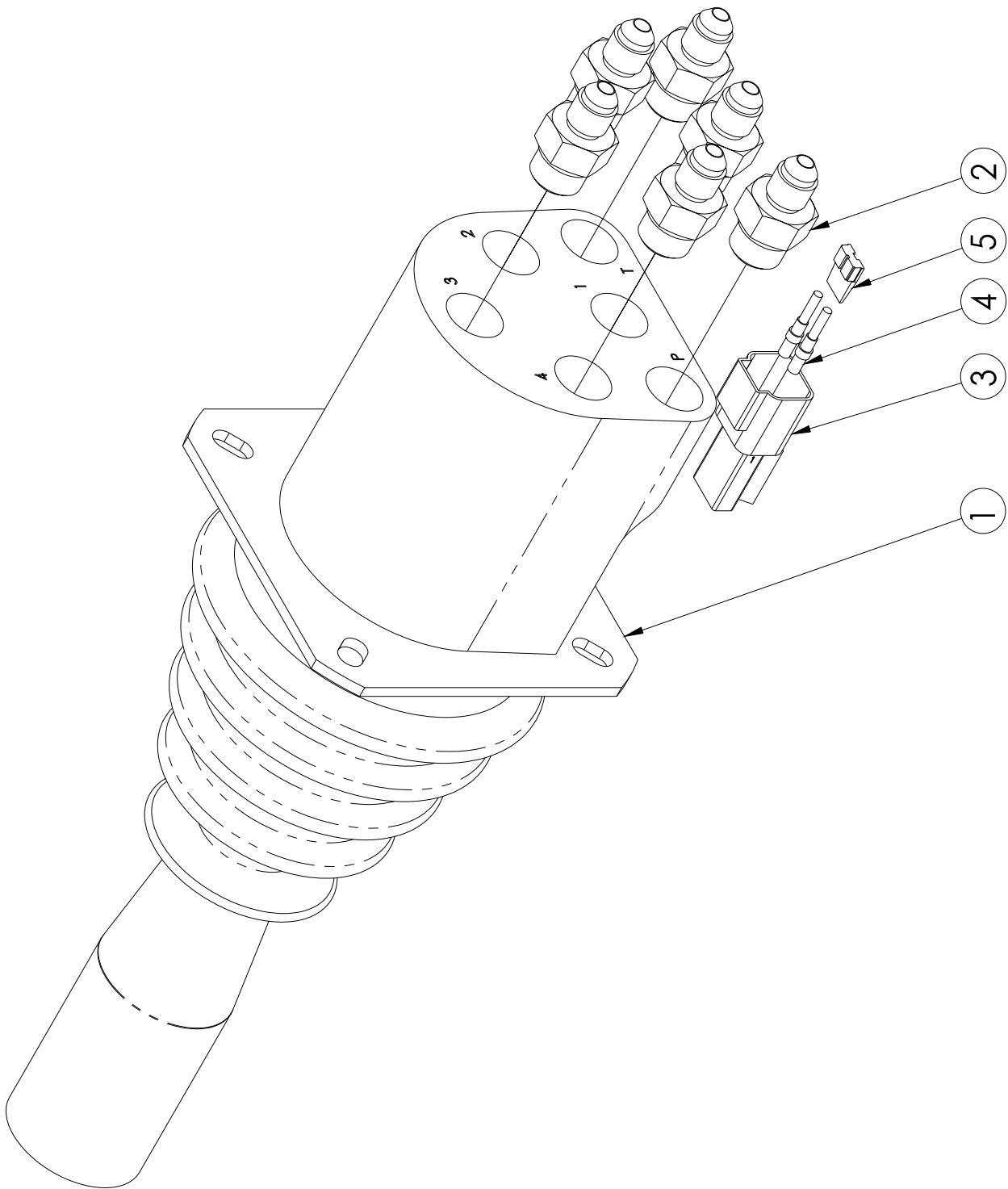


FIGURE 4-1baa



Figure 4-1baa

Drawing Rev -

A172908

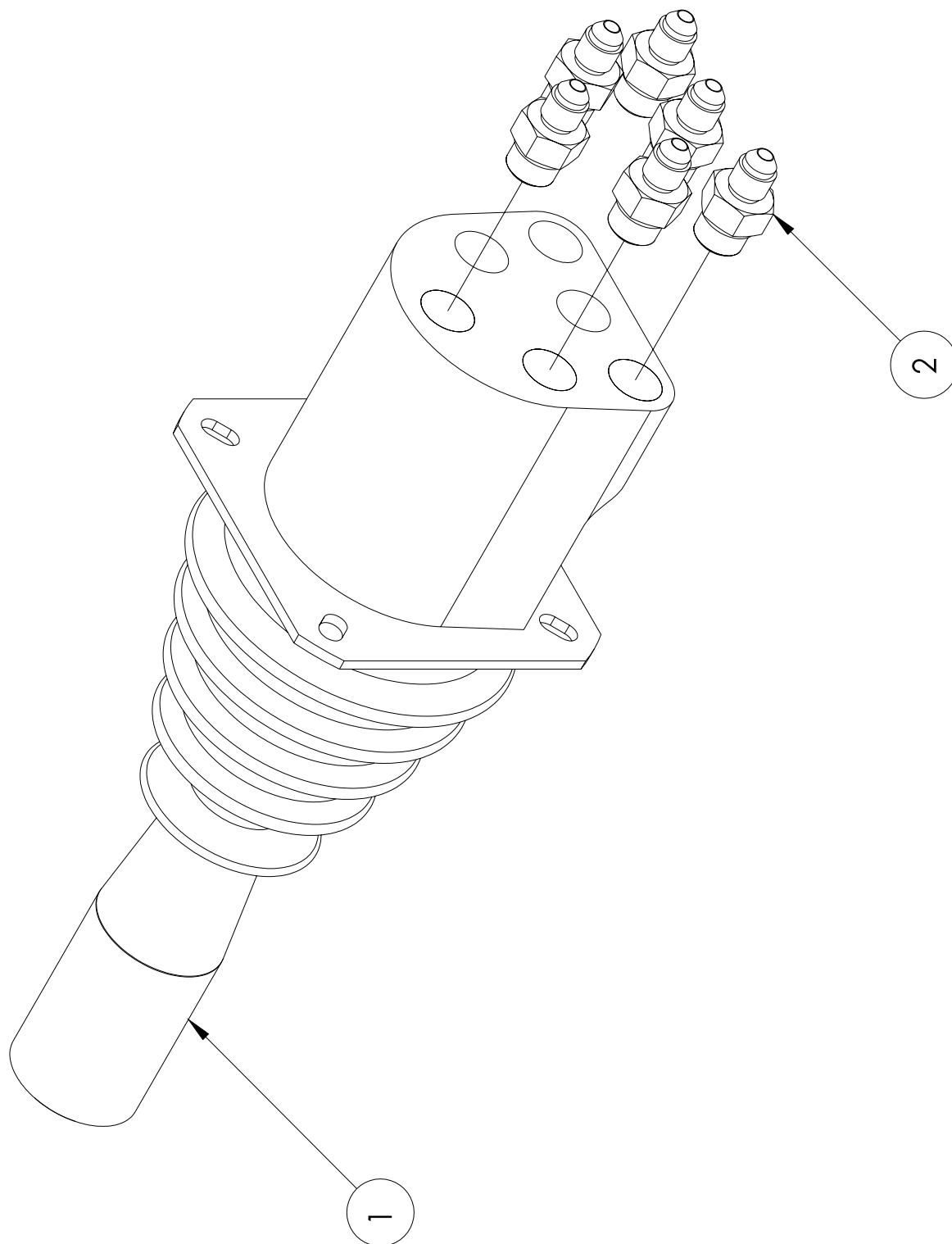


FIGURE 4-1bab

HYDRAULIC REMOTE CONTROL ASSEMBLY

Figure 4-1bab

A114184

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A114051	1	Joystick, Remote Control Hydraulic
2	A16637	6	Adapt, 6Sae - 4Jicm

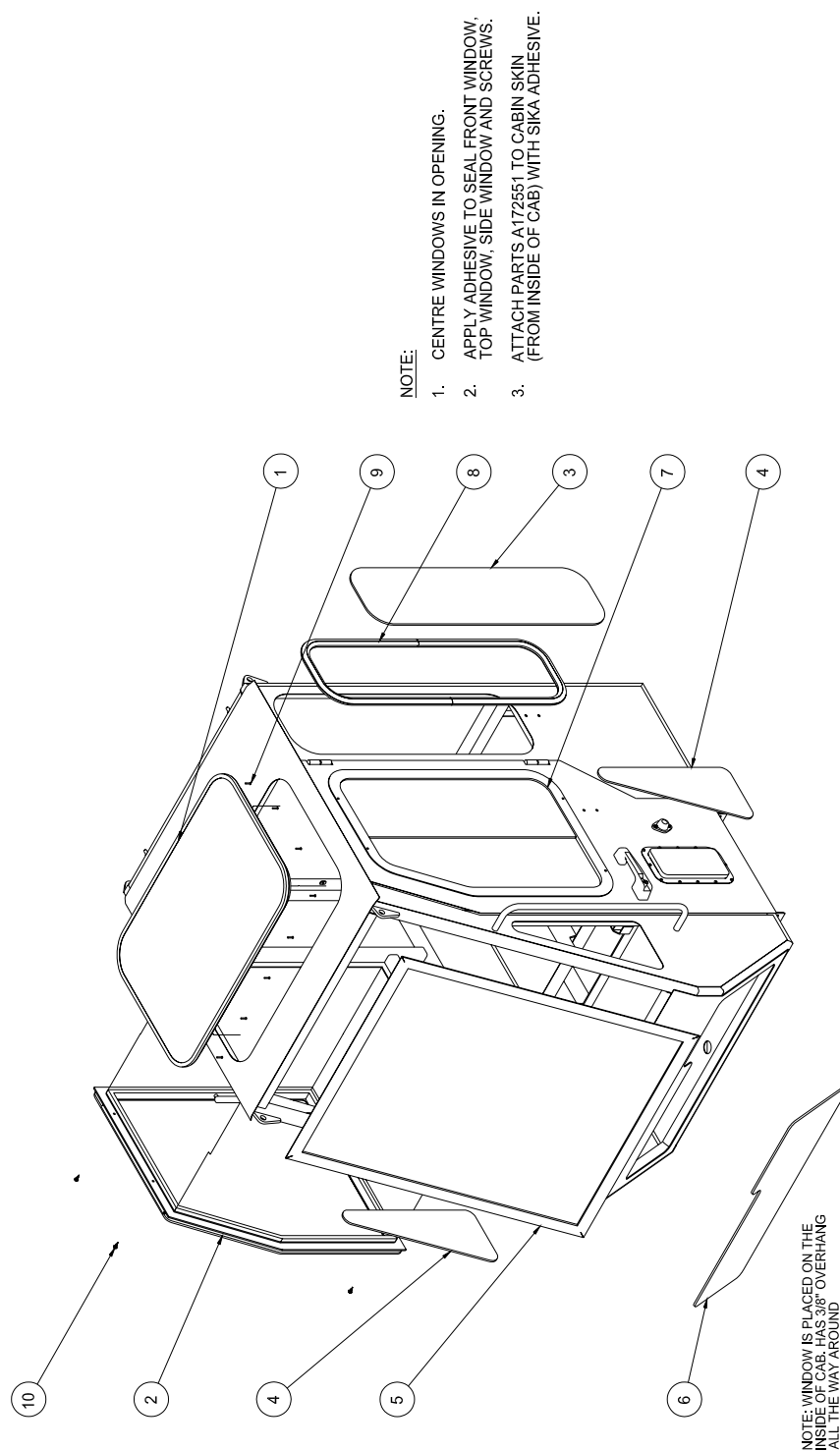


FIGURE 4-1c

WINDOW INSTALLATION**Figure 4-1c****A172513****Drawing Rev B**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172543	1	Window, Roof
2	A172546	1	Window, RH Front
3	A172550	1	Window, Rear Side
4	A172551	2	Window, LH Front Side
5	A172545	1	Window, Front
6	A172553	1	Window, Bottom
7	RM02673-90	1	Weatherstripping,
8	FS00056	14	Screw, 6-32 X 1/4 Phil Rnd Hd
9	A102110	4	Screw, 1/4-20 Nc X 3/4" Tecks3
10	RM02804	2	Caulking

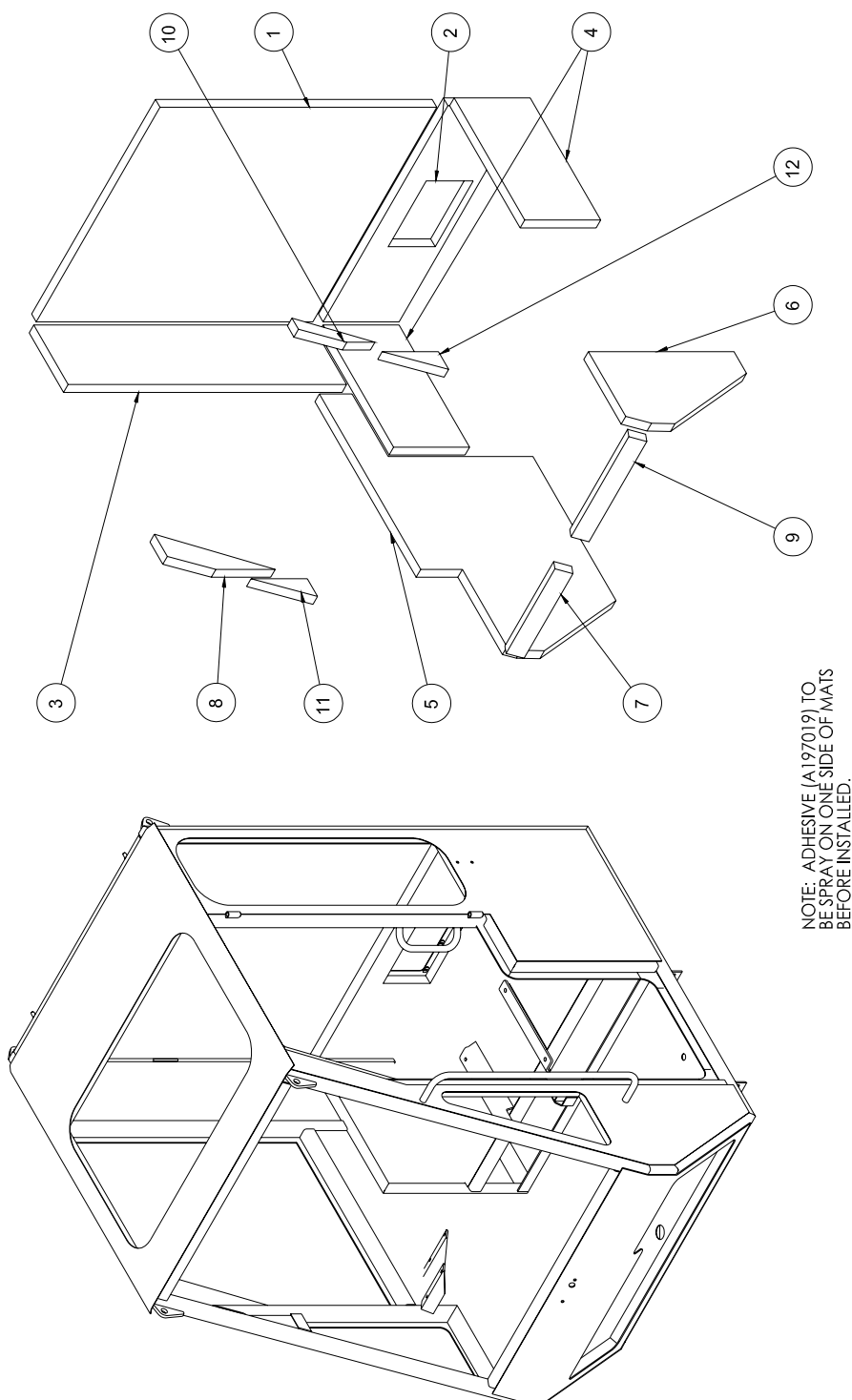


FIGURE 4-1d

INSULATION INSTALLATION

Figure 4-1d

A172512

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172726	1	Insul, Rear Top
2	A172727	1	Insul, Rear Bottom
3	A172728	1	Insul, Right Back
4	A172729	2	Insul, Back Side
5	A172730	1	Insul, Right Side
6	A172732	1	Insul, Left Front
7	A172733	1	Insul, Front Right
8	A172734	1	Insul, Right Top
9	A172736	1	Insul, Front Left
10	A172737	1	Insul, Left Top
11	A172738	1	Insul, Right Triangle
12	A172739	1	Insul, Left Triangle

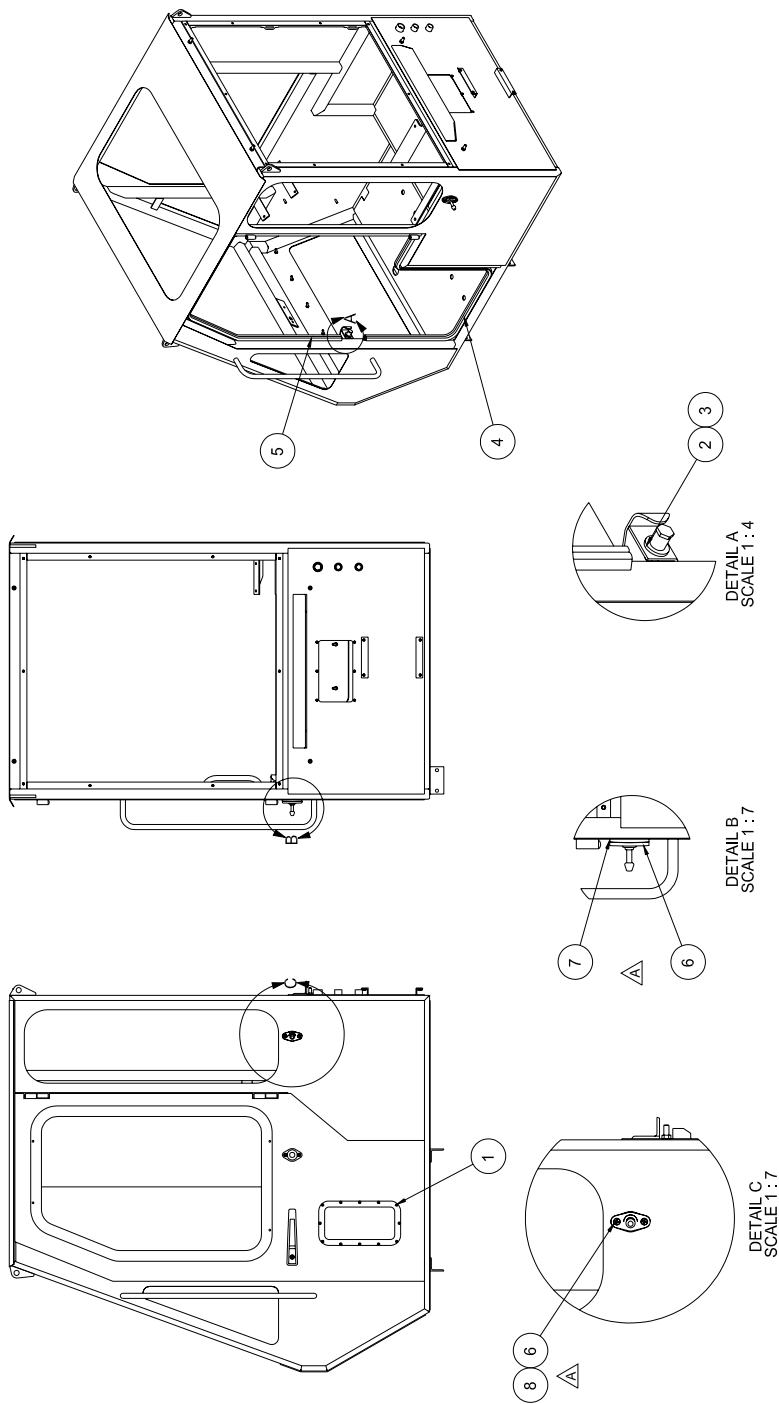


FIGURE 4-1e

DOOR INSTALLATION

Figure 4-1e

A172750

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172485	1	Door Assembly	Ref Fig 4-1ea
2	A102508H	1	Nut, 7/16-14Nc (Hex) Gr5	
3	A195936	1	Bolt, Striker	
4	RM02665-60	1	Weatherstripping	
5	RM02665-54	1	Weatherstripping	
6	A195224-1	1	Plunger, 1-3/4"	
7	A172855	1	Spacer, Door Stop	
8	FS00163	2	Screw, 1/4-20Nc X 1", Fh Phil	
9	A102700	2	Nut-Lock, 1/4-20Nc Gr5	

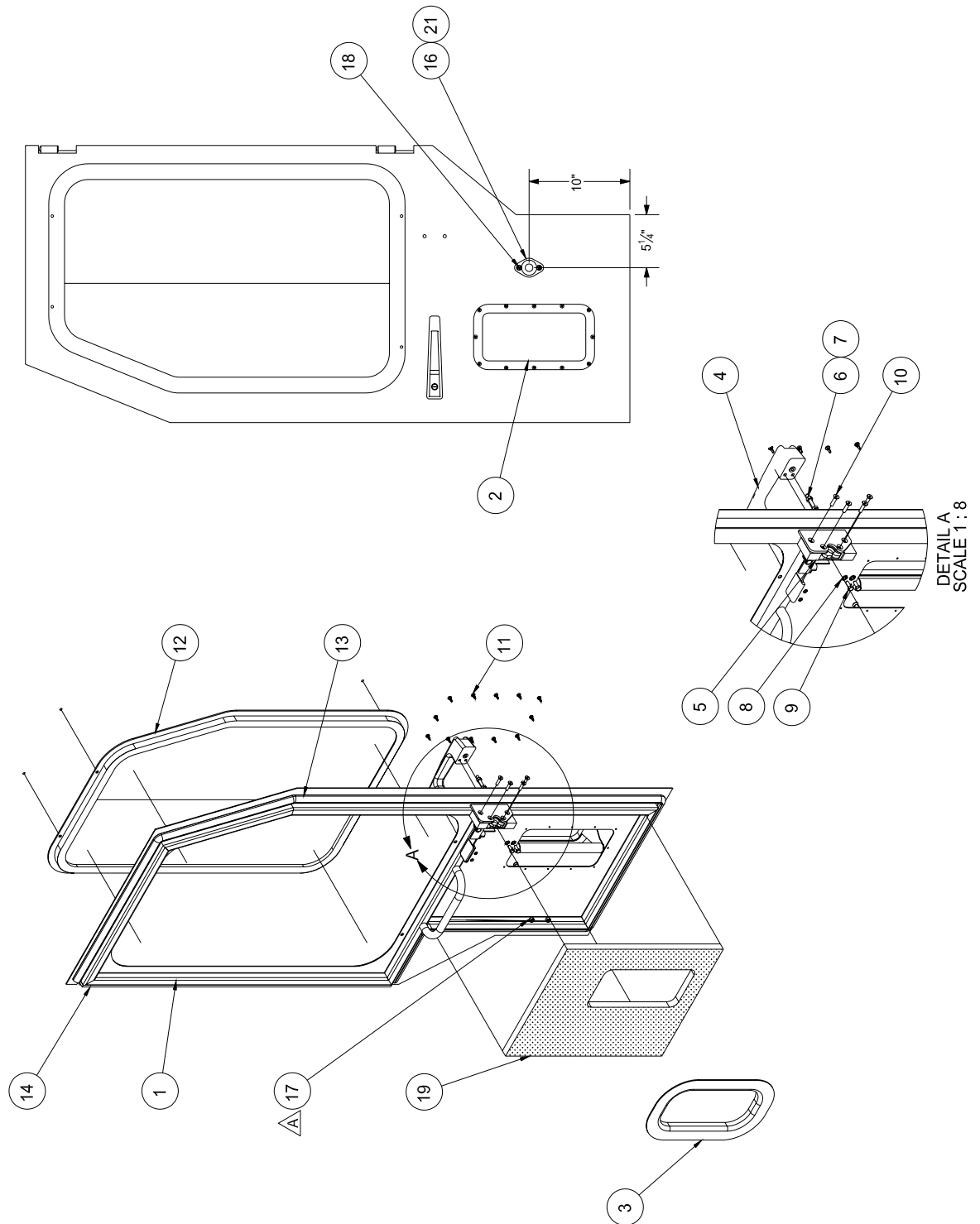


FIGURE 4-1ea

DOOR ASSEMBLY

Figure		A172485		Drawing Rev A
ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172484	1	Cab Door Weldment	
2	A162579	1	Vent, Door	
3	A168455	1	Trim Ring Modify	
4	A169260	1	Handle, Push Lockable	
5	A195919	1	Latch, Two Rotor	
6	A172537	1	Insul, Door	
7	A102500H	1	Nut, 1/4-20 Unc (Hex) Gr 5	
8	A100016H	1	Bolt, 1/4-20Nc X 1-1/2" Gr 5 (Hex)	
9	A103235	2	Washer-Lock, 1/4" Id (Internal Tooth)	
10	A198066	2	Bolt, M6 X 16	
11	A109166H	4	Screw, M6 X 1.0 X 25Mm (Soc Counter Sunk)	
12	A102167	12	Screw, 10-24 Ncx 1/2" Self Tap Phil Truss	
13	A172538	1	Window, Door	
14	A102333	4	Screw, 1/4-20Ncx5/8 Tph Blk Oxide Mch	
15	RM02658	125	Weatherstripping, .562"W X .662" Ht Epdm Med	
16	RM01304	38	Tape, 1/4" X 3/4" Closed Cell	
17	RM02804	1	Caulking, Sika #222 UV Black Sealant	
18	A195224-2	1	Socket-Small Hole	
19	A195224-3	1	Cup-Neoprene	
20	A102700	2	Nut-Lock, 1/4-20Nc Gr5	
21	FS00163	2	Screw, 1/4-20Nc X 1", Fh Phil	

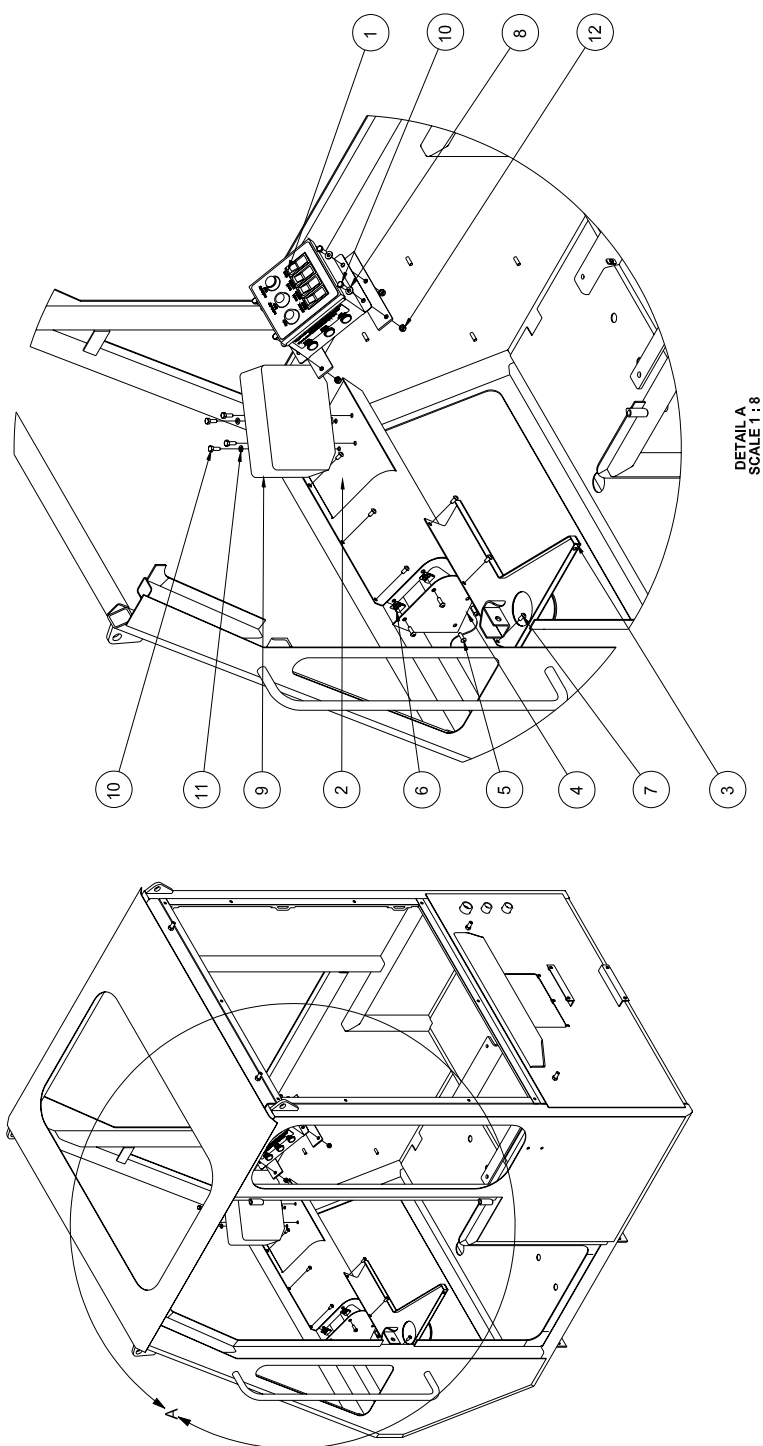


FIGURE 4-1f

DASH PANEL INSTALLATION

Figure 4-1f

A172772

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A172740	1	Control Panel Assembly	Ref Fig 4-1fa
2	A172742	1	Dash Panel Weldment	
3	A172760	1	Lh Dash Weldment	
4	A172754	1	Cover Plate, Dash	
5	FS00099	4	Screw, 1/4-20Nc X 3/4 (Button Hd Cap)	
6	FS00059	4	Nut, 1/4-20Nc (Slip U-Type)	
7	A102298	7	Screw, 1/4Nc X 1/2 Bhscs, Zinc Coated	
8	A103000	4	Washer, 1/4 (Flat)	
9	A123148-1	1	Box, Display, Load System, I-3,000	
10	A100004H	8	Bolt, 1/4-20Nc X 3/4" Gr 5 (Hex)	
11	A103200H	4	Washer-Lock, 1/4" (Plated)	
12	A102700	4	Nut-Lock, 1/4-20Nc Gr5	

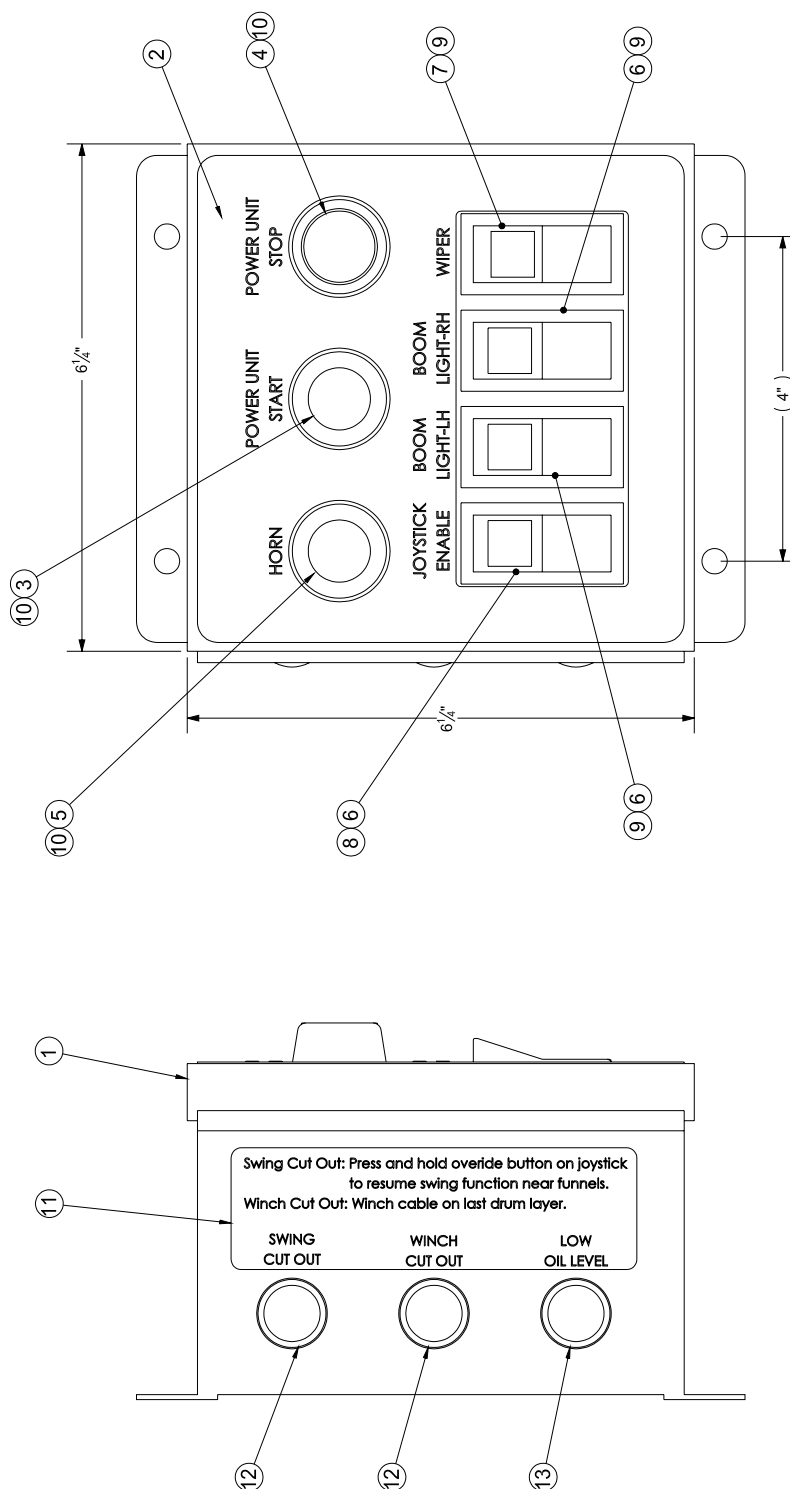


FIGURE 4-1fa

CONTROL PANEL ASSEMBLY**Figure 4-1fa****A172740****Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172741	1	Control Panel, Cab
2	A172773	1	Decal, Control Panel
3	A123223	1	Button, Pilot Push, Green W/Light
4	A123111	1	Button, Pilot Push, Red
5	A123128	1	Button, Push, Black A-B 800Tfp-F2
6	A192419	3	Switch - Rocker 2 Pos W/Light
7	A192460	1	Switch-Rocker, Spst 3 Post24V
8	A192449	1	Lens, Red Blank
9	A192495	3	Lens, Green Blank
10	A123109	3	Contact Block
11	A172912	1	Decal, Warning Lights
12	K00035	2	Light, Indicator Red C/W 12V #53 Bulb
13	A121775	1	Light, Yellow 24V Abs

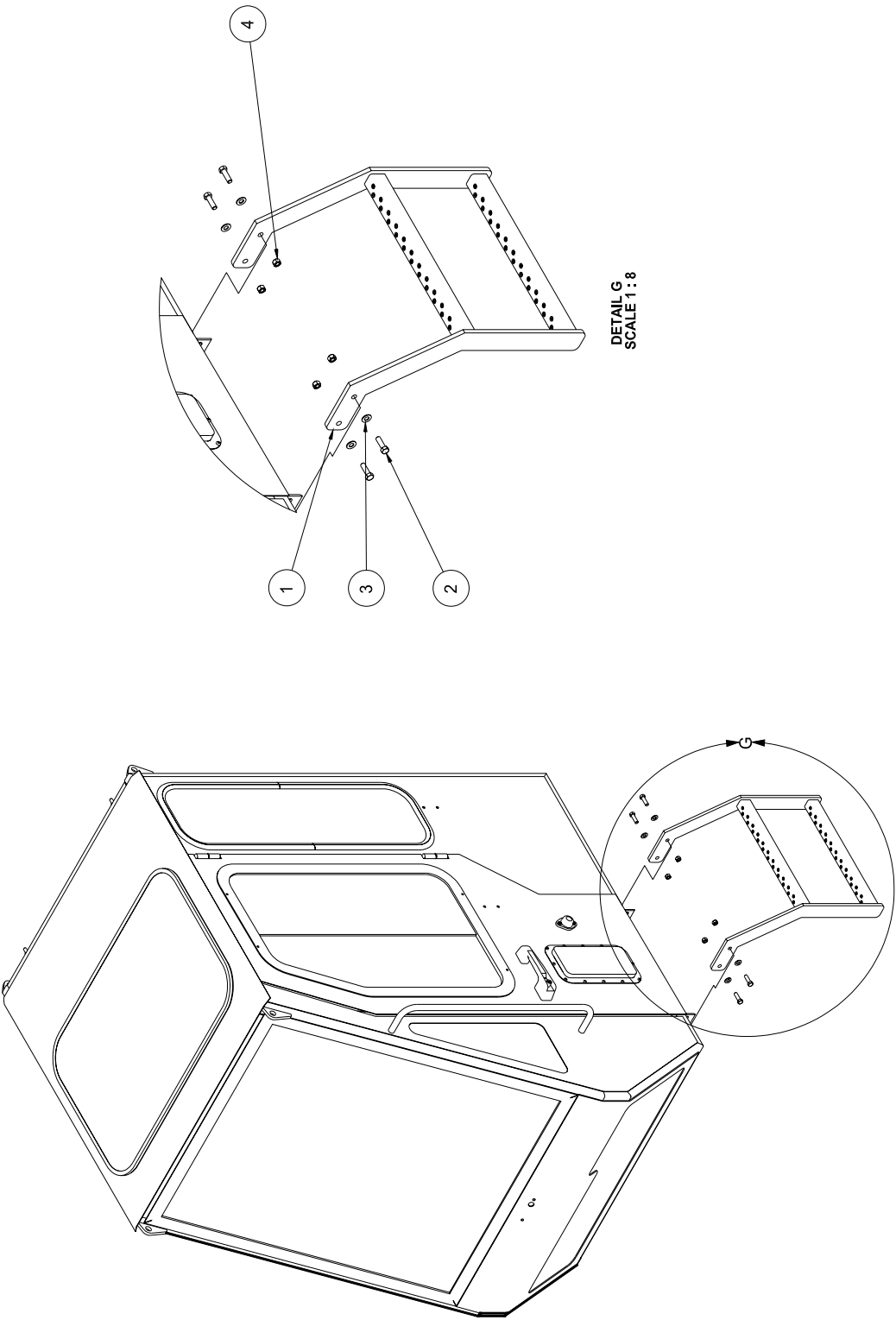


FIGURE 4-1g

LADDER INSTALLATION

Figure 4-1g

A172829

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172746	1	Ladder Weldment
2	A100212H	4	Bolt, 3/8-16Nc X 1-1/4" Gr 5 (Hex)
3	A103022H	4	Washer, 3/8" (Flat Hard Gr8)
4	A102504H	4	Nut, 3/8-16Nc (Hex) Gr5

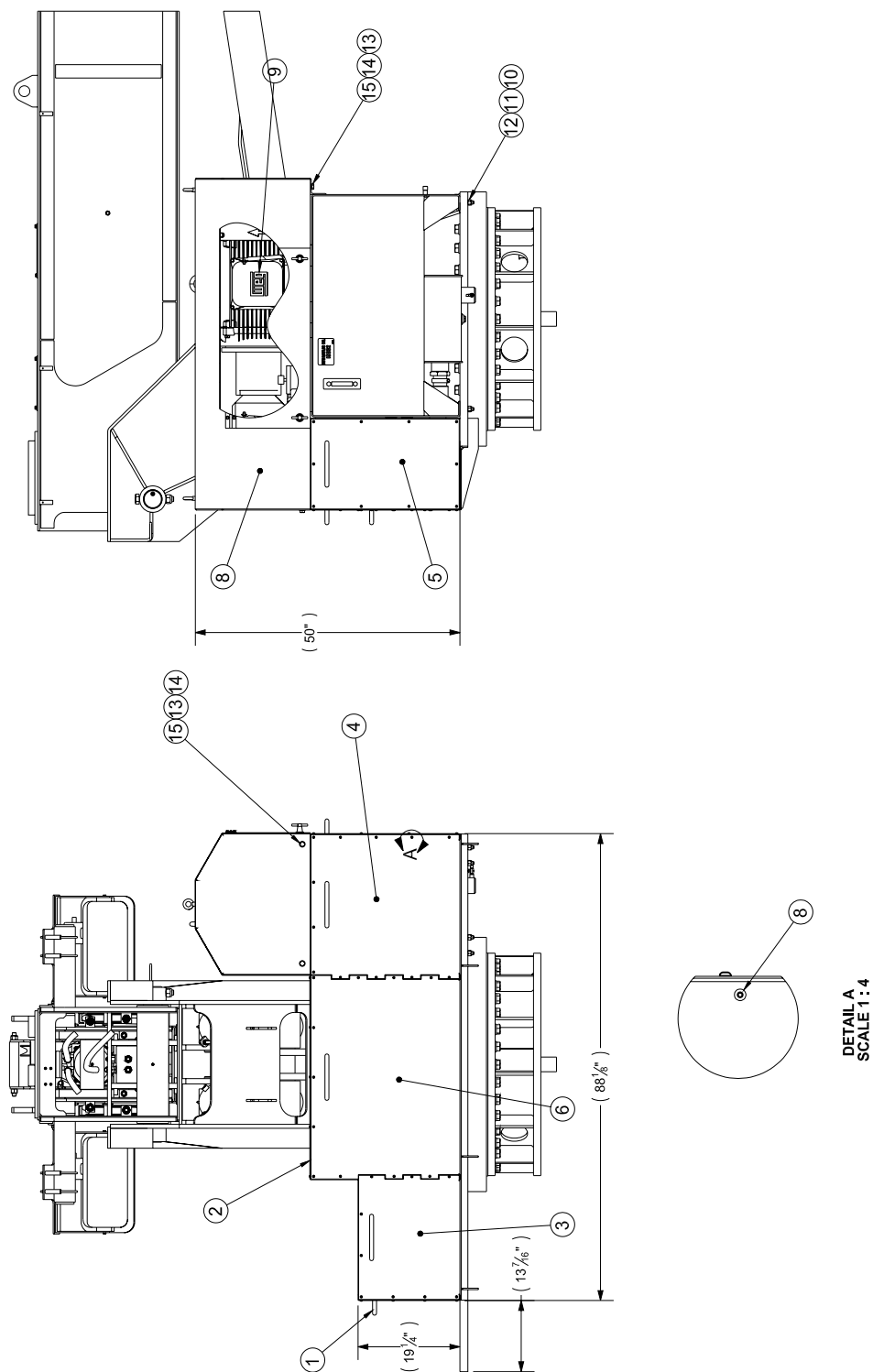


FIGURE 5

POWER UNIT INSTALLATION

Figure 5

A172163

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172823	1	Cover Sheet 8 Weldment
2	A172816	1	Sheet Metal, Cover Sheet 9
3	A172824	1	Cover Sheet 7 Weldment
4	A172826	1	Cover Sheet 5 Weldment
5	A172827	1	Cover Sheet 4 Weldment
6	A172825	1	Cover Sheet 6 Weldment
7	A102298	63	Screw, 1/4Nc X 1/2 Bhscs, Zinc Coated
8	A172836	1	Cover Hood Assembly
9	A172608	1	Power Unit Assembly
10	A103026	8	Washer, 5/8" (Flat Hard)
11	A100641	8	Bolt, 5/8-11Nc X 3" Gr 8 (Hex)
12	A102721	8	Nut-Nylock, 5/8-11Nc Gr8
13	A102513H	4	Nut, 1/2-13Nc (Hex) Gr8
14	A103004	4	Washer, 1/2" (Flat)
15	A100413H	4	Bolt, 1/2-13 Nc X 1-1/4" Gr 8 (Hex)

Ref Fig 5-1

Ref Fig 5-2

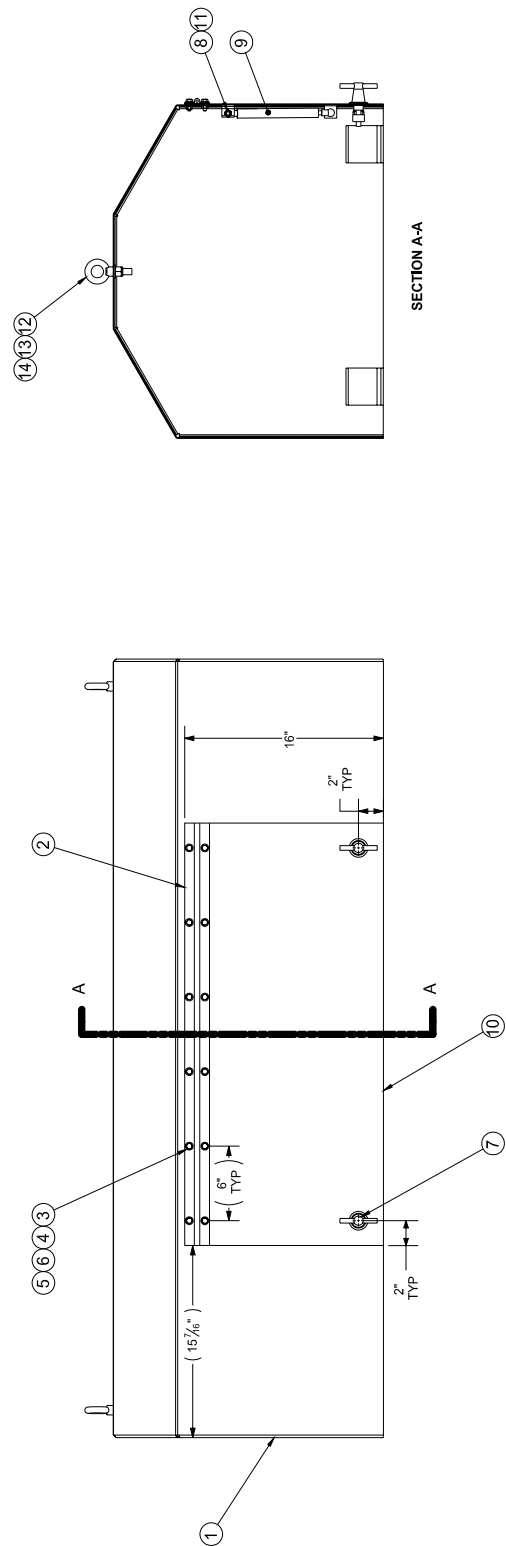


FIGURE 5-1

COVER HOOD ASSEMBLY

Figure 5-1

A172836

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172818	1	Cover Hood Weldment
2	A172837	1	Hinge, 1/16 X 2" W/H (Steel)
3	A103000	12	Washer, 1/4 (Flat)
4	A103200H	12	Washer-Lock, 1/4" (Plated)
5	A102500H	12	Nut, 1/4-20 Unc (Hex) Gr 5
6	A100004H	12	Bolt, 1/4-20Nc X 3/4" Gr 5 (Hex)
7	A166534	2	Latch, T-Handle
8	A195960	4	Ball Studs, Gas Spring
9	A172867	2	Gas Spring 12.5" Ext. 8.25" Ret.
10	A172870	1	Cover Door Weld'T
11	A102740H	4	Nut-Nylock, 5/16-18Nc Gr5
12	A102092	2	Bolt, 1/2-13 Nc X 1-1/2" (Forged) (Eye)
13	A103004	2	Washer, 1/2" (Flat)
14	A102713H	2	Nut-Nylock, 1/2-13Nc Gr8

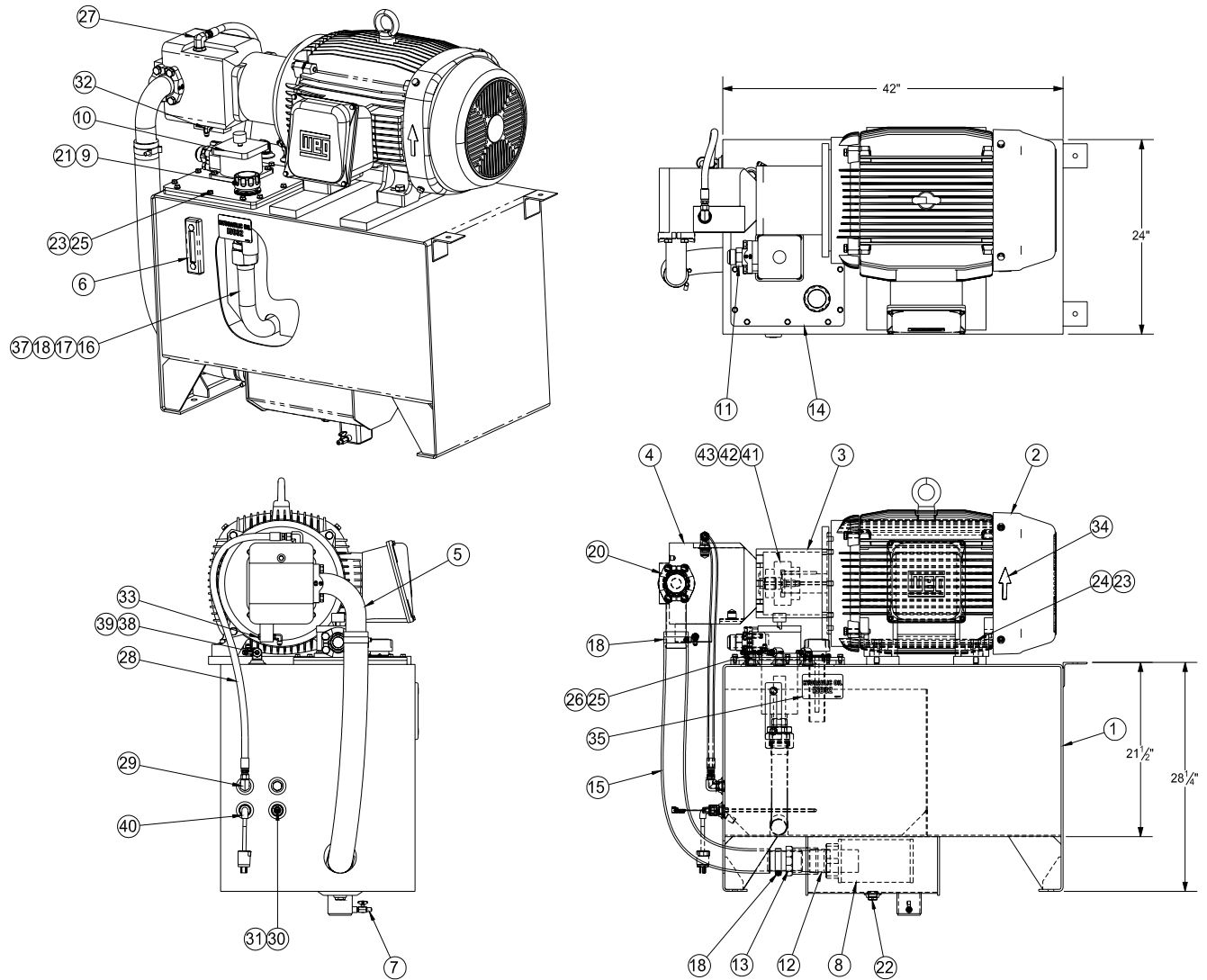


FIGURE 5-2

POWER UNIT ASSEMBLY

Figure 5-2
A172608
Drawing Rev F

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172610	1	Hydraulic Tank Weldment
2	A123147	1	Motor, Electric, 75 Hp, 3/60,460V
3	A114035	1	Bell Housing
4	A115265	1	Pump, Piston, Sauer
5	A115269	1	Hose-End-90, 2-1/2" Code 61 Flange - Beaded
6	A110055	1	Gauge, Fluid Temperature Rev A
7	H00755	1	Valve, Drain
8	A21257	1	Strainer, Suction
9	A114259	1	Filler, Breather W Blnk Dipstick
10	A115267	1	Return Filter Assembly
11	H00779	1	Adapt, 32Sae Flange (Code 61) -24Jicm
12	A111632	1	Adapt, 2-1/2 Nptm - 2-1/2Nptm - 2-1/2Lg (Nipple)
13	H00039	1	Hose-End, 2-1/2Nptm - 2-1/2 (Beaded)
14	A172703	1	Cover Plate
15	RM00652-37	1	Hose, 2-1/2" X 37" Suction
16	A115278	1	Tube Exhaust .065W
17	H00089	1	Nut-Hyd, 32Jic (Sae 37 Deg Flair) (Tube)
18	H00090	1	Sleeve-Hyd, 2Jic (Sae 37 Deg Flair) (Tube)
19	A153585	2	Clamp, T-Bolt 2.75" - 3.0"
20	A14993	1	Split Flange Kit 2-1/2" Code 61
21	A102158	6	Screw, #10-24Nc X 3/4 Mach Pan Hd Phil
22	A15103	2	Plug, 3/4 Nptm Hex Head Malleable Iron
23	A103202H	16	Washer-Lock, 3/8"
24	A100633	4	Bolt, 5/8-11Nc X 2-1/2" Gr 8 (Hex)
25	A100216H	16	Bolt, 3/8-16Nc X 1-1/2" Gr 5 (Hex)
26	A103022H	4	Washer, 3/8" (Flat Hard Gr8)
27	A110947	1	Adapt-90, 12Sae - 8Jicm
28	H00880-36	1	Hose-Assembly - 1/2
29	A14292	1	Adapt-90, 3/4Nptm - 8Jicm
30	A122059	1	Low Level Switch, Modified
31	H00322	1	Adapt, 1/2Nptf-3/4Nptm Galvanized
32	H00333	1	Adapt-90, 4Sae-6Jicm
33	A111301	1	Plug, 1/4 Sae Hex Head
34	A167873	1	Decal-Arrow, 1-1/2 X 4" (100%)
35	A167536	1	Decal-Hydraulic Oil Iso32
36	A14994	1	Split-Flange, 2" Code 61 Kit W/Bolts
37	A115294	1	Adapt, 1-1/2Nptm-32Jicm (37Deg Flare)
38	A15202	3	Adapt-90, 3/4Nptm - 6Jicm
39	A13893	1	Adapt-Tee, 6Jicf/S - 6Jicm (Run)
40	A123277	1	Harness, Oil Heater
41	A114036	1	Coupling Half
42	A114037	1	Coupling Half
43	A114038	1	Insert

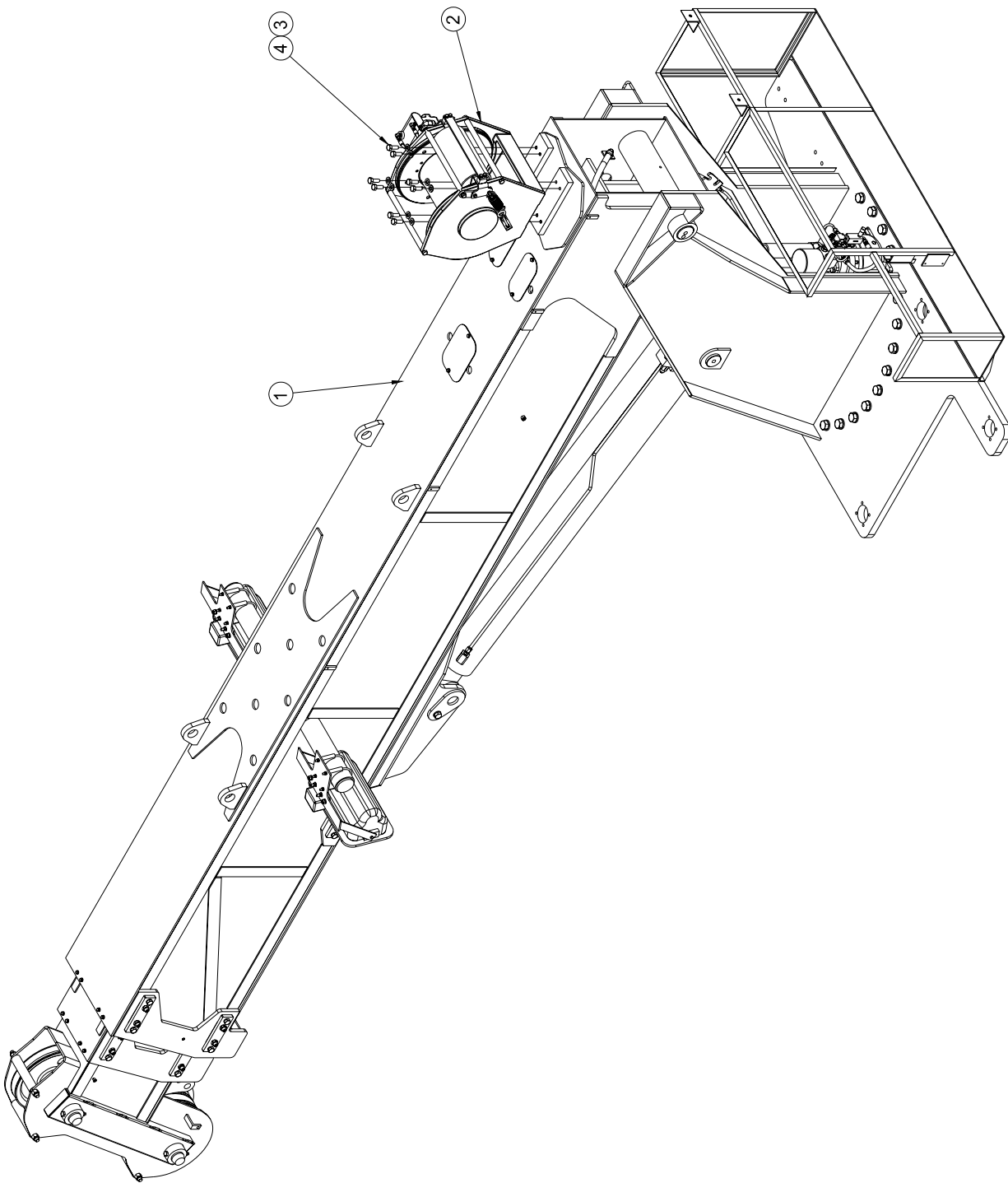


FIGURE 6

WINCH INSTALLATION

Figure 6

A172164

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A172821	1	Winch Assembly
2	A103026	8	Washer, 5/8" (Flat Hard)
3	A100621	8	Bolt, 5/8-11Nc X 1-3/4" Gr 8 (Hex)

Ref Fig 6-1

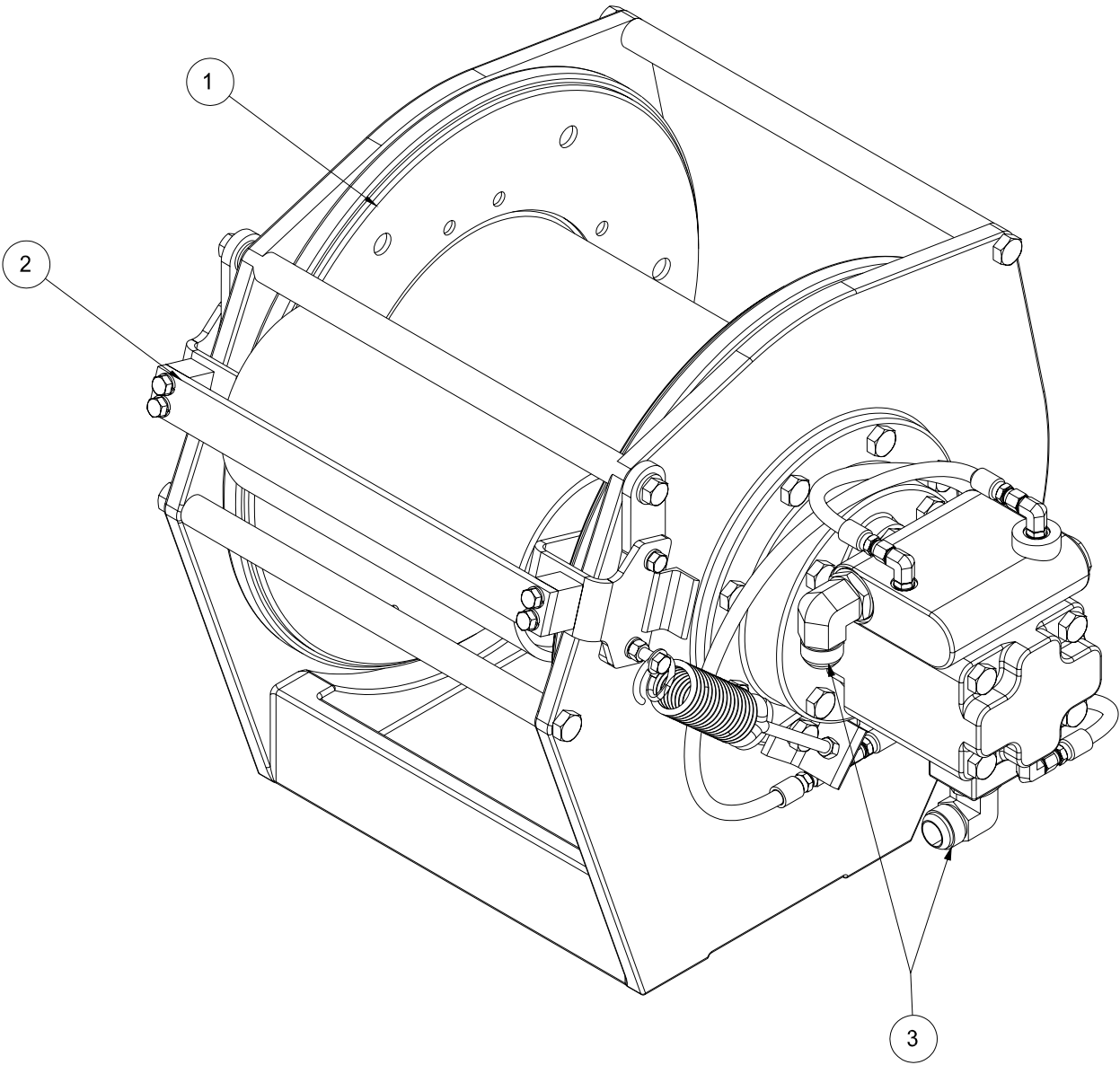


FIGURE 6-1

Figure 6-1			A172821	Drawing Rev B
ITEM	PART NO.	QTY.	DESCRIPTION	
1	A167635	1	Cable Follower Assembly	Ref Fig 6-1a
2	A172753	1	Winch Modification	
3	A13230	2	Adapt-90, 16Sae - 16Jicm	

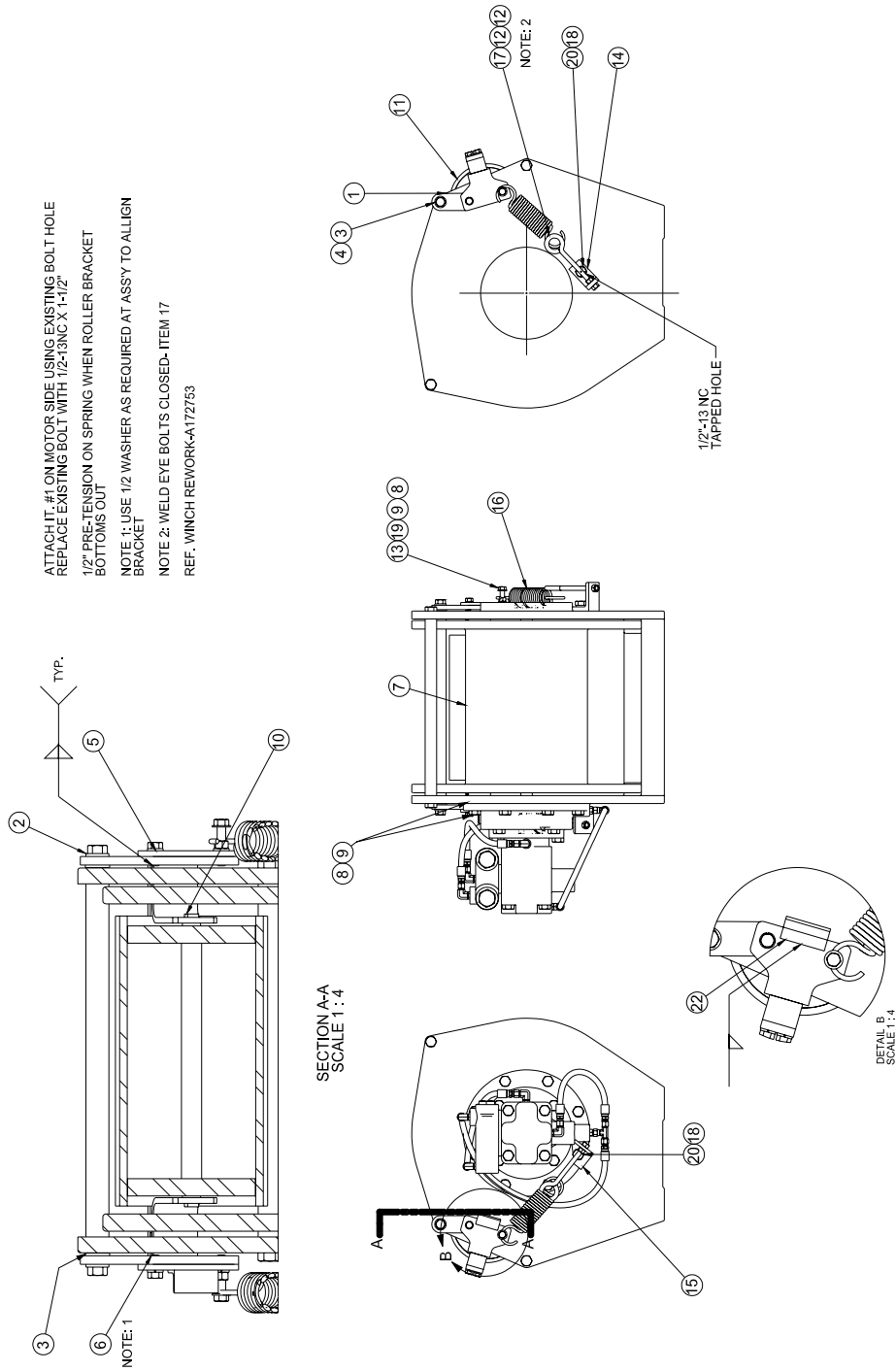


FIGURE 6-1a

CABLE FOLLOWER ASSEMBLY

Figure 6-1a

A167635

Drawing Rev B

ITEM	PART NO.	QTY.	DESCRIPTION
1	A164450	2	Arm
2	A164454	2	Bushing Oilite Flange
3	A103024	2	Washer, 1/2" Hard (Flat)
4	A100424H	2	Bolt, 1/2-13Nc X 2" Gr 5 (Hex)
5	A164453	2	Bracket Support
6	A164559	2	Block, Plate 44W
7	A164452	1	Holding Bar
8	A103202H	8	Washer-Lock, 3/8"
9	A100204H	6	Bolt, 3/8-16Nc X 3/4" Gr 5 (Hex)
10	A163691	1	Shaft
11	A172725	1	Drum Machining
12	A102504H	6	Nut, 3/8-16Nc (Hex) Gr5
13	A100220H	2	Bolt, 3/8-16Nc X 1-3/4" Gr 5 (Hex)
14	A164449	1	Angle 44W, 3/8 X 2-1/2 X 2-1/2 X 1-1/4", Rev B
15	A167913	1	Angle 44W, 1/4W X 2 Sqr X 2"
16	A164576	2	Extension Spring
17	A102094	2	Bolt, 3/8-16Nc X 6", C/W Nuts, Bent (Eye)
18	A100409H	2	Bolt, 1/2-13Nc X 1" Gr 8 (Hex)
19	A103022H	2	Washer, 3/8" (Flat Hard Gr8)
20	A103204	2	Washer-Lock, 1/2" (High Alloy)
21	A13457	2	Bearing Ball
22	A172886	1	Angle, Switch Contact

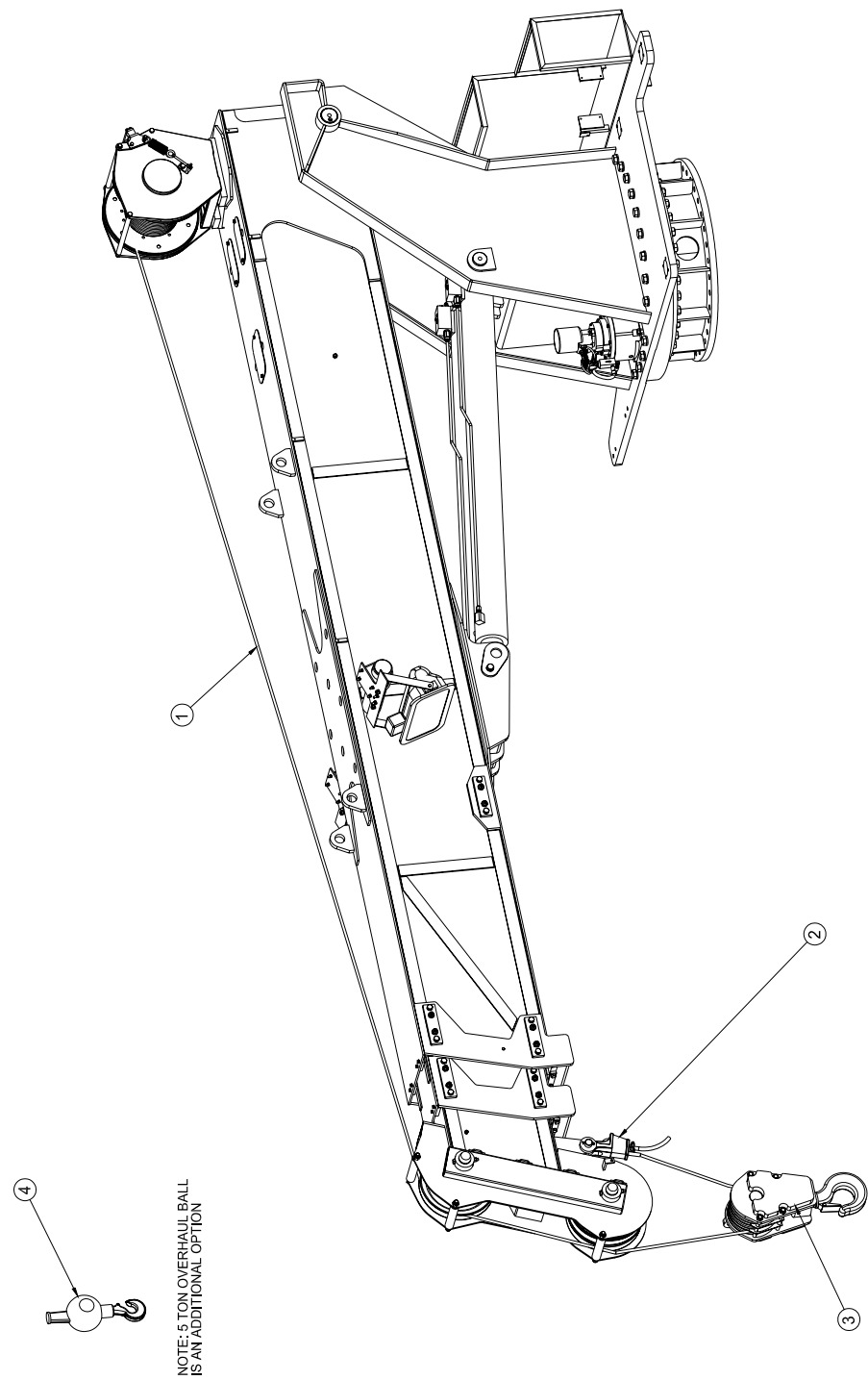


FIGURE 7



Figure 7 **A172841** **Drawing Rev -**

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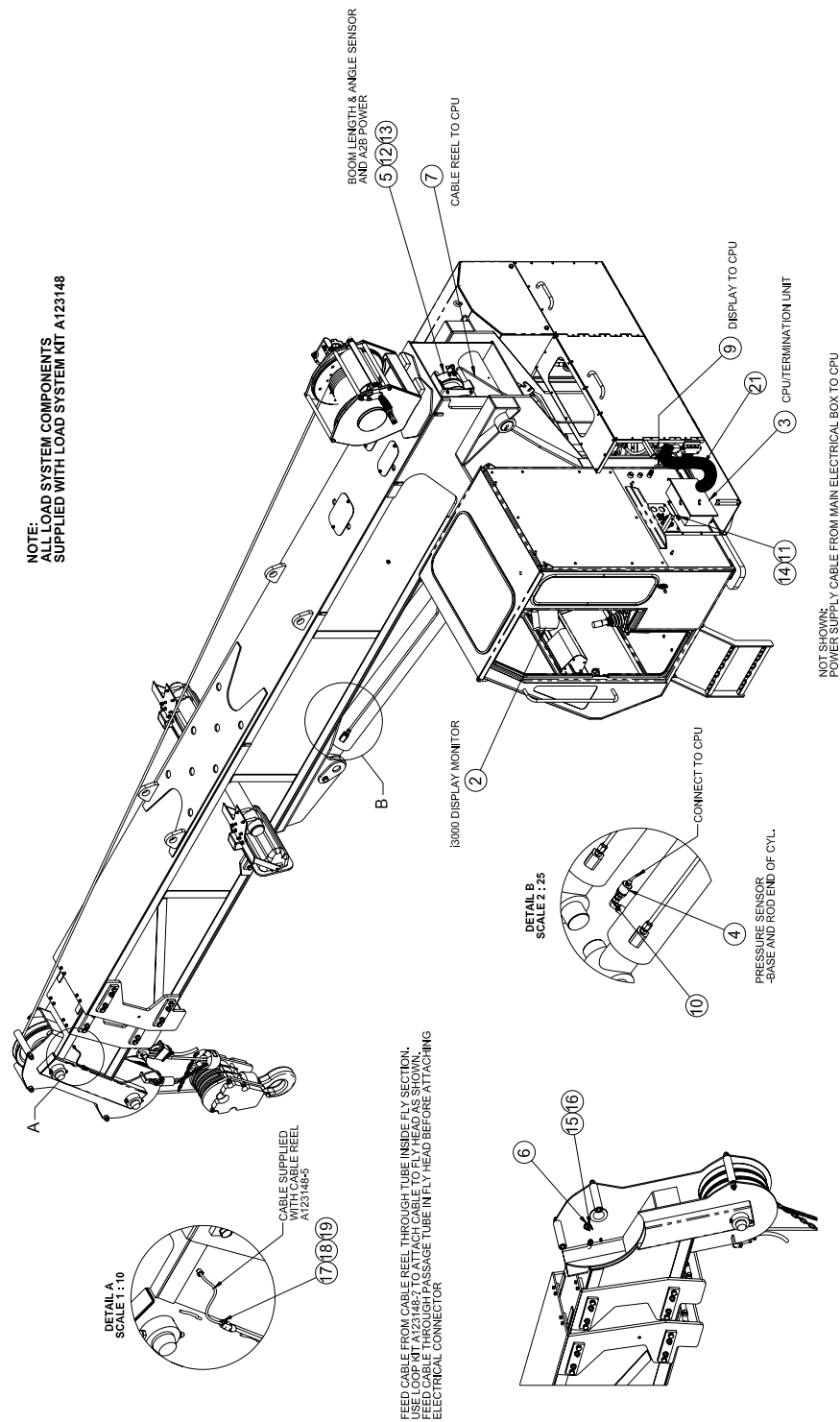


FIGURE 8

LOAD SYSTEM INSTALLATION

Figure 8

A172166

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123148	1	Load System, I-3000
2	A172600	1	Reel Mount Assembly
3	H00459	2	Adapt-90, 3/8Nptf/S-6Saem
4	A122162	1	Strain Relief Kit
5	A122168	1	Strain Relief Kit
6	A100004H	5	Bolt, 1/4-20Nc X 3/4" Gr 5 (Hex)
7	A102700	4	Nut-Lock, 1/4-20Nc Gr5
8	A103000	4	Washer, 1/4 (Flat)
9	A103200H	4	Washer-Lock, 1/4" (Plated)
10	A103086	2	Washer, 3/8" X 1.25 Od (Fender)
11	A102504H	2	Nut, 3/8-16Nc (Hex) Gr5
12	A120504	1	Plug, 4 Pos Soc Connector
13	A120505	1	Wedge, Lock Plug 4 Pos Soc
14	A121755	4	Terminal, Socket 18-16 Ga
15	A167780	6	Cable-Tie, 6" Black
16	A123278	1	Elec. Harness

Ref Fig 8-1

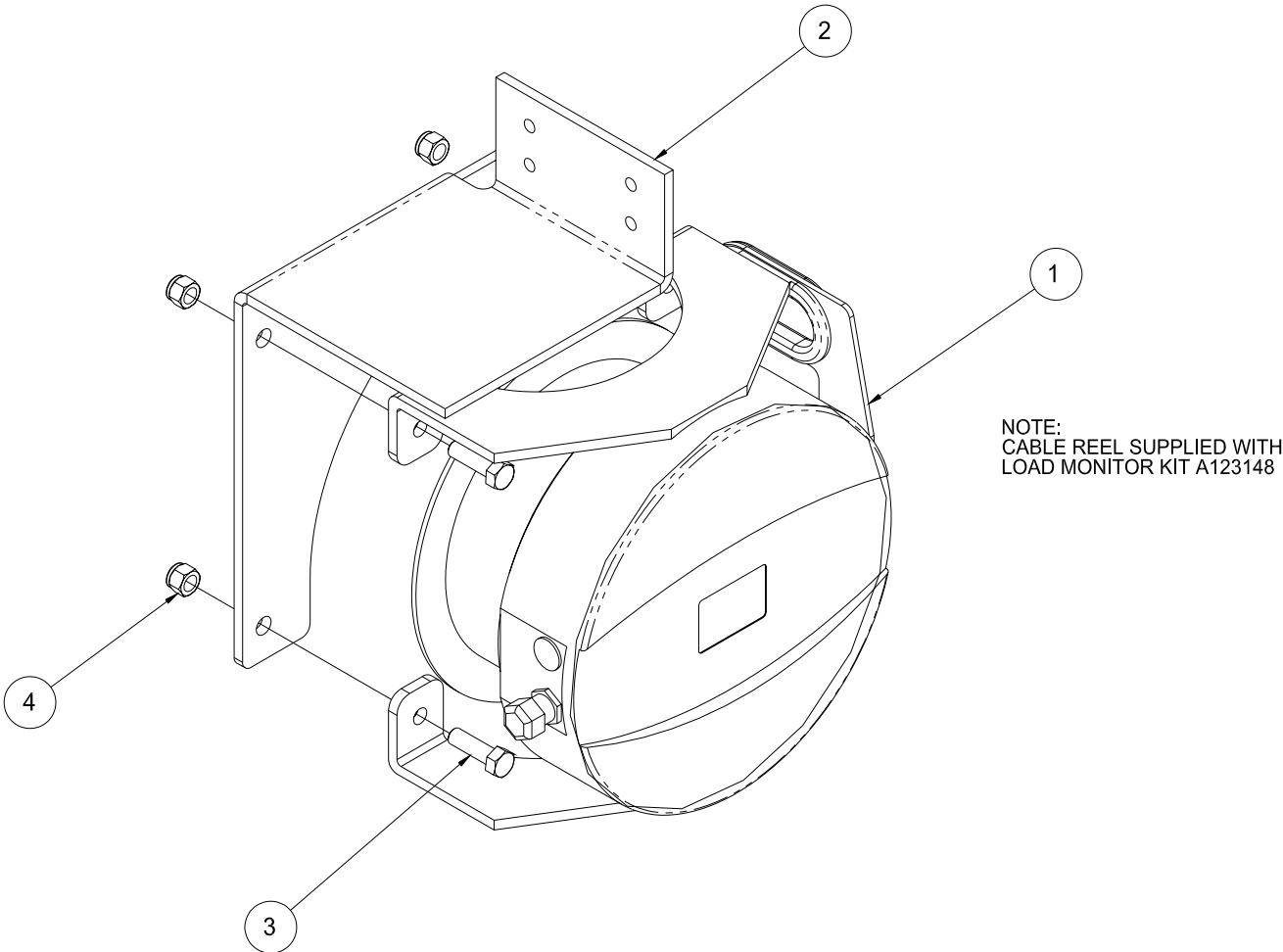


FIGURE 8-1

Figure 8-1 A172600 Drawing Rev A

A172908 8.103

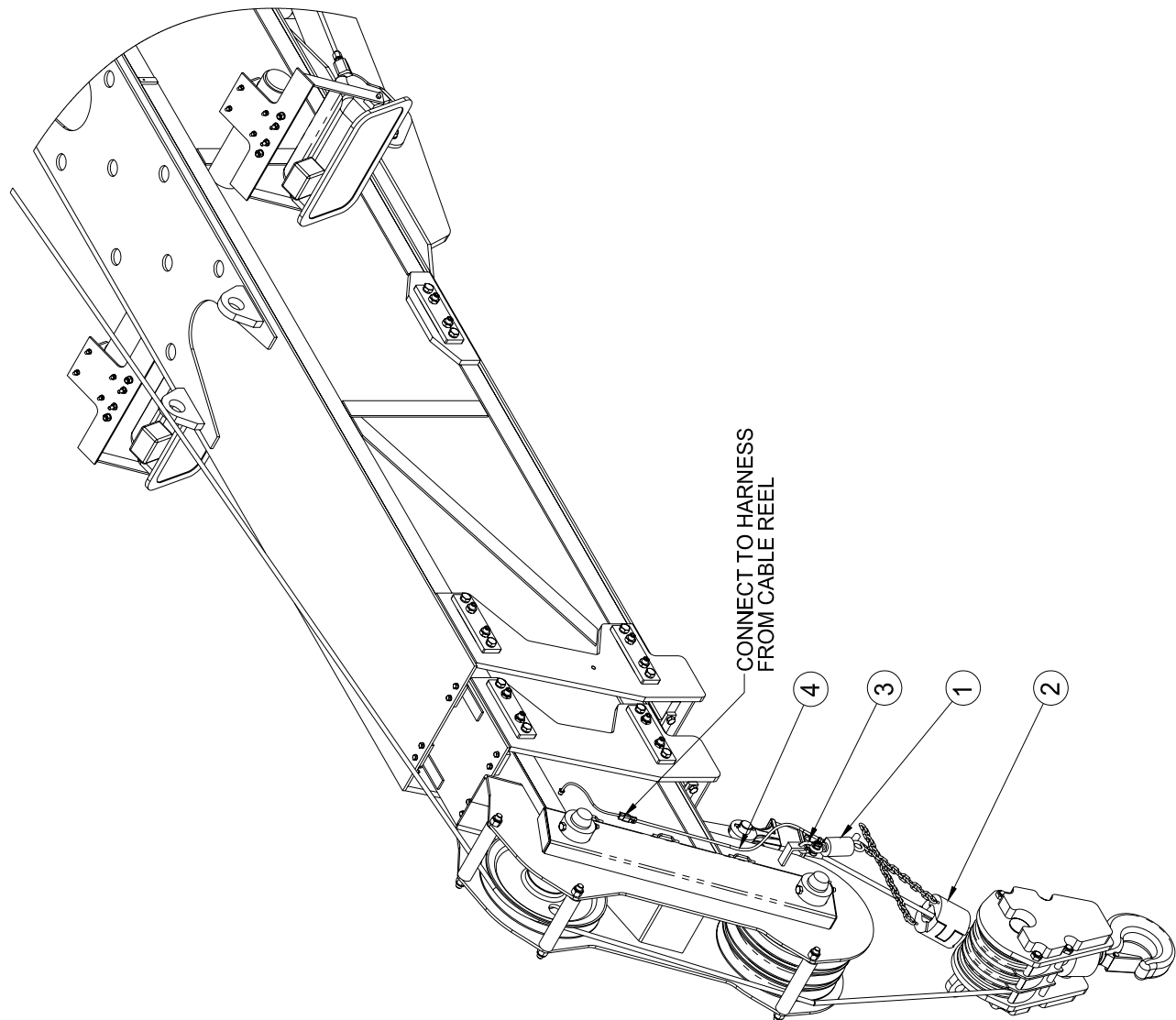


FIGURE 9

ANTI-TWO BLOCK INSTALLATION

Figure 9

A172842

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123241	1	A2B Switch, Modified
2	M00300	1	Weight, Anti Two Block
3	FS00182	1	Shackle, 3/8 1 Ton
4	A167780	2	Cable-Tie, 6" Black

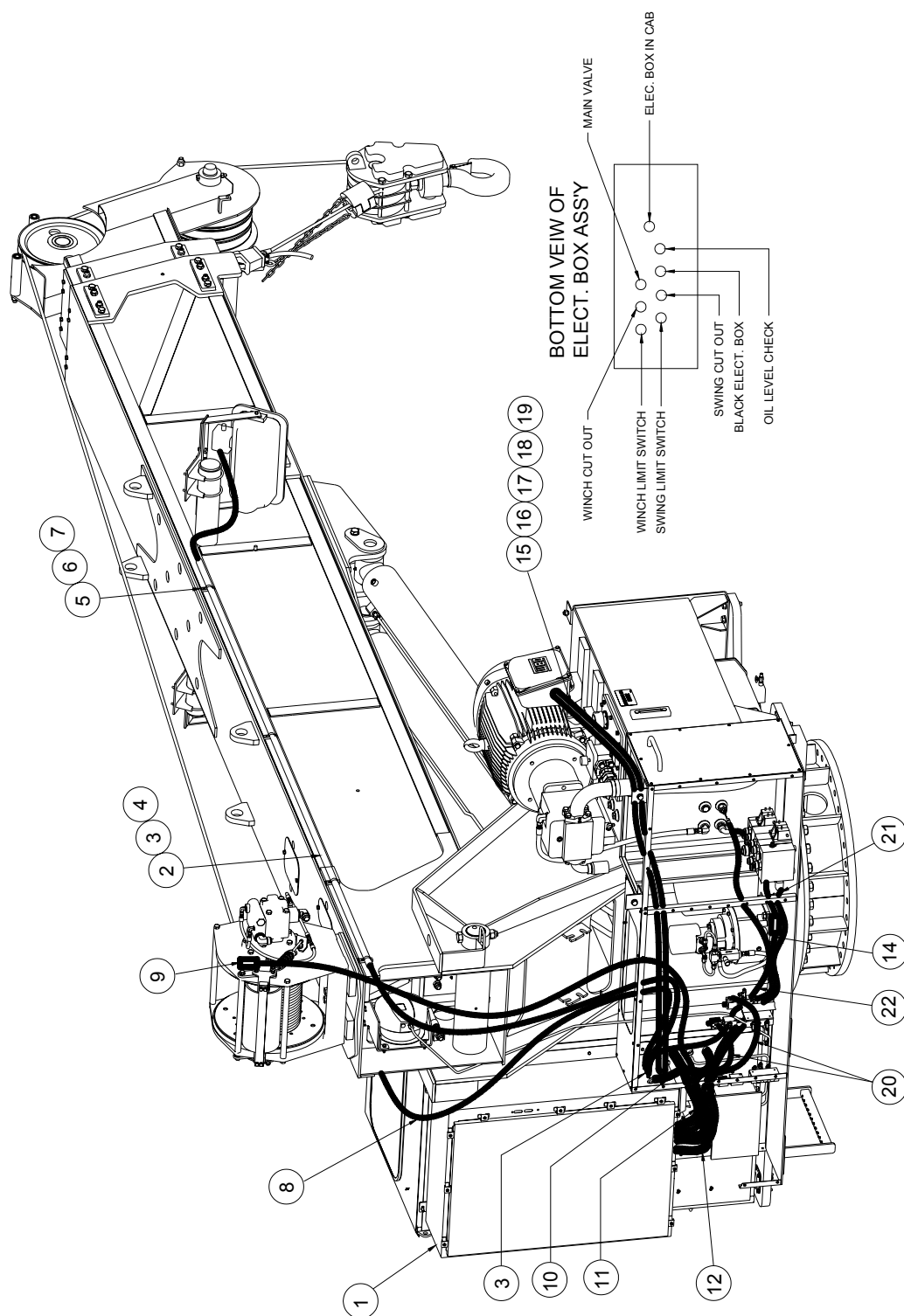


FIGURE 10

ELECTRICAL INSTALLATION

Figure 10

A123130

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123131	1	Electrical Schematic
2	A123272	1	Electrical Box Assembly
3	RM00917-144	2	Pipe, 1/2" Dia
4	A122162	14	Strain Relief Kit, 1/2" Npt
5	A110215	4	Coupling, 1/2 -14Nptf Full(Wrght Steel)
6	A121384	8	Clip-Half 3/4"
7	A100000H	8	Bolt, 1/4-20Nc X 1/2" (Hex)
8	A103000	8	Washer, 1/4 (Flat)
9	RM00594-216	2	Cable, 16-3 600V Yellow X 216
10	A172778	1	Switch, Limit Lever
11	RM02825-36	1	Conduit, 3/4" X 36 (Liquid-Tite) Flexible
12	SE0079-36	1	Conduit, Flexible, 1/2"(Liquid-Tite)X 36" Lg
13	RM01695-36	1	Cable, 18-3 600V Control X 36"Lg
14	RM01695-72	1	Cable, 18-3 600V Control X 72"Lg
15	A123276	1	Electrical Harness
16	RM00482-120	1	Conduit, 1-1/2" Flexible (Liquid-Tite) X 120"Lg
17	RM02733-120	4	Wire, 16 Ga 600V, 110 C,Daa1068A X 120" Lg
18	RM00383-120	3	Wire, 1 Ga 2Kv, 110C, X120"Lg
19	RM02700-120	1	Wire, 6 Ga Green X 120"Lg
20	A123234	1	Reducer, 3" - 1-1/2" , Threaded
21	A123278	1	Electrical Harness
22	A123279	1	Electrical Harness (Main Valve)
23	A123280	1	Electrical Harness (Oil Level)

Ref Fig 10-1

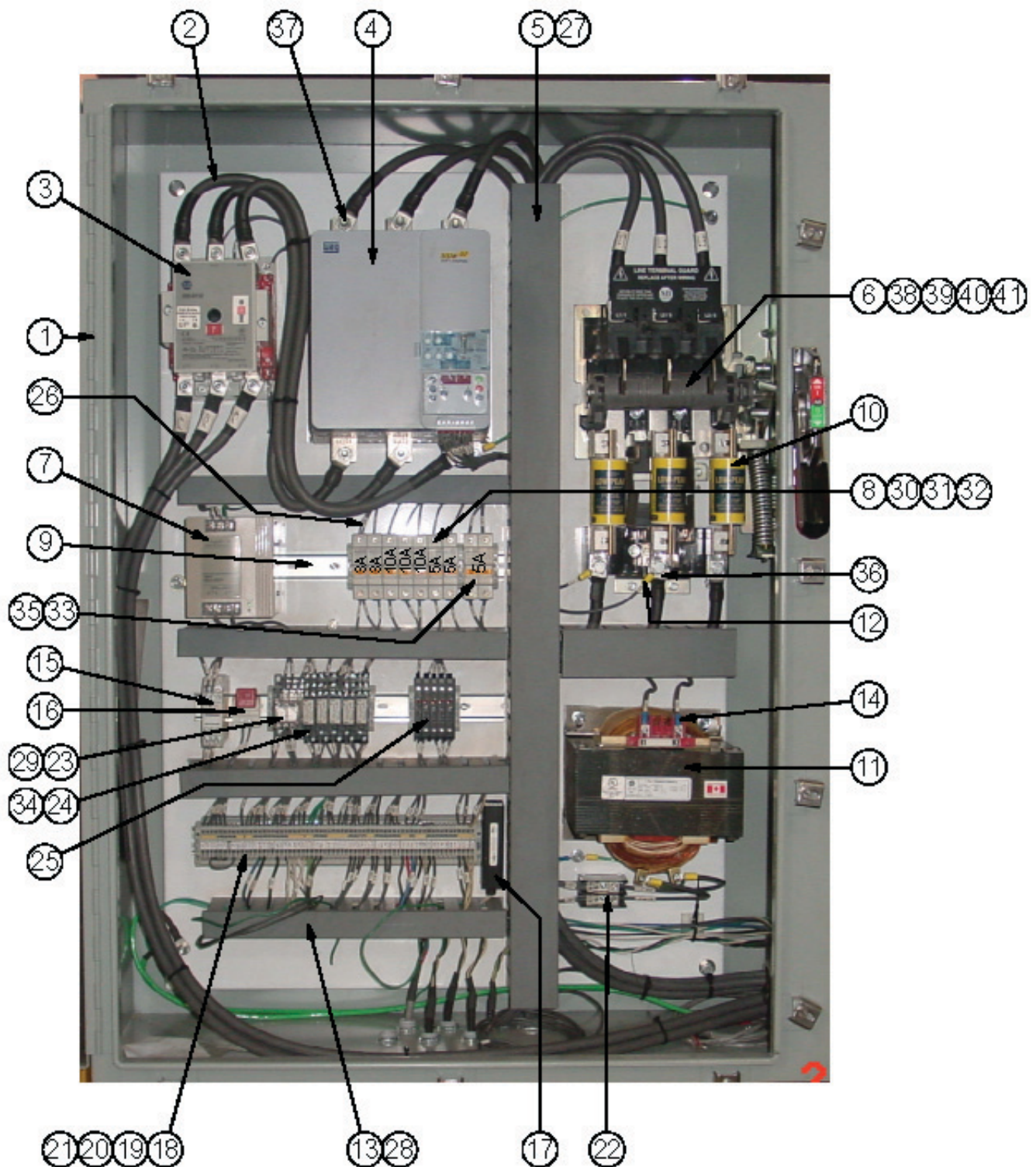


FIGURE 10-1

ELECTRICAL BOX ASSEMBLY

Figure 10-1

A123272

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A123218	1	Enclosure
2	RM00383-180	1	Wire, 1 Ga 2Kv 110C 1068 Spec X 180" Lg
3	A123192	1	Contactor
4	A123158	1	Soft Start
5	RM02372-42	1	Duct, 2 X 3 Wire Way X 42" Lg Panduit
6	A123193	1	Switch, Fusible
7	A123220	1	Power Supply, Output, 240 Watt, 24 V Dc
8	A123178	7	Holder, Fuse, 600 V 1 Pole
9	RM00549-42	1	Din-Rail, 35mm, 199-Dr1 X 42" Lg
10	A123198	3	Fuse, J Type, 150 Amp, 600 V
11	A123191	1	Transformer
12	A121586	5	Terminal, Ring, 12-10 Awg, 3/8" Stud
13	RM02815-56	1	Cover, 6' (1") X 56" Lg Panduit
14	A121597	2	Terminal, Ring, 16-14 Awg, #10 Stud
15	A123076	1	Thermistor, Monitor
16	A123208	1	Controller, Thermostat
17	A123206	1	Heater, 30 Watt 120 Volt
18	A122739	1	Terminal Block End Barrier
19	A122735	64	Terminal Block
20	A122740	2	Terminal Block End Anchor
21	A122828	64	Terminal Marker
22	A122745	1	Power Block
23	A123202	1	Relay, 3Pdt
24	A123200	5	Relay, Power Dpdt 24 Vdc
25	A123102	1	Terminal Block
26	RM02733-150	1	Wire, 16 Ga 600V, 110 C
27	RM02822-42	1	Duct, 2" X 42" Wireway Cover Panduit
28	RM00547-56	1	Duct, 1" X 3 Panduit X56
29	A123203	1	Base, Relay
30	A123236	3	Fuse, Low Peak, 600V
31	A123269	3	Fuse, 10 Amp Time Delay Low Peak 600V
32	A123235	2	Fuse, Low Peak, 600V
33	A123177	1	Holder, Fuse, 600 V 2 Pole
34	A123201	5	Base, Relay
35	A123199	2	Fuse, Atqr, 8 Amp
36	A123217	3	Lug, Panduit
37	A123216	12	Lug, Panduit
38	A123194	1	Rod, Connecting
39	A123195	1	Fuse Block Kit
40	A123196	1	Fuse Clip Assembly
41	A123197	1	SS Handle

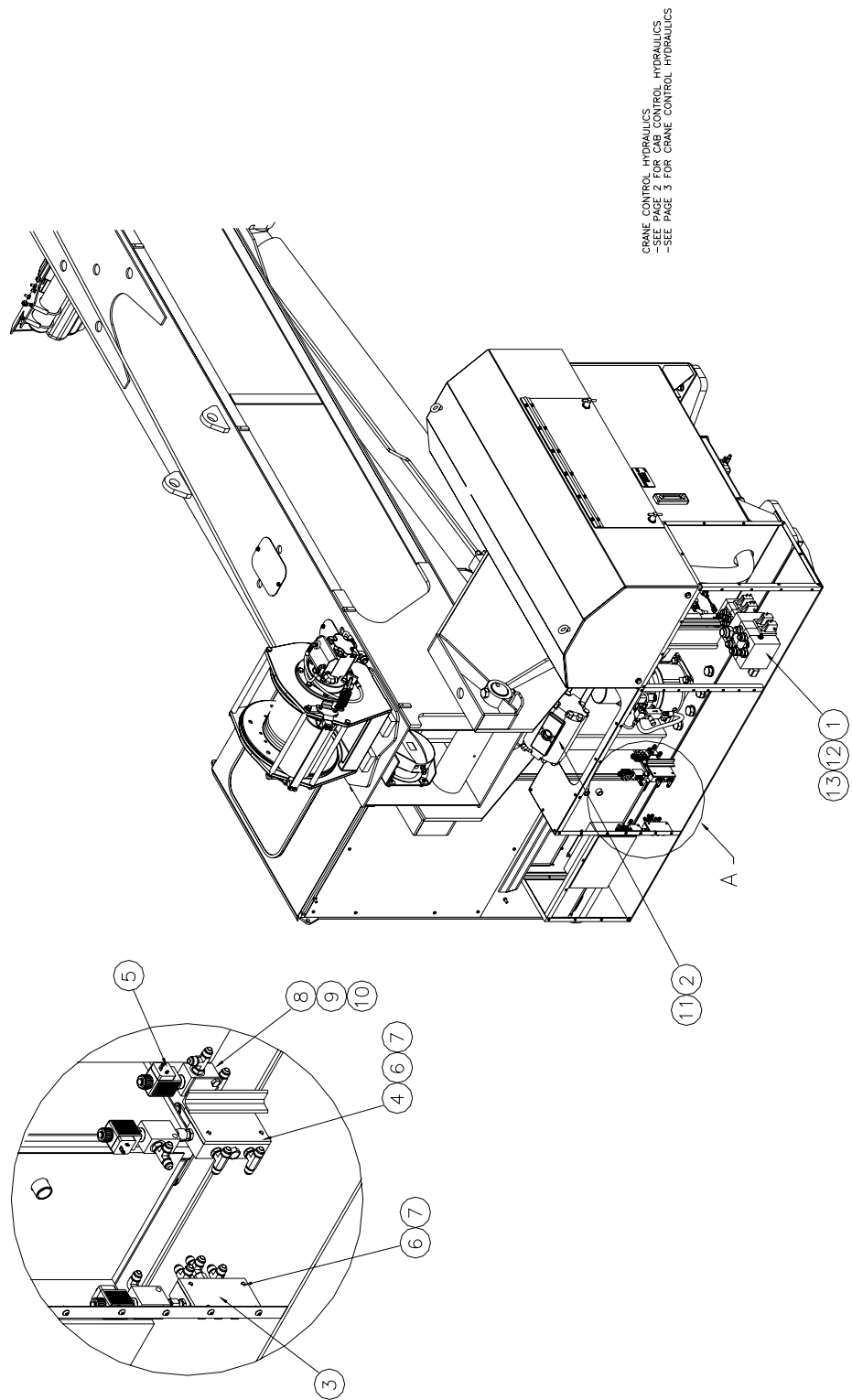


FIGURE 11A

HYDRAULIC INSTALLATION

(SHEET 1 OF 3)

Figure 11A

A115187

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A115183	1	Hydraulic Schematic	
2	A115287	1	Control Valve Assembly	Ref Fig 11-1
3	A112386	1	Flow Divider, Gear Type	
4	A115281	1	Cutout Valve Assembly-Overload	Ref Fig 11-2
5	A115282	1	Cutout Valve Assembly-Swing	Ref Fig 11-3
6	A115291	1	Cut Out Valve Assembly, Winch	Ref Fig 11-4
7	A100020H	2	Bolt, 1/4-20Nc X 1-3/4" Gr 5 (Hex)	
8	A103200H	2	Washer-Lock, 1/4" (Plated)	
9	A100120H	1	Bolt, 5/16-18Nc X 1-3/4" Gr 5 (Hex)	
10	A103001H	1	Washer, 5/16" (Flat)	
11	A102740H	1	Nut-Nylock, 5/16-18Nc Gr5	
12	A102720	4	Nut-Nylock, 5/8-11Nc Gr5	
13	A109177	4	Bolt, M12 X 1.75 X 18Mm (Hex)	
14	A109176	4	Washer-Lock, M12 Max Od 19.5mm Crbn Stl	
15	H16563-38	10	Hose Assembly - 1/4"	
16	H15500-38	2	Hose Assembly - 1/4"	
17	H00851-46	3	Hose Assembly - 3/8"	
18	H15502-30	3	Hose Assembly - 1/4"	
19	H00851-36	2	Hose Assembly - 3/8"	
20	H15502-40	1	Hose Assembly - 1/4"	
21	H15502-35	1	Hose Assembly - 1/4"	
22	H00851-34	1	Hose Assembly - 3/8"	
23	H15502-36	1	Hose Assembly - 1/4"	
24	H00862-7.5	1	Hose Assembly - 3/8"	
25	H00851-19	1	Hose Assembly - 3/8"	
26	H00851-50	1	Hose Assembly - 3/8"	
27	H00851-120	1	Hose Assembly - 3/8"	
28	H00850-75	1	Hose Assembly - 3/8"	
29	H15502-79	1	Hose Assembly - 1/4"	
30	A113156	1	Split Flange Kit Code 62 1-1/4	
31	H16782-35	1	Hose Assembly - 1"	
32	H16766-40	1	Hose Assembly - 1-1/2"	
33	H00883-38	2	Hose Assembly - 1/2"	
34	H00882-77	2	Hose Assembly - 1/2"	
35	H16785-45	1	Hose Assembly - 1"	
36	H15679-75	1	Hose Assembly - 1"	
37	A15047	1	Split Flange Kit 1-1/4" Sae Code 61	
38	A15045	2	Split Flange Kit 3/4" Sae Code 61	
39	H16780-40	1	Hose Assembly - 3/4"	
40	H16780-38	1	Hose Assembly - 3/4"	

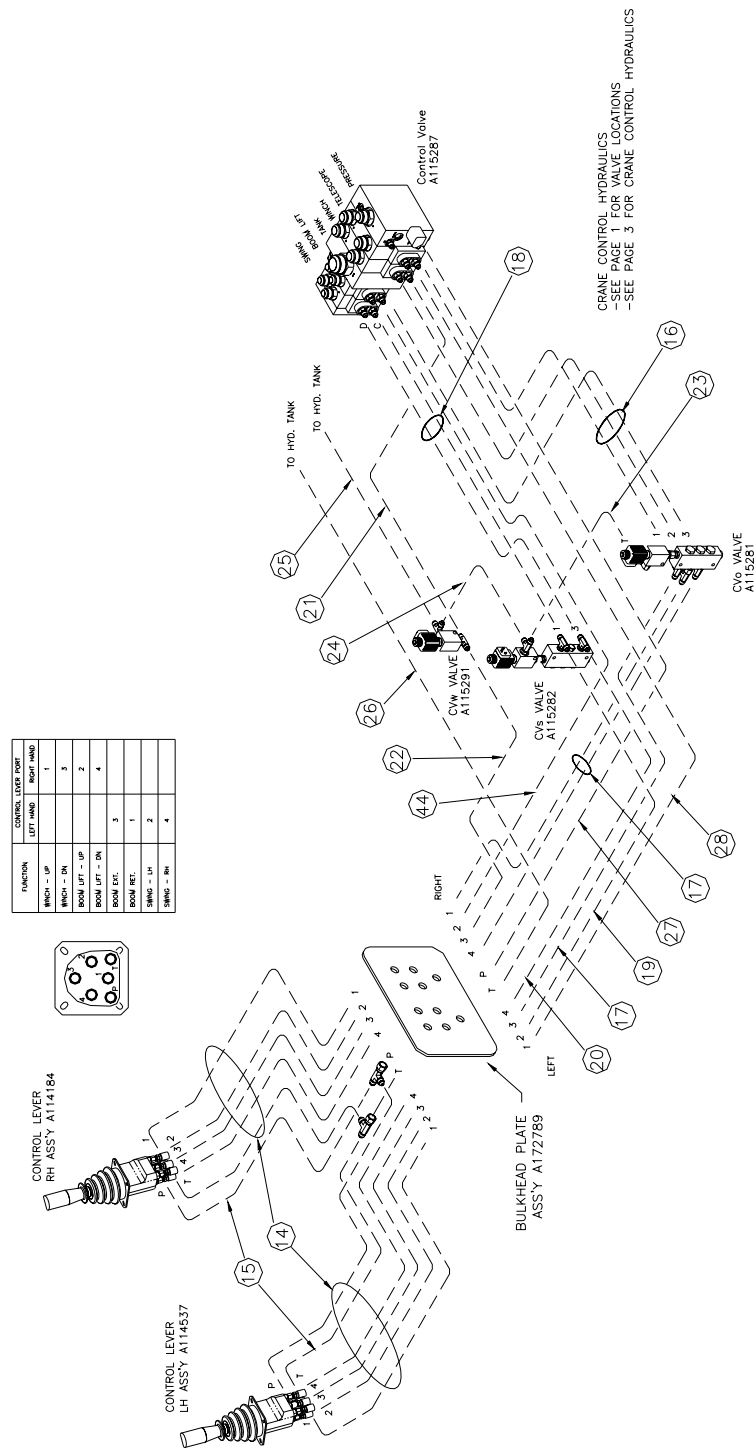


FIGURE 11B

HYDRAULIC INSTALLATION

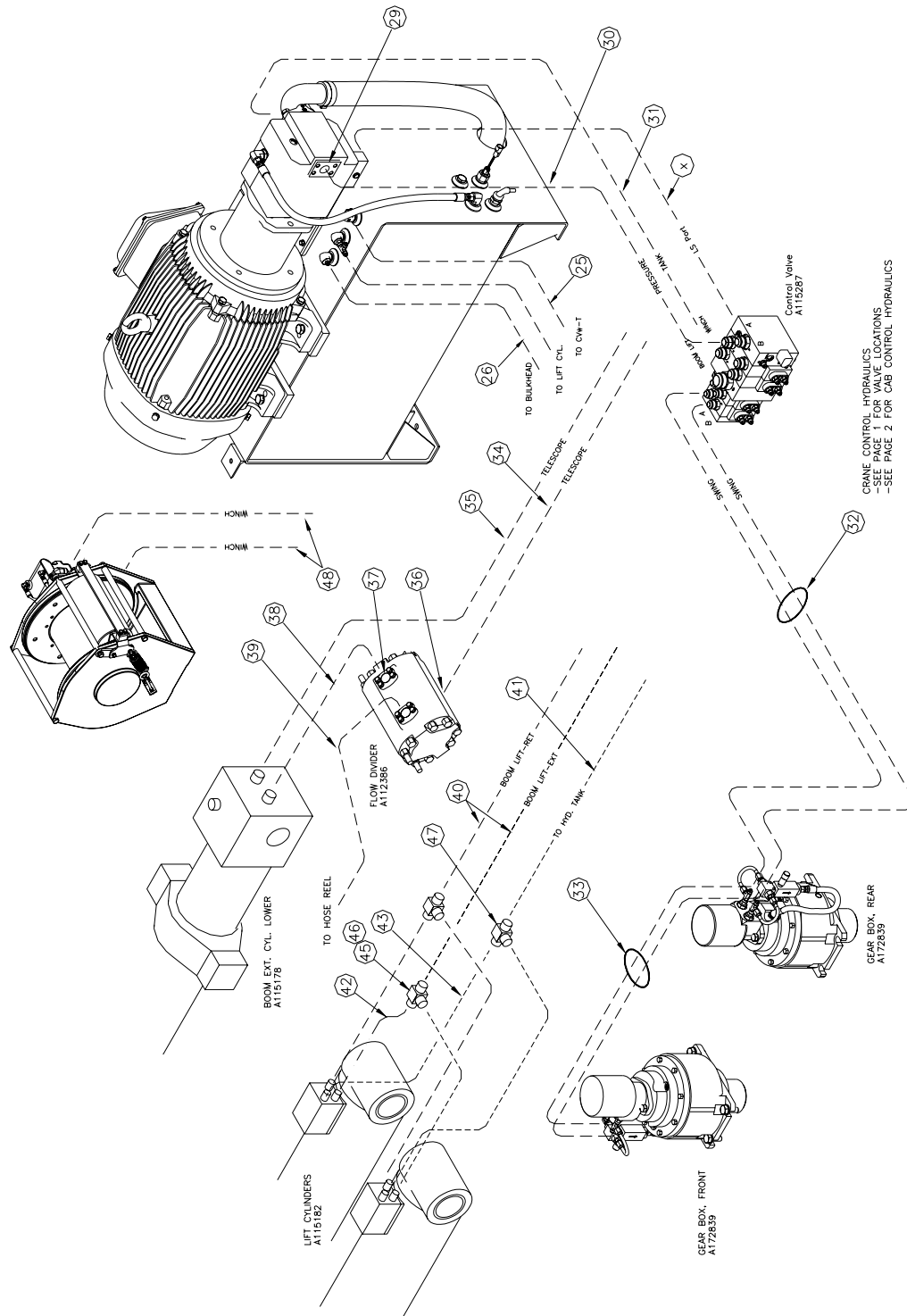
(SHEET 2 OF3)

Figure 11B

A115187

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
41	H00900-52	2	Hose Assembly - 3/4"
42	H00851-52	1	Hose Assembly - 3/8"
43	H00882-18	4	Hose Assembly - 1/2"
44	H00853-18	2	Hose Assembly - 3/8"
45	H15502-73	1	Hose Assembly - 1/4"
46	A14009	2	Adapt-Tee, 12Jicm (Union)
47	A112623	4	Adapt, 12Jicf - 8Jicm (Reducer)
48	A13250	1	Adapt-Tee, 6Jic (Union)
49	H00920-95	2	Hose Assembly - 1"
50	H00851-42	1	Hose Assembly - 3/8"



CRANE CONTROL HYDRAULICS
-SEE PAGE 1 FOR CONNECTIONS
-SEE PAGE 2 FOR CAB CONTROL HYDRAULICS

FIGURE 11C

HYDRAULIC INSTALLATION

(SHEET 3 OF 3)

Figure 11C

A115187

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION	
1	A115183	REF	Hydraulic Schematic	
2	A115287	REF	Control Valve Assembly	Ref Fig 11-1
3	A112386	REF	Flow Divider, Gear Type	
4	A115281	REF	Cutout Valve Assembly-Overload	Ref Fig 11-2
5	A115282	REF	Cutout Valve Assembly-Swing	Ref Fig 11-3
6	A115291	REF	Cut Out Valve Assembly, Winch	Ref Fig 11-4
7	A100020H	REF	Bolt, 1/4-20Nc X 1-3/4" Gr 5 (Hex)	
8	A103200H	REF	Washer-Lock, 1/4" (Plated)	
9	A100120H	REF	Bolt, 5/16-18Nc X 1-3/4" Gr 5 (Hex)	
10	A103001H	REF	Washer, 5/16" (Flat)	
11	A102740H	REF	Nut-Nylock, 5/16-18Nc Gr5	
12	A102720	REF	Nut-Nylock, 5/8-11Nc Gr5	
13	A109177	REF	Bolt, M12 X 1.75 X 18Mm (Hex)	
14	A109176	REF	Washer-Lock, M12 Max Od 19.5mm Crbn Stl	
15	H16563-38	REF	Hose Assembly - 1/4"	
16	H15500-38	REF	Hose Assembly - 1/4"	
17	H00851-46	REF	Hose Assembly - 3/8"	
18	H15502-30	REF	Hose Assembly - 1/4"	
19	H00851-36	REF	Hose Assembly - 3/8"	
20	H15502-40	REF	Hose Assembly - 1/4"	
21	H15502-35	REF	Hose Assembly - 1/4"	
22	H00851-34	REF	Hose Assembly - 3/8"	
23	H15502-36	REF	Hose Assembly - 1/4"	
24	H00862-7.5	REF	Hose Assembly - 3/8"	
25	H00851-19	REF	Hose Assembly - 3/8"	
26	H00851-50	REF	Hose Assembly - 3/8"	
27	H00851-120	REF	Hose Assembly - 3/8"	
28	H00850-75	REF	Hose Assembly - 3/8"	
29	H15502-79	REF	Hose Assembly - 1/4"	
30	A113156	REF	Split Flange Kit Code 62 1-1/4	
31	H16782-35	REF	Hose Assembly - 1"	
32	H16766-40	REF	Hose Assembly - 1-1/2"	
33	H00883-38	REF	Hose Assembly - 1/2"	
34	H00882-77	REF	Hose Assembly - 1/2"	
35	H16785-45	REF	Hose Assembly - 1"	
36	H15679-75	REF	Hose Assembly - 1"	
37	A15047	REF	Split Flange Kit 1-1/4" Sae Code 61	
38	A15045	REF	Split Flange Kit 3/4" Sae Code 61	
39	H16780-40	REF	Hose Assembly - 3/4"	
40	H16780-38	REF	Hose Assembly - 3/4"	
41	H00900-52	REF	Hose Assembly - 3/4"	
42	H00851-52	REF	Hose Assembly - 3/8"	
43	H00882-18	REF	Hose Assembly - 1/2"	
44	H00853-18	REF	Hose Assembly - 3/8"	
45	H15502-73	REF	Hose Assembly - 1/4"	
46	A14009	REF	Adapt-Tee, 12Jicm (Union)	
47	A112623	REF	Adapt, 12Jicf - 8Jicm (Reducer)	
48	A13250	REF	Adapt-Tee, 6Jic (Union)	
49	H00920-95	REF	Hose Assembly - 1"	
50	H00851-42	REF	Hose Assembly - 3/8"	

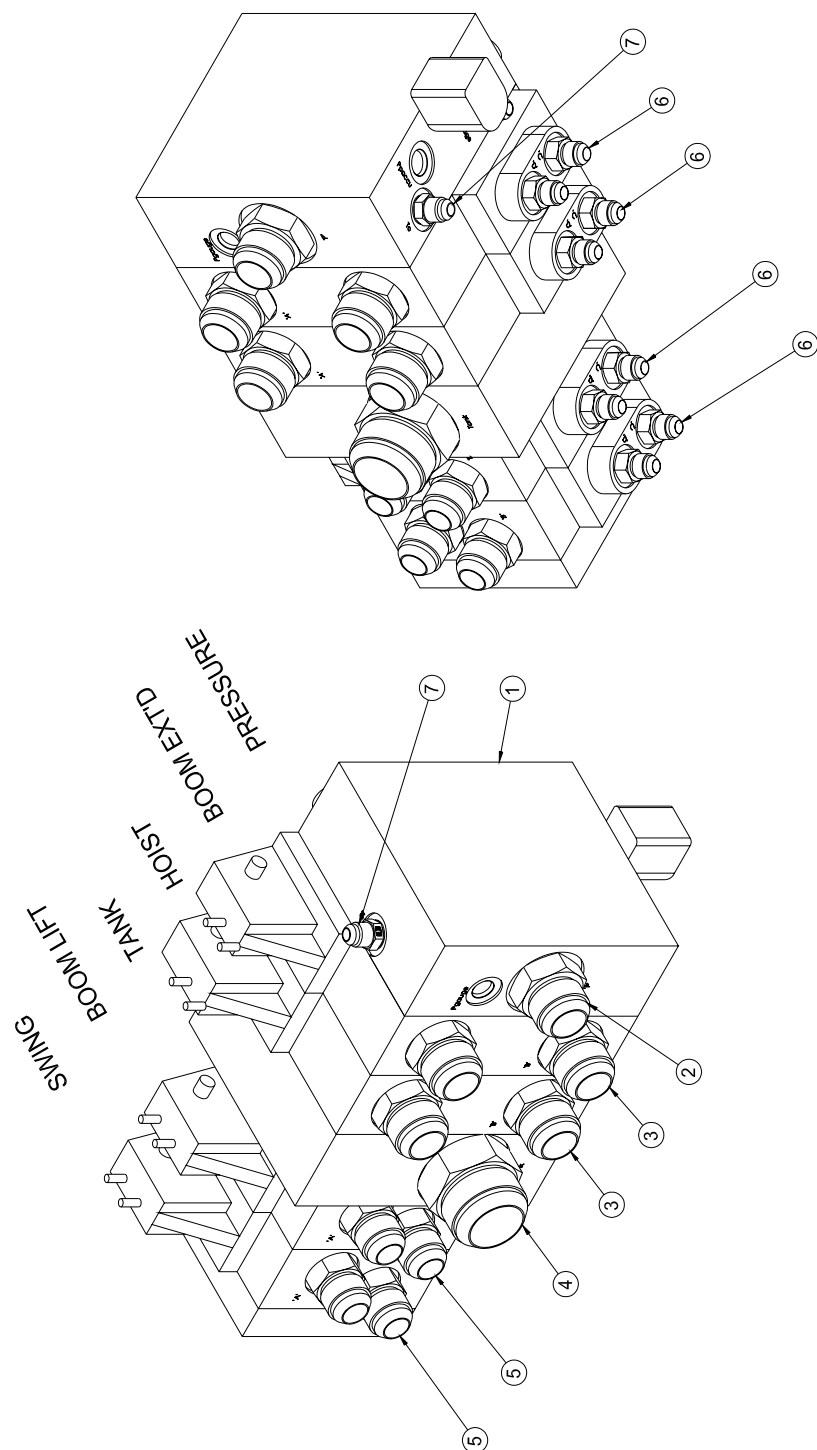


FIGURE 11-1

CONTROL VALVE ASSEMBLY

Figure 11-1

A115287

Drawing Rev A

ITEM	PART NO.	QTY.	DESCRIPTION
1	A115184	1	Valve, Control
2	A13231	1	Adapt, 16Sae - 16Jicm
3	A16928	4	Adapt, 12Sae - 16Jicm
4	A115028	1	Adapter, 20 Sae - 24 Jic Str
5	A13915	4	Adapt, 10Sae - 12Jicm
6	A13240	8	Adapt, 6Sae - 6Jicm
7	A13925	3	Adapt, 4Bsp - 6Jicm

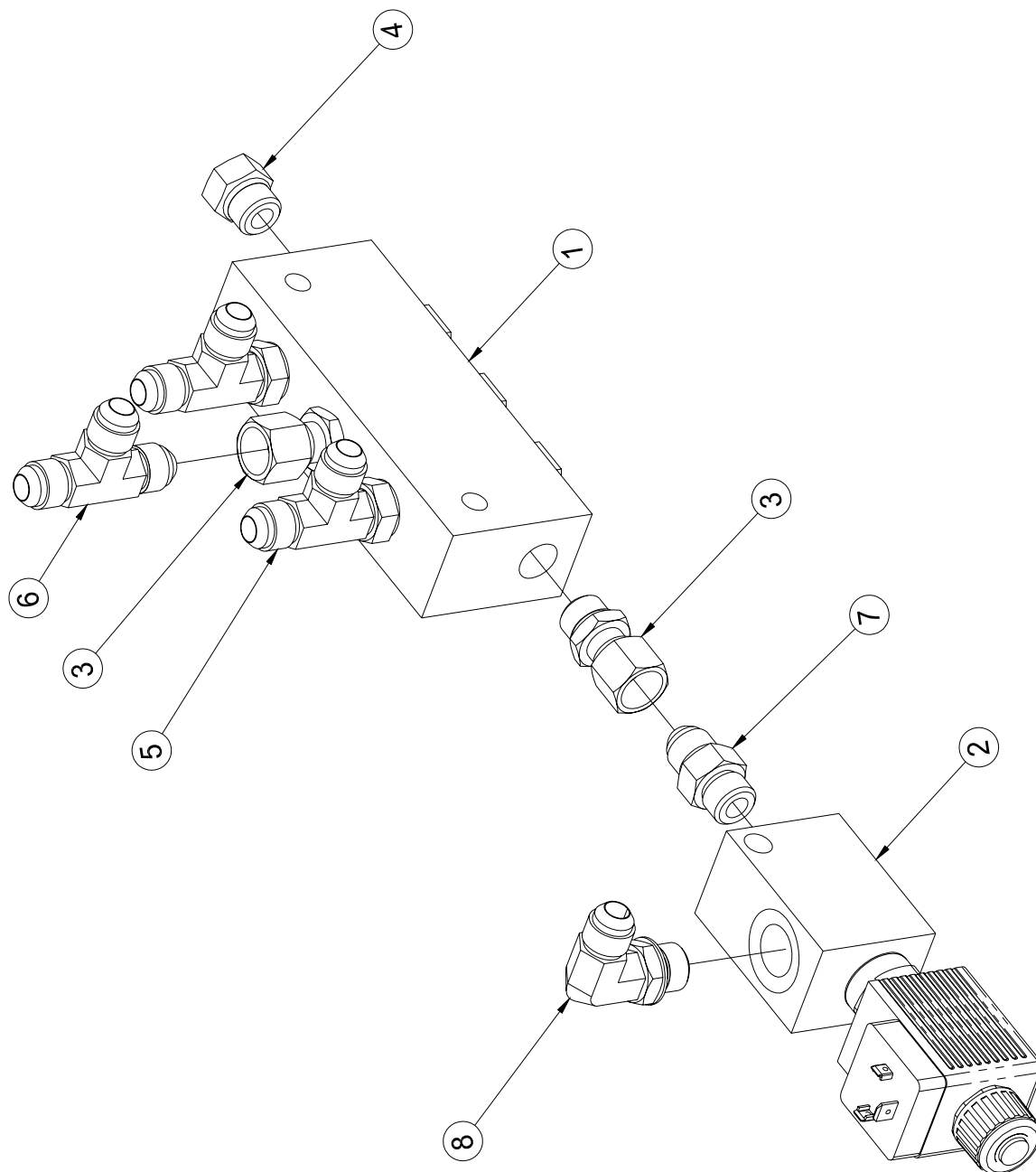


FIGURE 11-2

CUTOUT VALVE ASSEMBLY-OVERLOAD

Figure 11-2

A115281

Drawing Rev -

ITEM	PART NO.	QTY.	DESCRIPTION
1	A114444	1	Valve, Check Block, Assembly
2	A115241	1	Valve, Directional Control
3	A112651	2	Adapt, 6Saem - 6Jicf/S
4	H00107	1	Plug, 6Sae Hex Head
5	A13250	1	Adapt-Tee, 6Jic (Union)
6	A13240	1	Adapt, 6Sae - 6Jicm
7	A13253	1	Adapt-90, 6Sae - 6Jicm

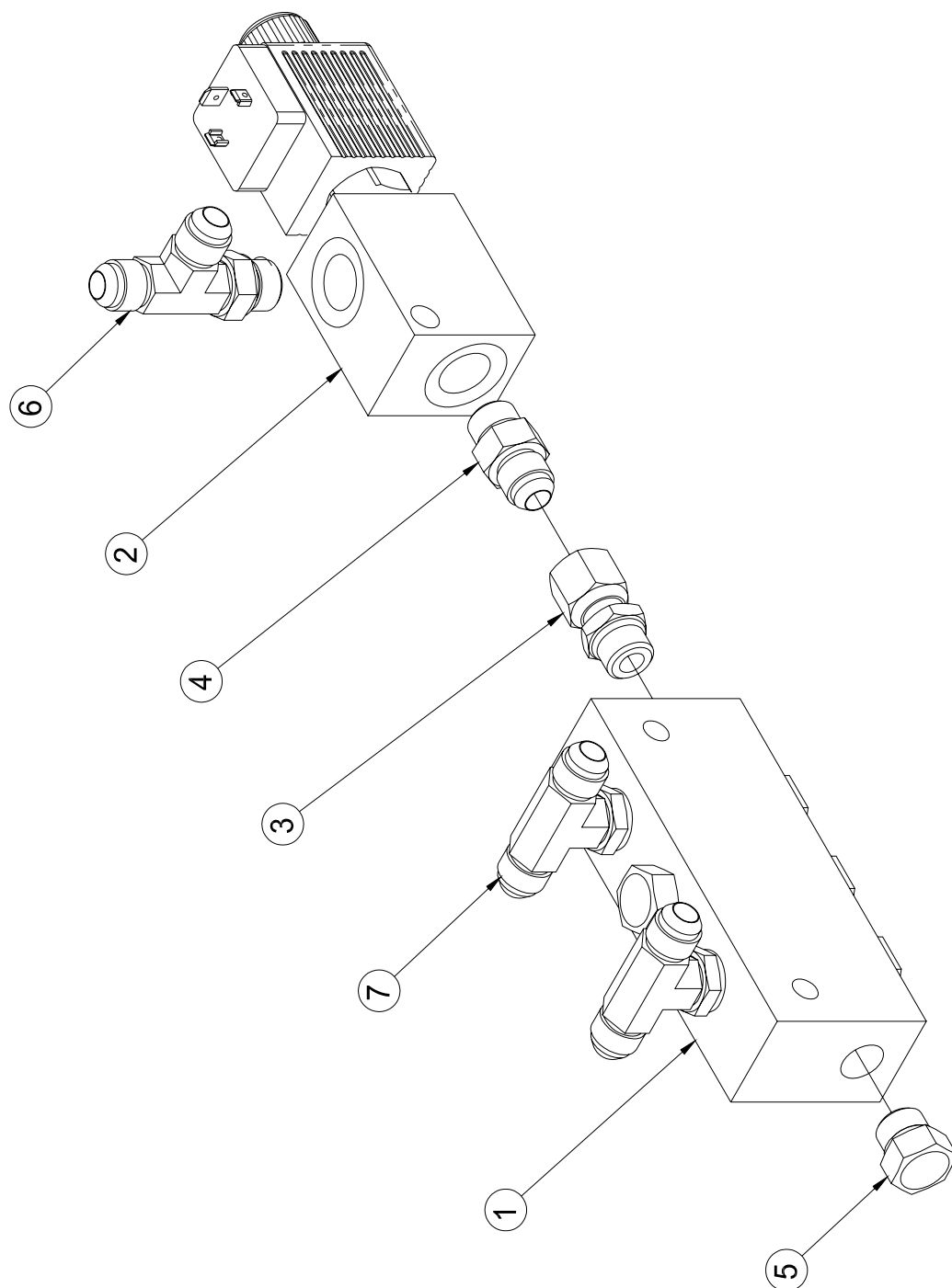


FIGURE 11-3

CUTOUT VALVE ASSEMBLY-SWING**Figure 11-3****A115282****Drawing Rev A**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A114444	1	Valve, Check Block, Assembly
2	A115241	1	Valve, Directional Control
3	A112651	1	Adapt, 6Saem - 6Jicf/S
4	A13240	1	Adapt, 6Sae - 6Jicm
5	H00107	2	Plug, 6Sae Hex Head
6	A13858	1	Adapt-Tee, 6Sae - 6Jicm (Run)
7	A13242	2	Adapt-Tee, 6Sae - 6Jicm (Branch)

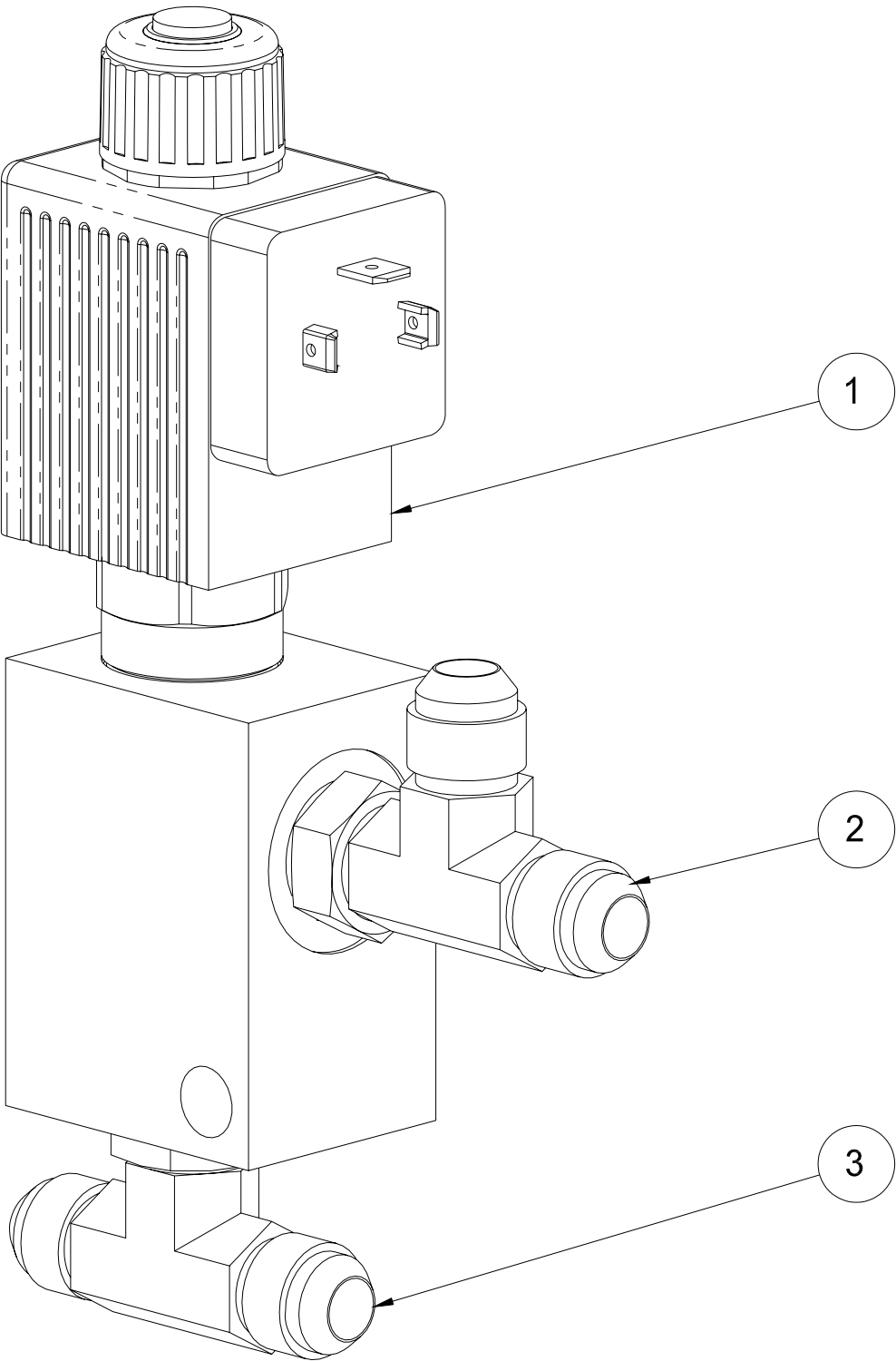
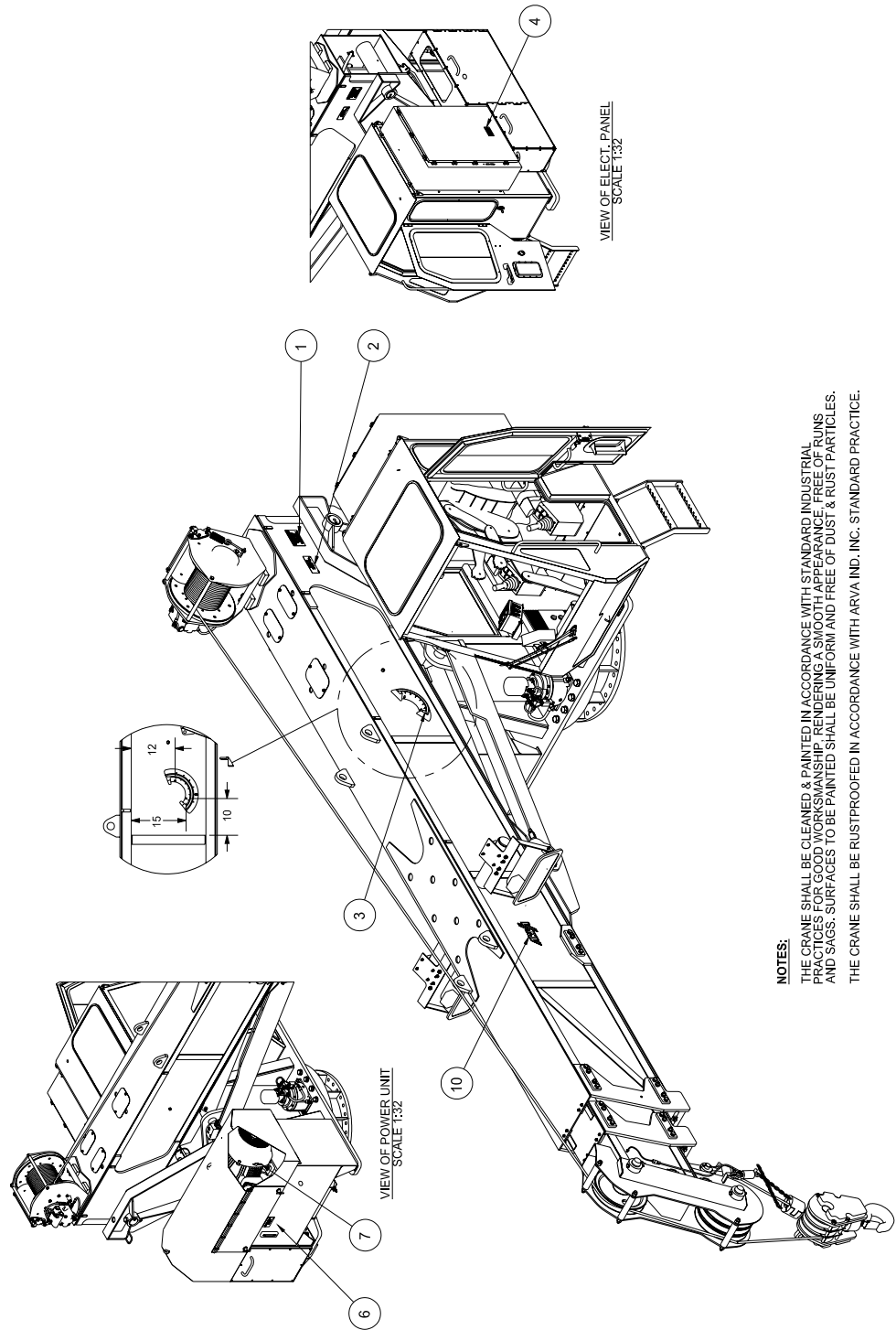


FIGURE 11-4

Figure 11-4

Drawing Rev A

A172908



NOTES:
THE CRANE SHALL BE CLEANED & PAINTED IN ACCORDANCE WITH STANDARD INDUSTRIAL PRACTICES FOR CRANES. ALL SURFACES SHALL BE UNIFORM AND FREE OF DUST & RUST PARTICLES.
THE CRANE SHALL BE RUSTPROOFED IN ACCORDANCE WITH ARVA IND. INC. STANDARD PRACTICE.

FIGURE 12

[illegible]

FLUID SPECIFICATION

Part No.	Quantity	Description	Location
A167955	3.3 LTRS	Oil, SPARTAN 150	HOIST
SF0100	272 LTRS	Hyd. OIL, ISO 32	OIL RESERVOIR,MAIN
REF	(367 LTRS)	Hyd. OIL, ISO 32	COMPLETE SYSTEM
A167719	1.2 LTRS (X2)	OIL, GEAR 80W-90	SWING GEAR PLNTRY SYSTM

FIGURE 13

FLUID SPEC, PE-48M CRANE**Figure 13****A173025****Drawing Rev -**

ITEM	PART NO.	QTY.	DESCRIPTION
1	A167955	3	Lube-Gear, Winch
2	SF0100	272	Oil, Hydraulic Univis N32
3	A167719	2	Oil, Gear 80W - 90

IMAGE NOT
AVAILABLE

FIGURE 14



Figure 14		A172908		Drawing Rev -			
ITEM	PART NO.	QTY.	DESCRIPTION				
1	SC0414	1	Binder, 2" D-Ring White Customizer Heavy Duty				
2	SC0256	1	Index Tab, 1 - 10 White				
3	SC0389	4	Index Maker Clear 8 Tab				
4	SB0127	2	Cover Paper 8 1/2 X 11 Single Sheet				
5	SC0592	1	Paper, Hot Pink For Manuals				
6	SC0399	1	Paper, Multi-Purpose Copy 8 1/2 X 11				

