NTENANCE MANUAL

(1)

OPERATION AND MAINTENANCE MANUAL

for

DRAW OFF-HOLDBACK (DOHB) TENSION MACHINE

MANUFACTURED FOR USE WITH

CABLE LAYING SYSTEM

MANUFACTURED FOR

OCEAN CONSTRUCTION EQUIPMENT INVENTORY
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

MANUFACTURED BY

WESTERN GEAR CORPORATION
Western Gear Machinery Co.
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WGSO 42816

DECEMBER 1982

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19. ABSTRACT (Continue on reverse if necessary & identify by block number)
This manual provides description, installation, operation, troubleshooting, maintenance, and parts list information for the Draw Off-Holdback (DOHB) Tension Machine and its power unit manufactured by Western Gear Machinery Co., Everett, Washington.

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SAFETY SUMMARY

Extreme caution should be exercised when working with high-pressure, heavy mechanical equipment. Developing and practicing good safety habits are an essential part of maintenance. Follow the maintenance procedures given in this manual, paying special attention to WARNINGS, CAUTIONS, and NOTES. WARNINGS describe hazards to personnel, CAUTIONS describe hazards to equipment, and NOTES call attention to preferred techniques or present helpful information. Failure to follow the maintenance procedures given may result in injury to personnel or damage to equipment.

WARNING

Western Gear Machinery Co. has taken every reasonable precaution to ensure personnel safety by installing appropriate guards, covers, interlocks, and other safety devices. It is the responsibility of the user to review the operation and maintenance procedures with regard to safety requirements, and to exercise reasonable caution and observance of those requirements. It is incumbent upon the user to ensure that this equipment has been installed safely by providing guard rails beside walkways, around moving machinery, and around hazardous electrical sources; by providing safety lines and attaching points for use while working on elevated equipment; by posting signs alerting personnel to safety requirements, and by initiating procedures required to prevent injury or death to personnel.

When repairing hydraulic or pneumatic components, make certain that line pressure is zero before disconnecting hydraulic or pneumatic lines.

Never tighten leaking connections or fittings while lines are pressurized. Application of torque to fittings or connections while lines are pressurized may rupture the lines and result in injury to personnel.

Direct discharge of high pressure air can seriously injure personnel. Open discharge valves cautiously after standing clear and warning others away from the area.

Make certain that all electrical circuits are deenergized at the main breaker before performing maintenance on electrical components.

When performing maintenance operations, tag the equipment controls: DANGER - DO NOT OPERATE - EQUIPMENT BEING REPAIRED.

Make certain work area is safe and clear of unnecessary personnel and equipment.

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides description, installation, operation, troubleshooting, maintenance, and parts list information for the Draw Off-Holdback (DOHB) Tension Machine and its power unit manufactured by Western Gear Machinery Co., Everett, Washington.

1-3. EQUIPMENT PURPOSE.

1-4. The DOHB tension machine (figure 1-1) ensures proper tensioning of the cable as it is payed out or hauled in. The DOHB power unit provides hydraulic power for operating the DOHB tension machine. Both the DOHB tension machine and power unit are located on the main deck, aft of the superstructure.

1-5. EQUIPMENT SUPPLIED.

1-6. Table 1-1 lists the quantity, nomenclature, drawing number, approximate weight, and dimensions of the DOHB tension machines and their dual power unit.

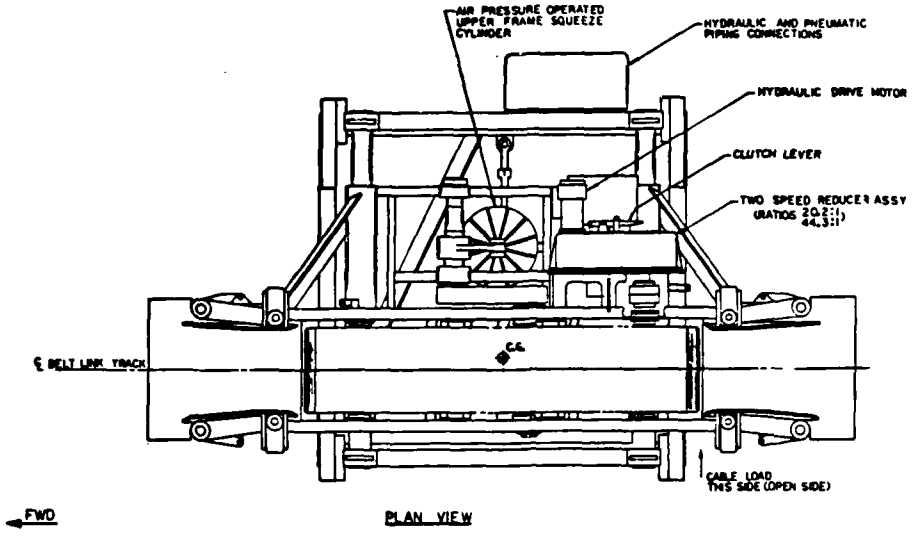
Table 1-1. Equipment Supplied

QTY	NOMENCLATURE	DRAWING NUMBER	APPROX WT LBS	DIMENSIONS INCHES HGT	LG	WD
1	DOHB Tension Machine Assembly	D316127	8,500	64.8* 52.4**	127.8	75.4
1	DOHB Power Unit	D316128	3,500	48.0	59.4	44.8

* - track up
** - track down

1-7. EQUIPMENT SPECIFICATIONS.

1-8. Table 1-2 lists the design characteristics of the DOHB tension machine and power unit.



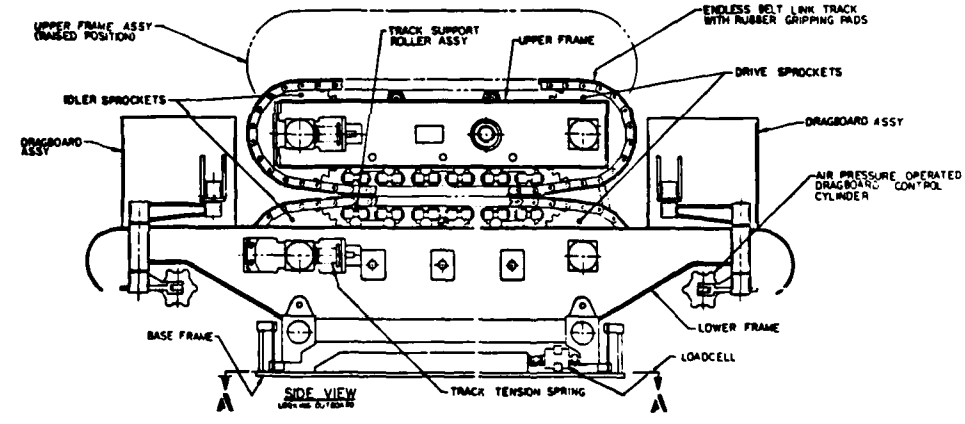


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Figure 1-1. Outline and General Arrangement (Sheet 1 of 3)

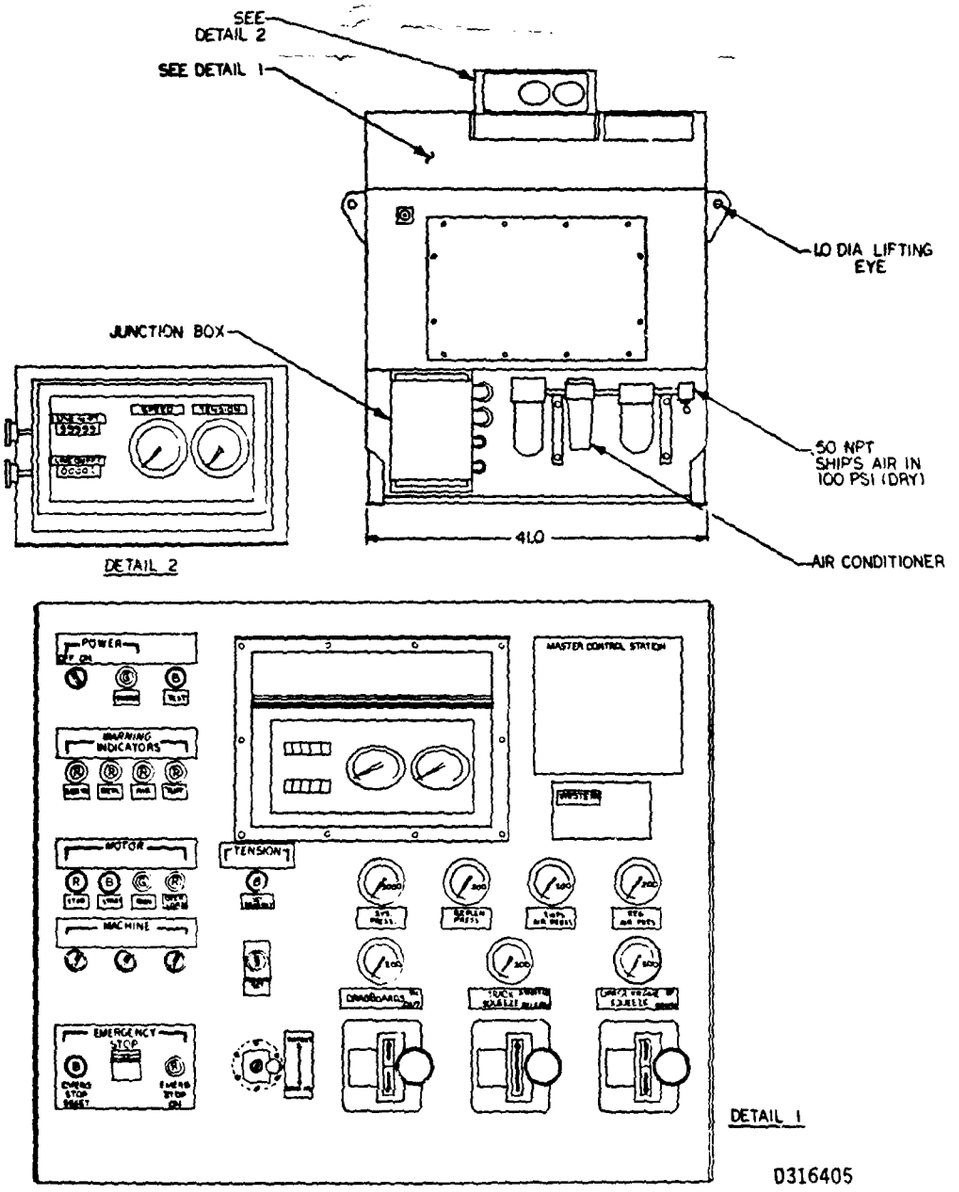


Figure 1-1. Outline and General Arrangement (Sheet 2 of 3)

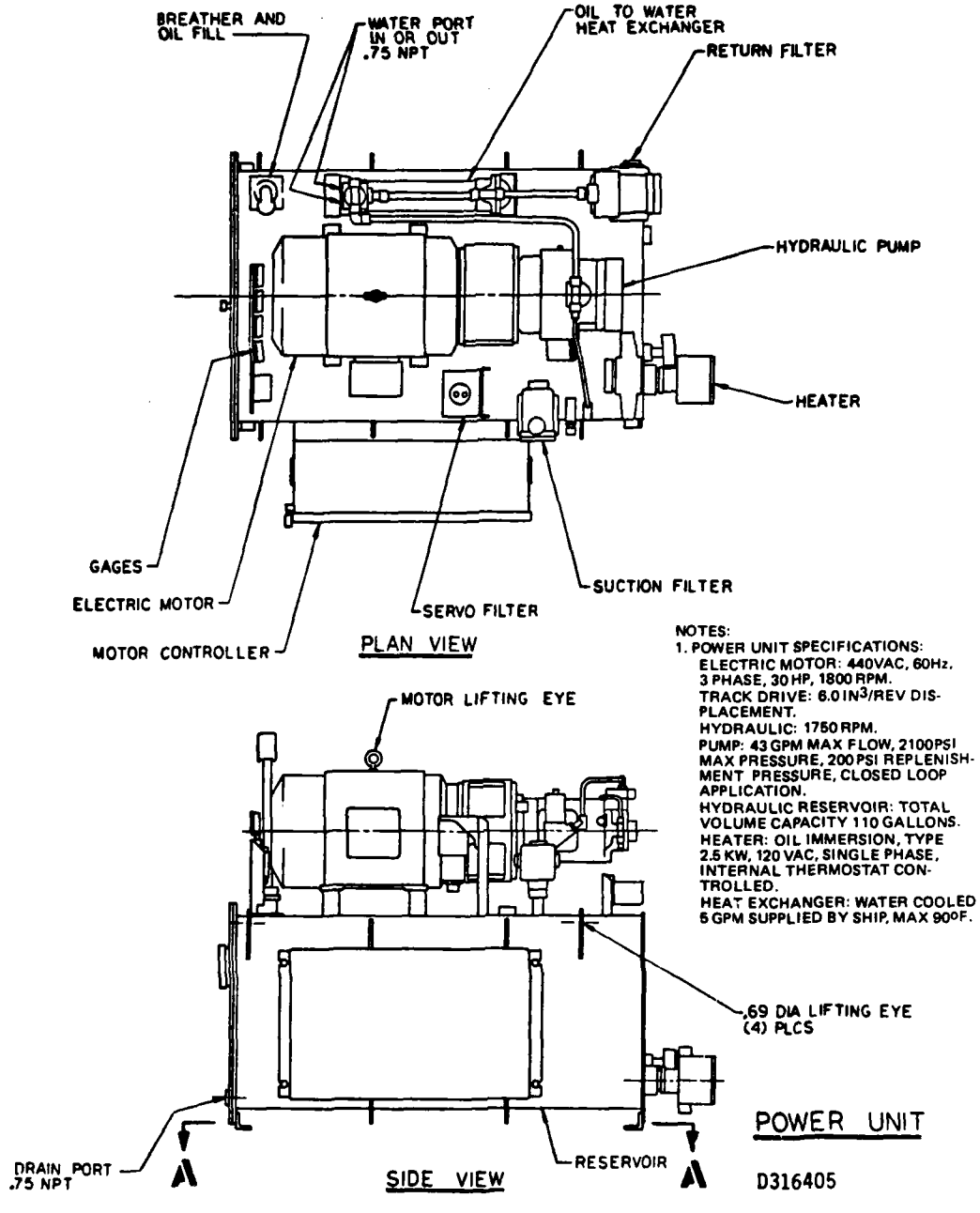


Figure 1-1. Outline and General Arrangement (Sheet 3 of 3)

Table 1-2. Equipment Specifications

DOHB Tension Machine	
Low Gear Tension	2,250 pounds at 315 fpm
High Gear Tension	1,125 pounds at 670 fpm
Height - Upper Frame Raised	64.8 inches
DOHB Power Unit	
Electric Motors	
Horsepower	30 hp
Electrical Input	440 vac, 3 phase, 60 Hz
Full Load Speed	1,800 rpm
Enclosure	Watertight
Motor Controllers	
Type	AC Magnetic
Electrical Inputs	440 vac, 3 phase, 60 Hz 115 vac, 1 phase, 60 Hz
Enclosure	Watertight, NEMA IV
Hydraulic Tank	
Capacity	120 U.S. gallons
Immersion Heater	
Rating	2,500 watts, 120 vac, 60 Hz
Thermostatic Control	On at 50°F (10°C) Off at 80°F (27°C)
Relief Valve Settings	
High Pressure Relief Valves	2,100 psi
Replenishing Relief Valves	300 psi

1-9. GENERAL DESCRIPTION.

1-10. The DOHB tension machine is a hydraulically powered, pneumatically operated machine capable of applying 2,250 pounds of tension at a cable speed of 315 fpm. Power to drive the machine is provided by an electrohydraulic power unit. Air for operation of the pneumatic controls is supplied through the control console from ship's air supply. For high speed operation (670 fpm), tension is reduced to 1,125 pounds.

1-11. The major components of the DOHB tension machine (figure 6-1) are:

1. Bedplate, upper frame, and lower frame assemblies.

2. Upper and lower track assemblies, two drive and two idler sprockets, drive shafts, idler shafts, two pair of pillow blocks with a track support roller connected between each pair, three roller frames with four pressure rollers each, and three rocker shafts. See figure 6-1.

3. Two reducer gearboxes (figures 6-4 and 6-5), one for each track assembly, with a hydraulic drive motor each.

4. A main pressure (lift and squeeze) cylinder. See figure 6-1.

5. Three track cylinders located within the lower track loop. See figure 6-1.

6. Two sets of dragboards with one air power cylinder each.

1-12. The major components of the power unit (figure 6-8) are:

1. One 120 gallon tank.

2. One 30 hp electric drive motor.

3. One variable delivery pump with integral replenishing pump.

4. One hydroelectric actuator.

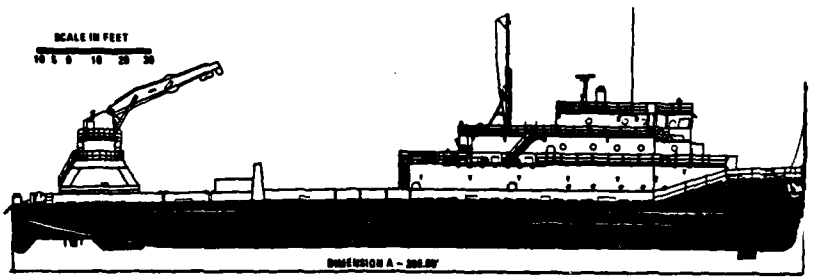
5. One heat exchanger.

6. One dual relief valve assembly.

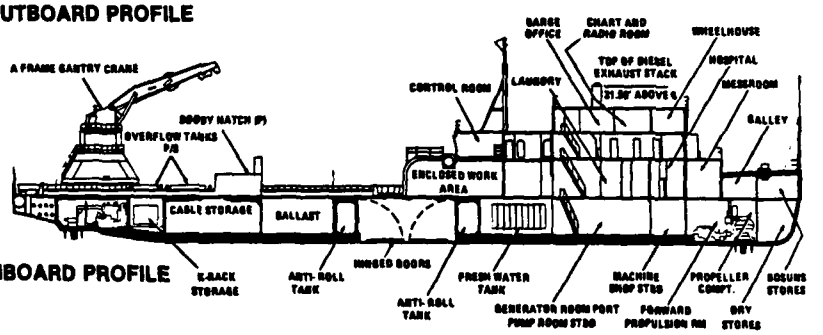
7. One bypass and brake control valve. See figure 6-10.

8. One motor controller.

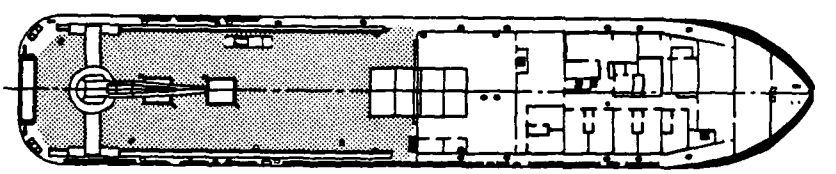
1-13. A functional description of the DOHB tension machine and power unit is contained in section IV.



OUTBOARD PROFILE



INBOARD PROFILE



MAIN DECK ARRANGEMENT

NOTE:
SHADED PORTION DENOTES POSSIBLE LOCATION OF DOHB TENSIONER SYSTEM.

Due to the multipurpose design of SEACON, its inventory of equipment includes many systems which can be easily removed or installed anywhere on the main deck to accommodate its present mission. The DOHB tensioner system built for installation onboard SEACON is designed to be a part of this wide ranging inventory of special purpose equipment. Although the system will usually be installed on the main deck aft of the superstructure, varying missions dictate varying equipment configurations and therefore exact locations for the DOHB tensioner machine and control console cannot be shown in this manual.

Figure 1-2. Shipboard Locations

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains precautions and procedures for the initial installation or reinstallaion, if extensive repairs require the removal of the machinery for major component replacement.

2-3. SAFETY SUMMARY.

WARNING

Western Gear Machinery Co. has taken every reasonable precaution to ensure personnel safety by installing appropriate guards, covers, interlocks, and other safety devices. It is the responsibility of the user to review the operation and maintenance procedures with regard to safety requirements, and to exercise reasonable caution and observance of those requirements. It is incumbent upon the user to ensure that this equipment has been installed safely by providing guard rails beside walkways, around moving machinery, and around hazardous electrical sources; by providing safety lines and attaching points for use while working on elevated equipment; by posting signs alerting personnel to safety requirements, and by initiating procedures required to prevent injury or death to personnel.

Use extreme care when handling, moving or lifting to avoid injury to personnel or damage to equipment.

CAUTION

Use a sling to lift the tension machine at all four lifting points. Also, use a sling to lift the power unit at all four lifting points.

2-4. INSTALLATION.

CAUTION

Failure to install the machinery properly can cause component damage and result in equipment failure.

2-5. DOHB TENSION MACHINE. See figure 2-1 for tension machine installation and clearance requirements. Refer to figure 1-2 and ship's plans for the location of each DOHB tension machine. Drill mounting holes as required and shim to compensate for any unevenness in the deck surface.

2-6. POWER UNIT. See figure 2-1 for power unit dimensions and mounting hole locations. Drill mounting holes as required and shim as required to compensate for any unevenness in the deck surface.

2-7. HYDRAULIC AND PNEUMATIC HOSES. See figure 2-2 for interconnecting hoses. After the power unit and tension machines have been located and installed, make the interconnecting hose connections in accordance with figure 2-2 and flush the system. Use pumping and flushing units of sufficient capacity to ensure thorough flushing. Cleanliness is acceptable only when unfiltered flushing oil samples taken in accordance with paragraph 5-14 conform to NAS 1638, class 8, cleanliness levels; see table 2-1. Fill the hydraulic reservoir with the specified hydraulic fluid and determine that its cleanliness level meets the contamination limits specified in table 2-1 for class 8.

Table 2-1. Maximum Contamination Limits per NAS 1638
(Based on a 100 ml sample size)

PARTICLE SIZE RANGE (Microns)	CLASSES							
	5	6	7	8	9	10	11	12
5 to 15	8,000	16,000	32,000	64,000	128,000	256,000	512,000	1,024,000
15 to 25	1,425	2,850	5,700	11,400	22,800	45,600	91,200	182,400
25 to 50	253	506	1,012	2,025	4,050	8,100	16,200	32,400
50 to 100	45	90	180	360	720	1,440	2,880	5,760
Over 100	8	16	32	64	128	256	512	1,024

CAUTION

Pickle all piping and flanges in accordance with the procedures given in appendix A.

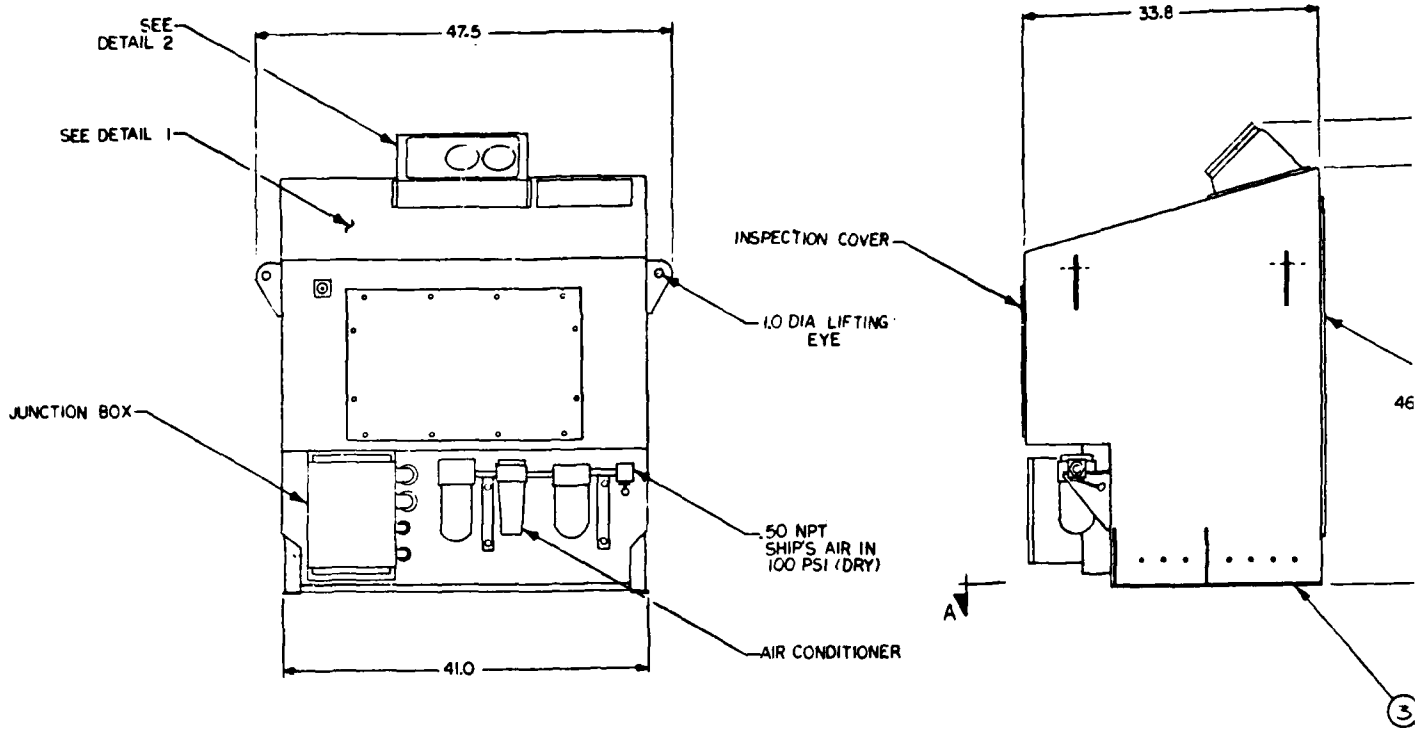
2-8. PREPARATION OF HYDRAULIC PIPING. Whenever hydraulic piping is replaced with another section of untreated piping, or repaired by welding, or any other method which could introduce contaminants, it shall be cleaned and preserved in a suitable solution as prescribed by appendix A.

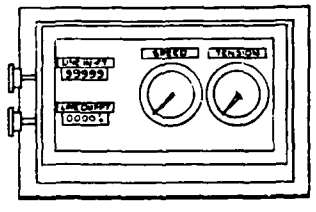
2-9. After the pickling process has been completed, seal all piping openings until ready to install.

NOTE

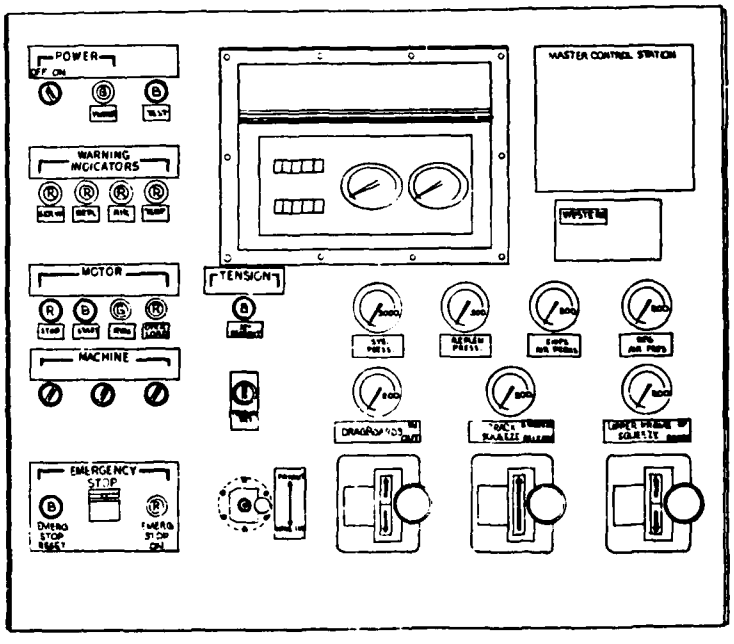
Use plastic caps on hydraulic piping and plywood on the flanges. DO NOT USE cork or rags.

2-10. ELECTRICAL CONNECTIONS. See figure 2-3 for electrical cable interconnections.





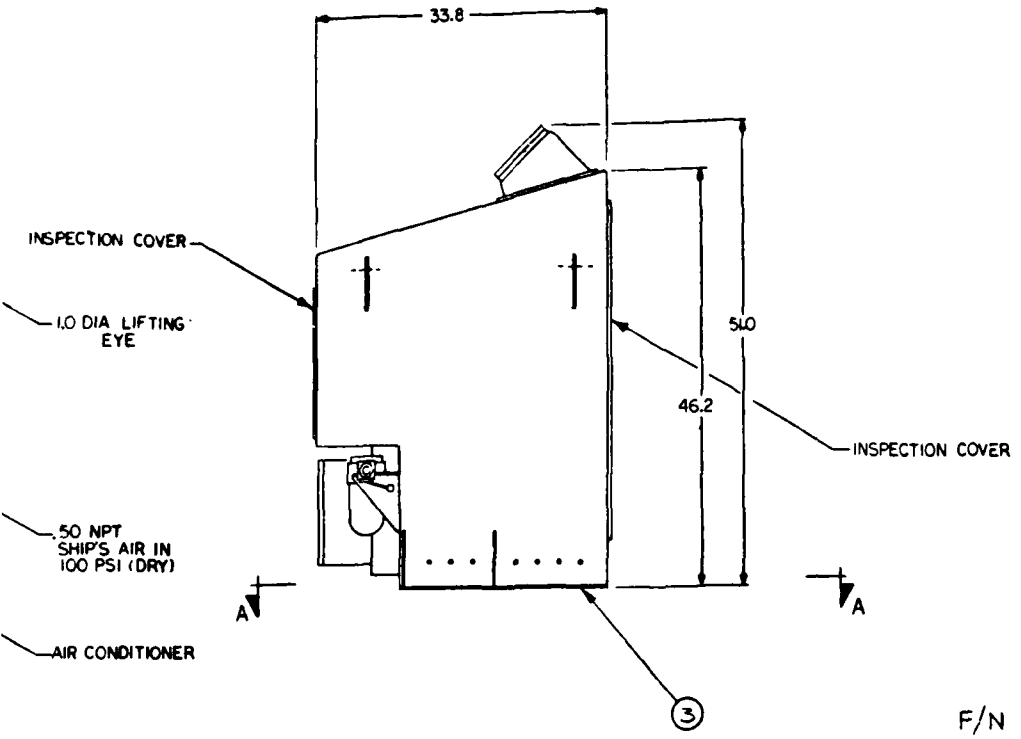
DETAIL 2



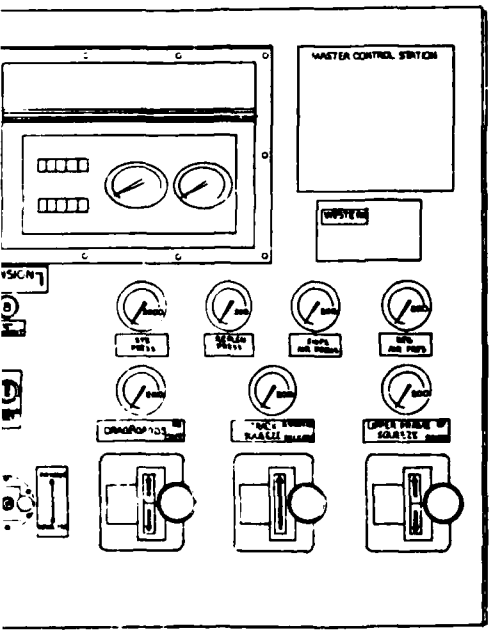
DETAIL 1

39.25

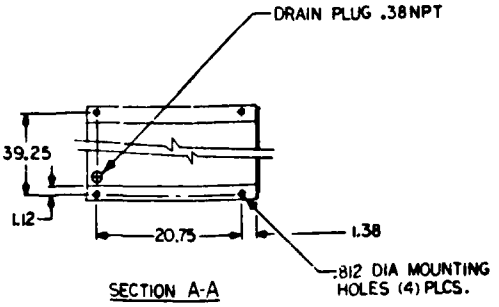
1.12



F/N 3 CONTROL CONSOLE



DETAIL 1



SECTION A-A

2

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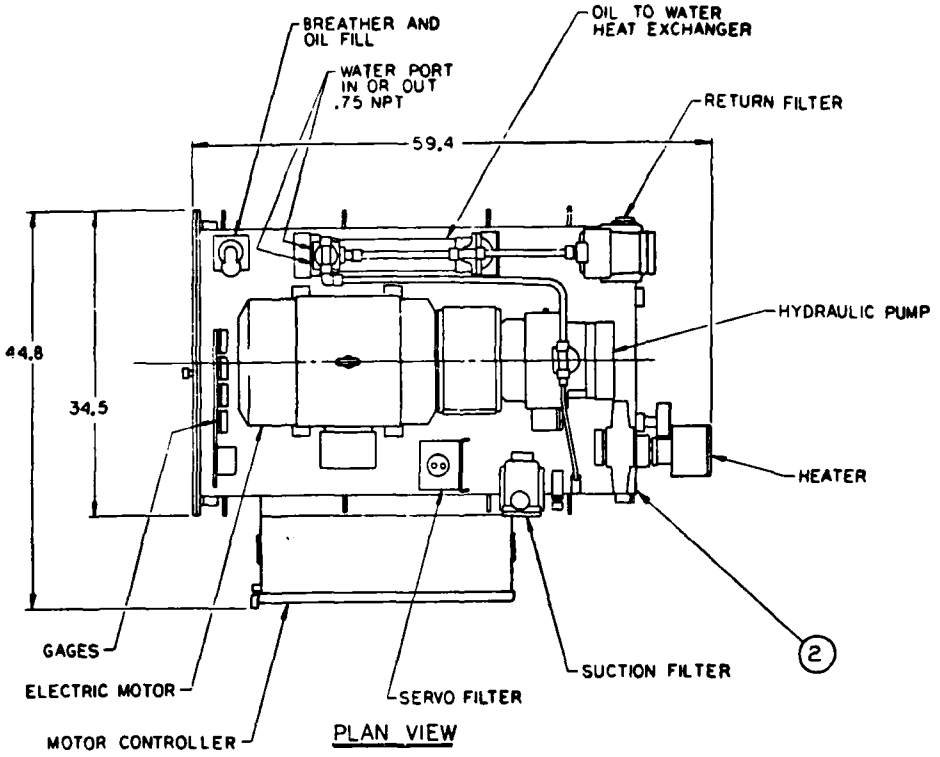
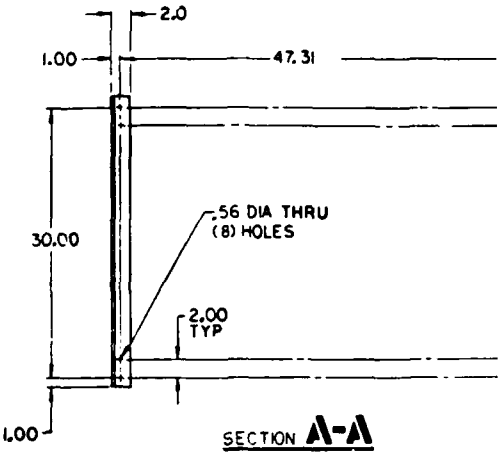
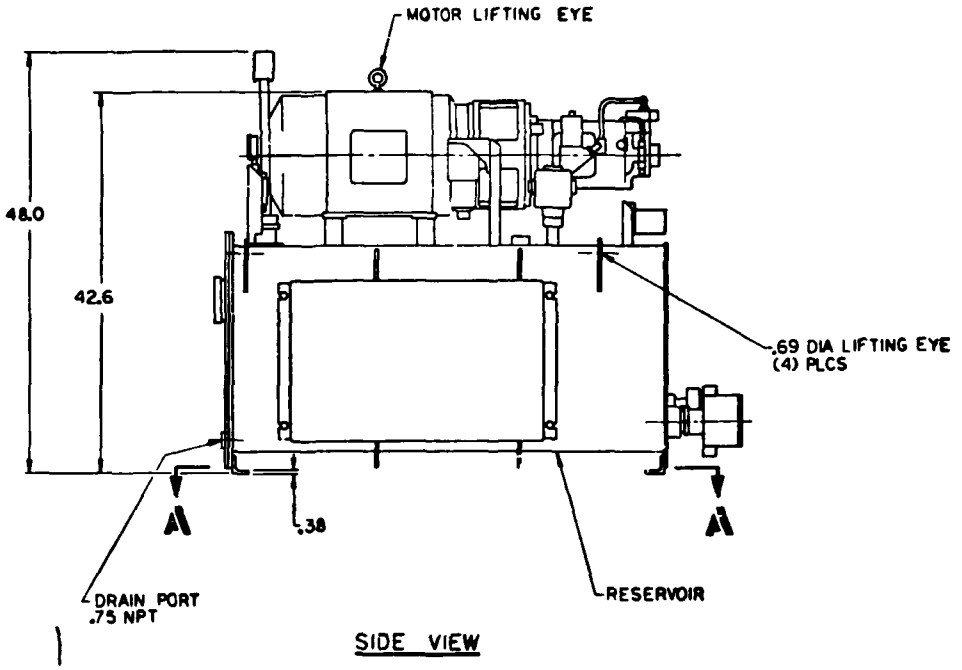
Figure 2-1. Outline and General Arrangement (Sheet 1 of 3)



PLAN VIEW



SECTION A-A



SIDE VIEW

NOTES:

1. POWER UN
   ELECTR
   TRACK
   HYDRAU
   PUMP:
   HYDRAU
   HEATE
   HEAT

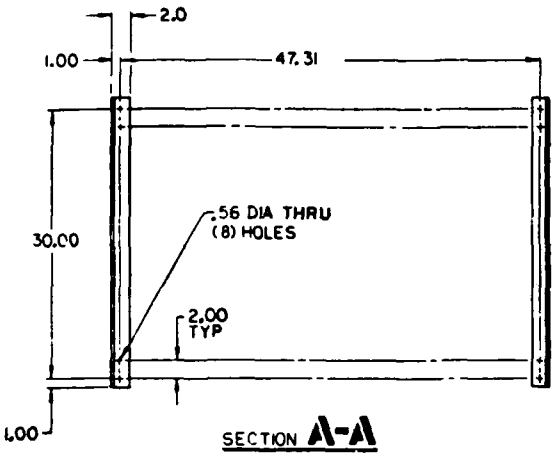
2. DRAWINGS
   F/N (4) HOSE
   F/N (5) HOSE
   F/N (6) HOSE

REFERENCE

1. HYDR
2. ELEC
3. INTE
4. INTE
5. LUBR
6. PNEU
7. ELEC

POWER UNIT

F/N 2



NOTES:

1. POWER UNIT SPECIFICATIONS:
   - ELECTRIC MOTOR: 440VAC, 60Hz, 3PHASE, 30 HP, 1800 RPM.
   - TRACK DRIVE: 6.0 IN^3/REV DISPLACEMENT
   - HYDRAULIC: 1750 RPM
   - PUMP: 43 GPM MAX FLOW, 2100 PSI MAX PRESSURE, 200 PSI REPLENISHMENT PRESSURE, CLOSED LOOP APPLICATION
   - HYDRAULIC RESERVOIR: TOTAL VOLUME CAPACITY 110 GALLONS
   - HEATER: OIL IMMERSION, TYPE 2.5 KW, 120 VAC, SINGLE PHASE, INTERNAL THERMOSTAT CONTROLLED
   - HEAT EXCHANGER: WATER COOLED, 5 GPM SUPPLIED BY SHIP, MAX 90°F

2. DRAWINGS NOT SHOWN:

F/N (4)	HOSE BUNDLE ASSY	C313737
F/N (5)	HOSE BUNDLE ASSY	C313738
F/N (6)	HOSE BUNDLE ASSY	C313739

REFERENCE DRAWINGS:

1.	HYDRAULIC SCHEMATIC	D316371
2.	ELECRICAL SCHEMATIC	D316126
3.	INTERCONNECT WIRE LIST	A307881
4.	INTERCONNECT PIPING DIAGRAM	D316704
5.	LUBRICATION DIAGRAM	D316406
6.	PNEUMATIC SCHEMATIC	D316383
7.	ELECTRICAL GENERAL ARR.	D316125

POWER UNIT
F/N 2

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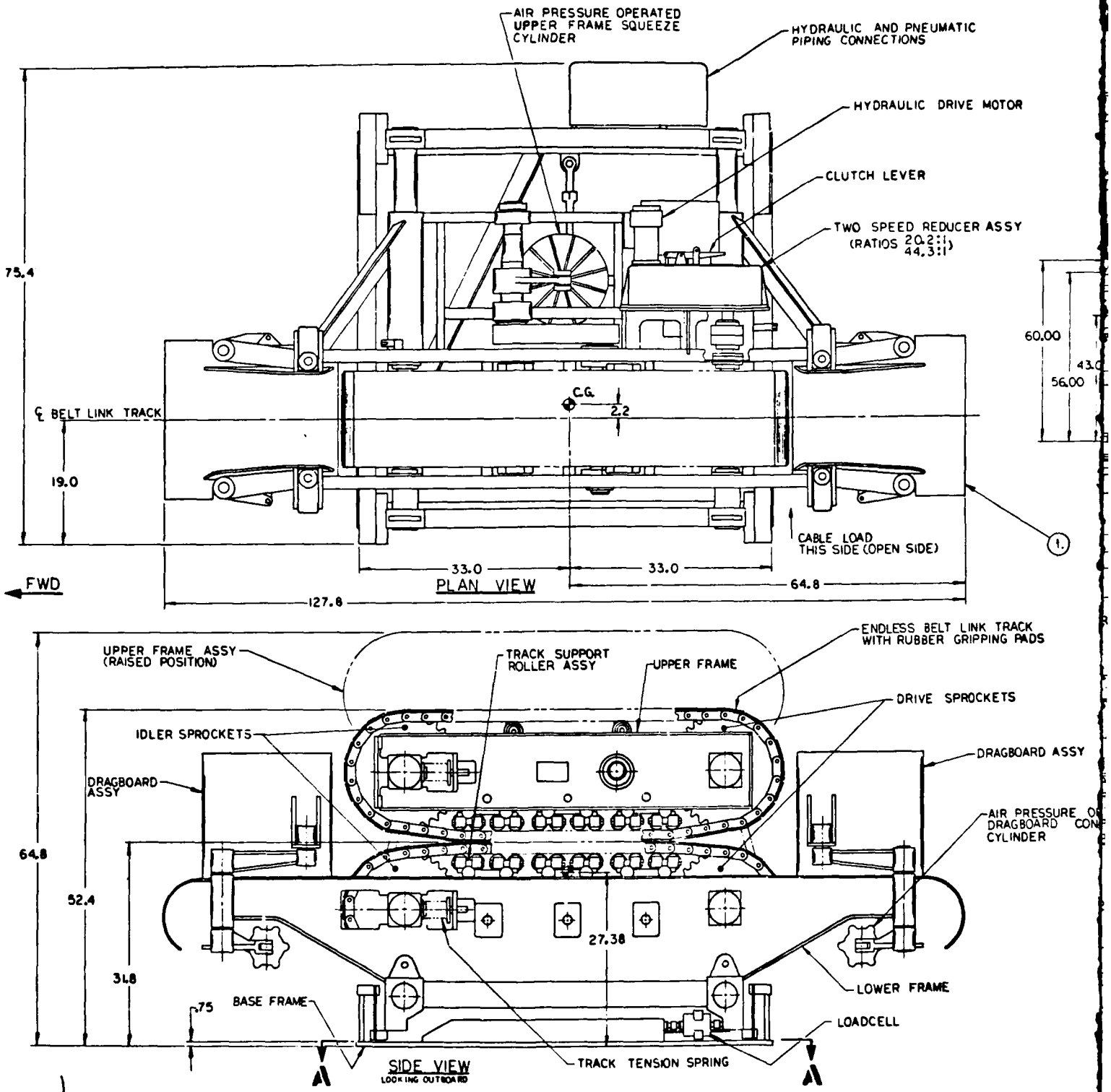
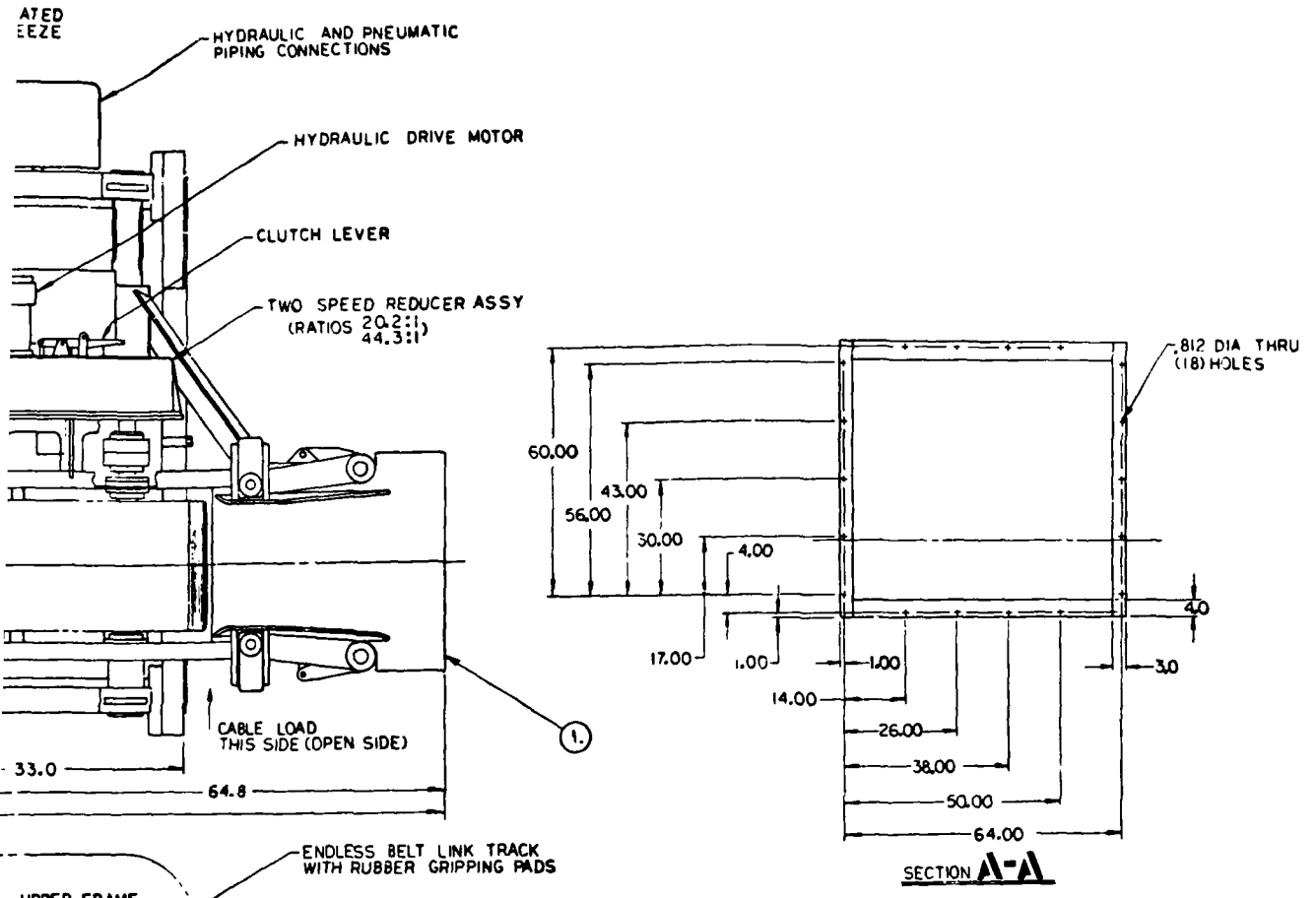
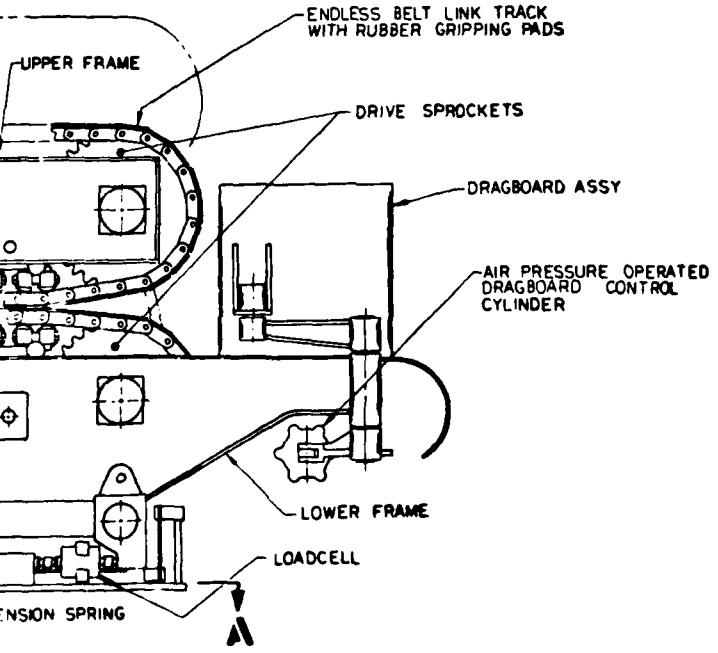
Figure 2-1. Outline and General Arrangement (Sheet 2 of 3)


AIR PRESSURE OPERATED UPPER FRAME SQUEEZE CYLINDER
HYDRAULIC AND PNEUMATIC PIPING CONNECTIONS
HYDRAULIC DRIVE MOTOR
CLUTCH LEVER
TWO SPEED REDUCER ASSY (RATIOS 20.2:1 44.3:1)
75.4
60.00
56.00
℄ BELT LINK TRACK
19.0
C.G.
2.2
CABLE LOAD THIS SIDE (OPEN SIDE)
1.
33.0
33.0
64.8
127.8
FWD
PLAN VIEW
UPPER FRAME ASSY (RAISED POSITION)
TRACK SUPPORT ROLLER ASSY
UPPER FRAME
ENDLESS BELT LINK TRACK WITH RUBBER GRIPPING PADS
DRIVE SPROCKETS
IDLER SPROCKETS
DRAGBOARD ASSY
DRAGBOARD ASSY
AIR PRESSURE OP DRAGBOARD CON CYLINDER
64.8
52.4
27.38
31.8
.75
BASE FRAME
LOWER FRAME
LOADCELL
TRACK TENSION SPRING
SIDE VIEW
LOOKING OUTBOARD





NOTES:

1. MAXIMUM OPERATING CONDITIONS: 0 TO 2,200 LBS AT 0 TO 304 F.P.M.
2. CALCULATED WEIGHT 8,500 LBS.

DO-H.B. MACHINE
F/N 1

D316405A

Figure 2-1. Outline and General Arrangement (Sheet 3 of 3)

NOTES:

1. HOSE DESIGNATIONS ARE AS FOLLOWS:
   AIR - - - - - - - - - -
   HYD. ——————————

2. SHIPS PIPING TO BE CLEANED AND FLUSHED BEFORE CONNECTION. FILTER UNITS ARE TO BE OF SUFFICIENT CAPACITY TO INSURE THOROUGH FLUSHING. PIPING CLEANLINESS IS ACCEPTABLE WHEN UNFILTERED FLUSHING OIL SAMPLES ACHIEVE NAS-1638, CLASS 8 CLEANLINESS LEVEL.

3. ALL CONNECTIONS ARE SUPPLIED WITH QUICK DISCONNECT FITTINGS.

4. ALL INTERCONNECTING HOSES FURNISHED BY WGMC.

5. MAXIMUM CLEANLINESS OF ALL INTERCONNECTING HYDRAULIC AND PNEUMATIC PIPING IS OF UTMOST IMPORTANCE.

6. PRESSURE OR FLOW IS DETERMINED BY WHAT IS PROVIDED BY THE SHIP.

PORT DESIGNATION CHART

SYMBOL		DESCRIPTION	PORT SIZE AND TYPE	PRESS.	FLOW
C9	D9	TRACK SQUEEZE		100 PSI	SEE NOTE 6
C10	D10	UPPER FRAME SQUEEZE (UP)		100 PSI	"
C11	D11	UPPER FRAME SQUEEZE (DOWN)		100 PSI	"
C14	D14	DRAGBOARDS OUT		100 PSI	"
C15	D15	DRAGBOARDS IN		100 PSI	SEE NOTE 6
C1	P1	SYSTEM PRESSURE GAGE		2100 PSI	GAGE LINE
C2	P2	REPLENISHMENT PRESSURE GAGE		200 PSI	GAGE LINE
P4	D4	BRAKE		535 PSI	5 GPM
P5	D5	HYDRAULIC PUMP		2100 PSI	43 GPM
P6	D6	HYDRAULIC PUMP		2100 PSI	43 GPM
P3	D3	DRAIN		75 PSI	7.6 GPM
		SHIPS AIR	.50 NPT FEMALE	100 PSI	SEE NOTE 6
		HEAT EXCHANGER	.75 NPT FEMALE	SEE NOTE 6	18 GPM

Figure 2-2. Interconnecting Hose Diagram (Sheet 1 of 2)

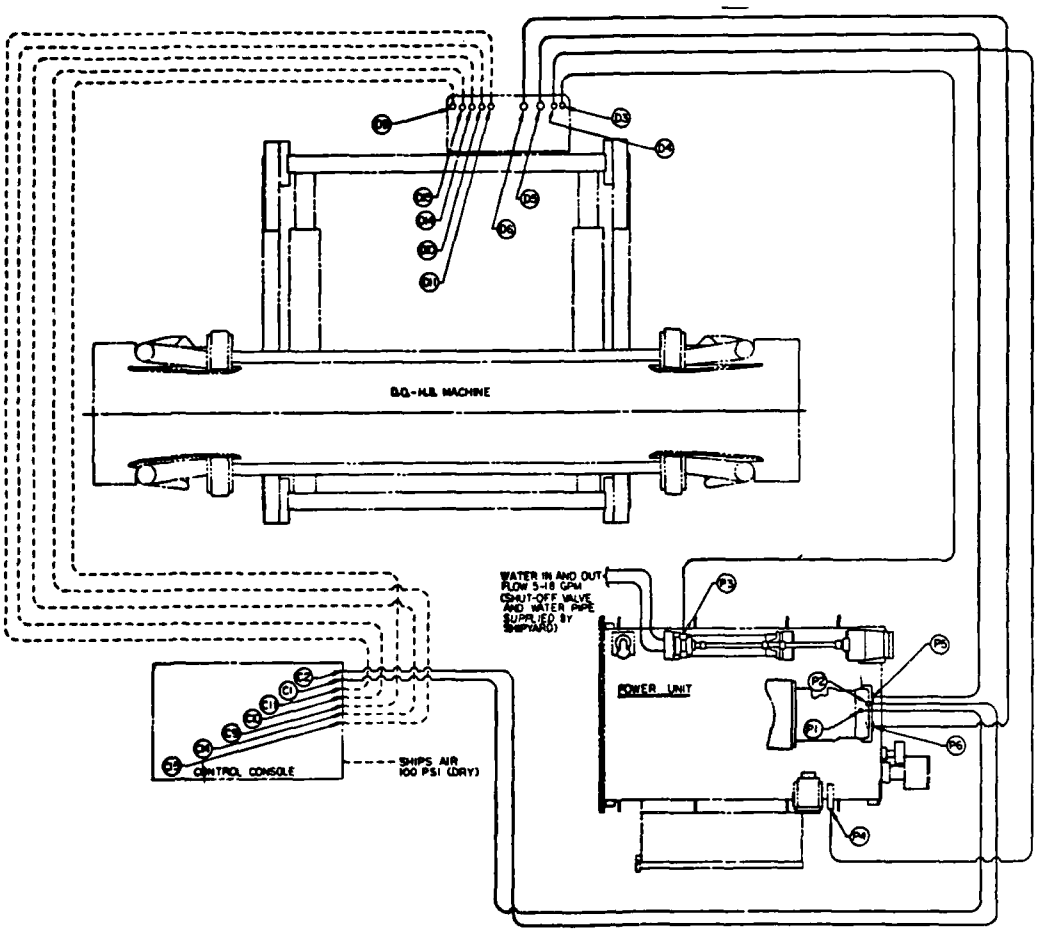
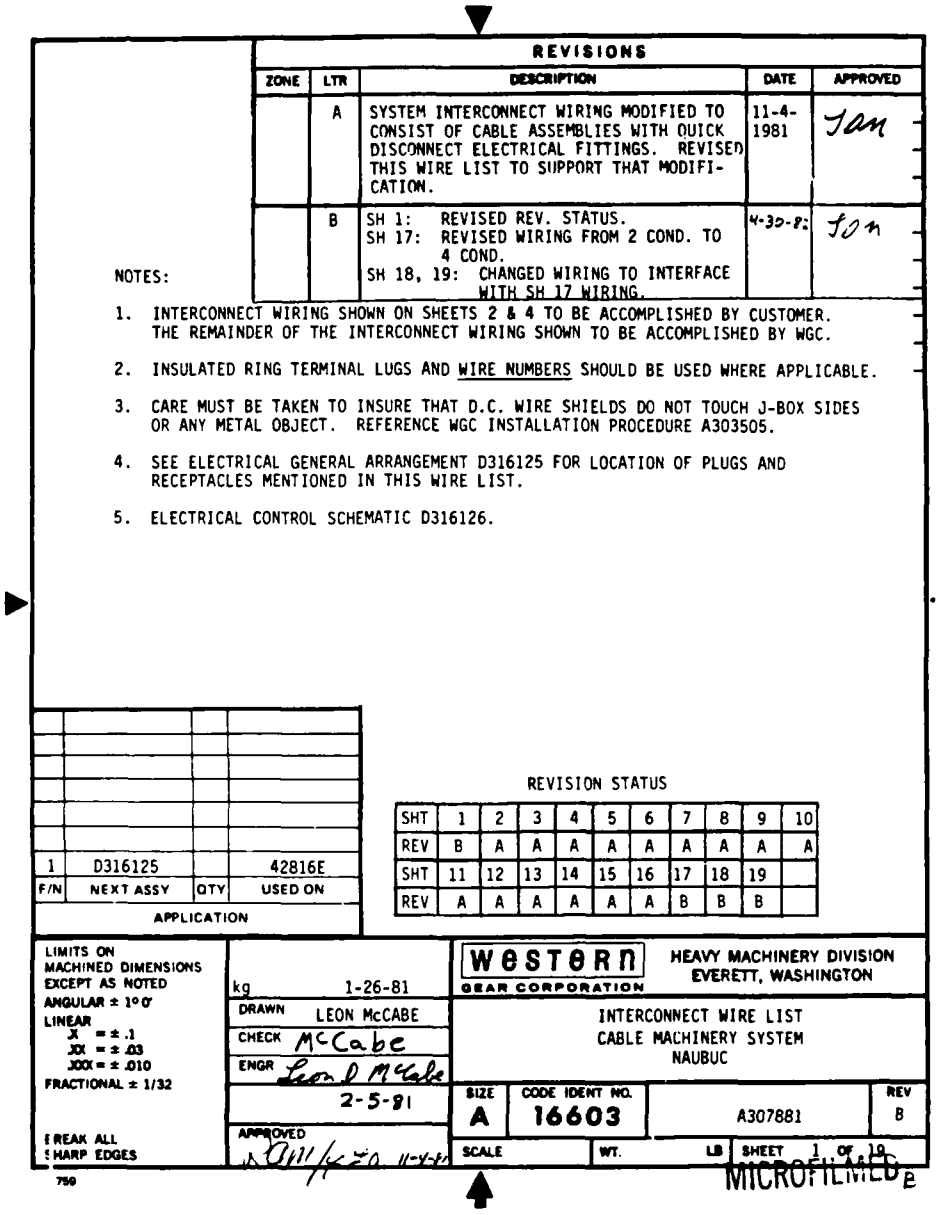


Figure 2-2. Interconnecting Hose Diagram (Sheet 2 of 2)



REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	SYSTEM INTERCONNECT WIRING MODIFIED TO CONSIST OF CABLE ASSEMBLIES WITH QUICK DISCONNECT ELECTRICAL FITTINGS. REVISED THIS WIRE LIST TO SUPPORT THAT MODIFICATION.	11-4-1981	Jan
	B	SH 1: REVISED REV. STATUS. SH 17: REVISED WIRING FROM 2 COND. TO 4 COND. SH 18, 19: CHANGED WIRING TO INTERFACE WITH SH 17 WIRING.	4-30-82	Jan

NOTES:

1. INTERCONNECT WIRING SHOWN ON SHEETS 2 & 4 TO BE ACCOMPLISHED BY CUSTOMER. THE REMAINDER OF THE INTERCONNECT WIRING SHOWN TO BE ACCOMPLISHED BY WGC.
2. INSULATED RING TERMINAL LUGS AND WIRE NUMBERS SHOULD BE USED WHERE APPLICABLE.
3. CARE MUST BE TAKEN TO INSURE THAT D.C. WIRE SHIELDS DO NOT TOUCH J-BOX SIDES OR ANY METAL OBJECT. REFERENCE WGC INSTALLATION PROCEDURE A303505.
4. SEE ELECTRICAL GENERAL ARRANGEMENT D316125 FOR LOCATION OF PLUGS AND RECEPTACLES MENTIONED IN THIS WIRE LIST.
5. ELECTRICAL CONTROL SCHEMATIC D316126.

F/N	NEXT ASSY	QTY	USED ON
1	D316125		42816E

APPLICATION

REVISION STATUS

SHT	1	2	3	4	5	6	7	8	9	10
REV	B	A	A	A	A	A	A	A	A	A
SHT	11	12	13	14	15	16	17	18	19	
REV	A	A	A	A	A	A	B	B	B	

LIMITS ON MACHINED DIMENSIONS EXCEPT AS NOTED
ANGULAR ± 1°0'
LINEAR
X = ± .1
XX = ± .03
XXX = ± .010
FRACTIONAL ± 1/32

BREAK ALL SHARP EDGES

kg 1-26-81
DRAWN LEON McCABE
CHECK McCabe
ENGR Leon McCabe 2-5-81
APPROVED 11-4-81

WESTERN GEAR CORPORATION
HEAVY MACHINERY DIVISION
EVERETT, WASHINGTON

INTERCONNECT WIRE LIST
CABLE MACHINERY SYSTEM
NAUBUC

SIZE	CODE IDENT NO.		REV
A	16603	A307881	B

SCALE | WT. | LB | SHEET 1 OF 19

MICROFILMED

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 1 of 19)

SPACE HEATER & CONTROL POWER			CABLE NO. W1	
CABLE TYPE THOF-4			UNIT A POWER SOURCE (120 VAC)	
SPARES WIRES 0			UNIT B J1-1	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
	101	BLK	PIN 1	120 VAC HOT
	102	WHT	PIN 2	120 VAC RETURN
	100	RED	PIN 3	GROUND

	SIZE	CODE IDENT NO.		REV
Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	A	16603	A307881	A
	SCALE			SHEET 2

8314

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 2 of 19)

SPACE HEATER & CONTROL POWER			CABLE NO. -	
CABLE TYPE 14 AWG			UNIT A P1-1	
SPARES WIRES -			UNIT B TB3 (J-BOX 1)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	101	RED	TB3-1	120 VAC HOT
PIN 2	102	RED	TB3-3	120 VAC RETURN
PIN 3	100	WHT	P1-1 MOUNTING SCREW	GROUND

	SIZE	CODE IDENT NO.		REV
WESTERN GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	A	16603	A307881	A
	SCALE			SHEET 3

8314

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 3 of 19)

POWER UNIT TANK HEATER POWER			CABLE NO. W3	
CABLE TYPE THOF-4			UNIT A POWER SOURCE (120 VAC)	
SPARES WIRES 0			UNIT B J3-4	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
	144	BLK	PIN 1	120 VAC HOT
	145	WHT	PIN 2	120 VAC RETURN
	100	RED	PIN 3	GROUND

	SIZE	CODE IDENT NO.		REV
western GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	A	16603	A307881	A
	SCALE			SHEET 4

8314

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 4 of 19)

POWER UNIT TANK HEATER POWER			CABLE NO. -	
CABLE TYPE 10 AWG			UNIT A P3-4	
SPARES WIRES -			UNIT B TANK HEATER (POWER UNIT)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	144	RED		120 VAC HOT
PIN 2	145	RED		120 VAC RETURN
PIN 3	100	WHT		GROUND

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881 REV A
	SCALE		SHEET 5

E314

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 5 of 19)

POWER UNIT PUMP MOTOR POWER			CABLE NO. W4	
CABLE TYPE FHOF-42			UNIT A POWER SOURCE (440 VAC)	
SPARES WIRES 0			UNIT B J4-2	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
	L1	BLK	PIN 1	440 VAC PHASE 1
	L2	WHT	PIN 2	440 VAC PHASE 2
	L3	RED	PIN 3	440 VAC PHASE 3
	100	GRN	PIN 4	GROUND
		REF: WGC DWG 8312548		

	SIZE	CODE IDENT NO.		REV
Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	A	16603	A307881	A
	SCALE			SHEET 6

E314

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 6 of 19)

POWER UNIT PUMP MOTOR POWER			CABLE NO. -	
CABLE TYPE 4 AWG			UNIT A P4-2	
SPARES WIRES -			UNIT B CONTACTOR INPUT (J-BOX 2)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	L1		L1	440 VAC PHASE 1
PIN 2	L2		L2	440 VAC PHASE 2
PIN 3	L3		L3	440 VAC PHASE 3
PIN 4	100		P4-2 MOUNTING SCREW	GROUND

	SIZE	CODE IDENT NO.		REV
western GEAR CORPORATION Heavy Machinery Division	A	16603	A307881	A
EVERETT, WASHINGTON 98201	SCALE		SHEET 7	

8314

A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 7 of 19)

POWER UNIT INDICATION & CONTROL			CABLE NO. -	
CABLE TYPE 14 AWG			UNIT A J5-1	
SPARES WIRES 1			UNIT B TB2 (J-BOX 1)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1				
PIN 2				
PIN 3	103	RED	TB2-2	120 VAC HOT
PIN 4	104	RED	TB2-4	120 VAC RETURN
PIN 5	106	RED	TB2-6	MOTOR RUN IND.
PIN 6	113	RED	TB2-8	RUN LATCH CONTACT
PIN 7	114	RED	TB2-10	MOTOR START
PIN 8	117	RED	TB2-12	MOTOR OVLD IND.
PIN 9	119	RED	TB2-14	SERVO PRESS LOW IND.
PIN 10	123	RED	TB2-16	SUMP TEMP HIGH IND.
PIN 11	136	RED	TB2-18	SPACE HTR 120 VAC HOT
PIN 12	137	RED	TB2-20	SPACE HTR 120 VAC RET
PIN 13	126	RED	TB2-22	BRAKE RELEASE SOL
PIN 14	130	RED	TB2-24	BRK REL STROKE ≠ 0 SOL
PIN 15	100	WHT	J5-1 MOUNTING SCREW	GROUND
PIN 16	SP	RED	TB2-23	SPARE

WESTERN GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV A
	SCALE			SHEET 8

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 8 of 19)

POWER UNIT INDICATION & CONTROL			CABLE NO. W5	
CABLE TYPE MHOF-14			UNIT A P5-1	
SPARES WIRES 1			UNIT B J5-2	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1			PIN 1	
PIN 2			PIN 2	
PIN 3	103	BLK	PIN 3	120 VAC HOT
PIN 4	104	WHT	PIN 4	120 VAC RETURN
PIN 5	106	RED	PIN 5	MOTOR RUN IND.
PIN 6	113	GRN	PIN 6	RUN LATCH CONTACT
PIN 7	114	ORN	PIN 7	MOTOR START
PIN 8	117	BLU	PIN 8	MOTOR OVLD IND.
PIN 9	119	WHT-BLK	PIN 9	SERVO PRESS LOW IND.
PIN 10	123	RED-BLK	PIN 10	SUMP TEMP HIGH IND.
PIN 11	136	GRN-BLK	PIN 11	SPACE HTR 120 VAC HOT
PIN 12	137	ORN-BLK	PIN 12	SPACE HTR 120 VAC RET
PIN 13	126	BLU-BLK	PIN 13	BRAKE RELEASE SOL
PIN 14	130	BLK-WHT	PIN 14	BRK REL STROKE 90 SOL
PIN 15	100	RED-WHT	PIN 15	GROUND
PIN 16	SP	GRN-WHT	PIN 16	SPARE
		REF: WGC DWG B312549		

WESTERN GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV A
	SCALE			SHEET 9

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 9 of 19)

POWER UNIT INDICATION & CONTROL			CABLE NO. -	
CABLE TYPE 14 AWG			UNIT A P5-2	
SPARES WIRES 1			UNIT B J-BOX 2 TB'S	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1				
PIN 2				
PIN 3	103	RED	CDS	120 VAC HOT
PIN 4	104	RED	CDS	120 VAC RETURN
PIN 5	106	RED	TB15-10	MOTOR RUN IND.
PIN 6	113	RED	TB15-12	RUN LATCH CONTACT
PIN 7	114	RED	TB15-14	MOTOR START
PIN 8	117	RED	TB15-16	MOTOR OVLD IND.
PIN 9	119	RED	TB15-2	SERVO PRESS LOW IND.
PIN 10	123	RED	TB15-4	SUMP TEMP HIGH IND.
PIN 11	136	RED	CDS	SPACE HTR 120 VAC HOT
PIN 12	137	RED	CDS	SPACE HTR 120 VAC RET
PIN 13	126	RED	TB15-6	BRAKE RELEASE SOL
PIN 14	130	RED	TB15-8	BRK REL STROKE SOL
PIN 15	100	WHT	P5-2 MOUNTING SCREW	GROUND
PIN 16	SP	RED	TB16-1	SPARE

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV A
	SCALE			SHEET 10

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 10 of 19)

POWER UNIT PUMP ACTUATOR COMMAND			CABLE NO. -	
CABLE TYPE 4 COND WITH SHIELD			UNIT A J6-1	
SPARES WIRES 2			UNIT B TB1 (J-BOX 1)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	247	BLK	TB1-18	(+) ACTUATOR
PIN 2	246	RED	TB1-20	(-) ACTUATOR
PIN 3		SHLD	TB1-16	
PIN 4	SP	GRN	TB1-22	SPARE
PIN 5	SP	WHT	TB1-24	SPARE

	SIZE	CODE IDENT NO.		REV
Western Heavy Machinery Division EVERETT, WASHINGTON 98201	A	16603	A307881	A
	SCALE			SHEET 11

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 11 of 19)

POWER UNIT PUMP ACTUATOR COMMAND			CABLE NO. W6	
CABLE TYPE TTRS-2			UNIT A P6-1	
SPARES WIRES 2			UNIT B J6-2	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	247	BLK-BLK	PIN 1	(+) ACTUATOR
PIN 2	246	BLK-WHT	PIN 2	(-) ACTUATOR
PIN 3		SHLD	PIN 3	
PIN 4	SP	WHT-BLK	PIN 4	SPARE
PIN 5	SP	WHT-WHT	PIN 5	SPARE
PIN 3		SHLD	PIN 3	
		REF: WGC DWG	B312550	

WESTERN GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE	CODE IDENT NO.		REV
	A	16603	A307881	A
	SCALE			SHEET 12

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 12 of 19)

POWER UNIT PUMP ACTUATOR COMMAND			CABLE NO. -	
CABLE TYPE 4 COND WITH SHIELD			UNIT A P6-2	
SPARES WIRES 2			UNIT B TB16 (J-BOX 2)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	247	BLK	TB16-11	(+) ACTUATOR
PIN 2	246	RED	TB16-12	(-) ACTUATOR
PIN 3		SHLD	TB16-10	
PIN 4	SP	GRN	TB16-8	SPARE
PIN 5	SP	WHT	TB16-9	SPARE

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV A
	SCALE		SHEET 13	

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 13 of 19)

DOHB SIGNALS (SYNCHRO)			CABLE NO. -	
CABLE TYPE 14 AWG			UNIT A J7-1	
SPARES WIRES 1			UNIT B TB2 (J-BOX 1)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1				
PIN 2				
PIN 3				
PIN 4	150	RED	TB2-1	S1
PIN 5	151	RED	TB2-3	S2
PIN 6	152	RED	TB2-5	S3
PIN 7	103	RED	TB2-7	R1
PIN 8	104	RED	TB2-9	R2
PIN 9	100	WHT	J7-1 MOUNTING SCREW	GROUND
PIN 10	SP	RED	TB2-13	SPARE

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE	CODE IDENT NO.		REV
	A	16603	A307881	A
	SCALE			SHEET 14

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 14 of 19)

DOHB SIGNALS (SYNCHRO)			CABLE NO. W7	
CABLE TYPE MHOF-7			UNIT A P7-1	
SPARES WIRES 1			UNIT B J7-3	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1			PIN 1	
PIN 2			PIN 2	
PIN 3			PIN 3	
PIN 4	150	BLK	PIN 4	S1
PIN 5	151	WHT	PIN 5	S2
PIN 6	152	RED	PIN 6	S3
PIN 7	103	GRN	PIN 7	R1
PIN 8	104	ORN	PIN 8	R2
PIN 9	100	BLU	PIN 9	GROUND
PIN 10	SP	WHT-BLK	PIN 10	SPARE
		REF: WGC DWG B312551		

	SIZE	CODE IDENT NO.		REV
western GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	A	16603	A307881	A
	SCALE		SHEET 15	

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 15 of 19)

DOHB SIGNALS (SYNCHRO)			CABLE NO. -	
CABLE TYPE 14 AWG			UNIT A P7-3	
SPARES WIRES 1			UNIT B TB14 (J-BOX 3)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1				
PIN 2				
PIN 3				
PIN 4	150	RED	TB14-2	S1
PIN 5	151	RED	TB14-4	S2
PIN 6	152	RED	TB14-6	S3
PIN 7	103	RED	TB14-8	R1
PIN 8	104	RED	TB14-10	R2
PIN 9	100	WHT	P7-3 MOUNTING SCREW	GROUND
PIN 10	SP	RED	TB14-12	SPARE

western GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV A
	SCALE			SHEET 16

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 16 of 19)

DOHB SIGNALS (LOAD CELL, TACH)			CABLE NO. -	
CABLE TYPE 4 COND WITH SHIELD			UNIT A J8-1	
SPARES WIRES 2			UNIT B TB1 (J-BOX 1)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	201	WHT	TB1-1	SYS A LOAD CELL (+) EXCIT.
PIN 2	200	GRN	TB1-3	(-) EXCIT.
PIN 3		SHLD	TB1-5	
PIN 4	202	RED	TB1-7	(+) SIGNAL
PIN 5	203	BLK	TB1-9	(-) SIGNAL
PIN 6				
PIN 7	251	WHT	TB1-2	SYS B LOAD CELL (+) EXCIT.
PIN 8	200	GRN	TB1-4	(-) EXCIT.
PIN 9		SHLD	TB1-6	
PIN 10	252	RED	TB1-8	(+) SIGNAL
PIN 11	253	BLK	TB1-10	(-) SIGNAL
PIN 12				
PIN 13	250	WHT	TB1-11	TACH (+) SIGNAL
PIN 14	200	GRN	TB1-13	(-) SIGNAL
PIN 15				
PIN 16	SP	RED	TB1-21	SPARE
PIN 17	SP	BLK	TB1-23	SPARE
PIN 18		SHLD	TB1-15	
PIN 19				

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV B
	SCALE			SHEET 17

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 17 of 19)

DOHB SIGNALS (LOAD CELL, TACH)			CABLE NO. W8	
CABLE TYPE TTRS-6			UNIT A P8-1	
SPARES WIRES 2			UNIT B J8-3	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	201	BLK-BLK	PIN 1	SYS A LOAD CELL (+) EXCIT.
PIN 2	200	BLK-WHT	PIN 2	(-) EXCIT.
PIN 3		SHLD	PIN 3	
PIN 4	202	WHT-BLK	PIN 4	(+) SIGNAL
PIN 5	203	WHT-WHT	PIN 5	(-) SIGNAL
PIN 3		SHLD	PIN 3	
PIN 7	251	RED-BLK	PIN 7	SYS B LOAD CELL (+) EXCIT.
PIN 8	200	RED-WHT	PIN 8	(-) EXCIT.
PIN 9		SHLD	PIN 9	
PIN 10	252	GRN-BLK	PIN 10	(+) SIGNAL
PIN 11	253	GRN-WHT	PIN 11	(-) SIGNAL
PIN 9		SHLD	PIN 9	
PIN 13	250	ORN-BLK	PIN 13	TACH (+) SIGNAL
PIN 14	200	ORN-WHT	PIN 14	(-) SIGNAL
PIN 18		SHLD	PIN 18	
PIN 16	SP	BLU-BLK	PIN 16	SPARE
PIN 17	SP	BLU-WHT	PIN 17	SPARE
PIN 18		SHLD	PIN 18	
PIN 19			PIN 19	
		REF: WGC DWG 8312552		

Western Gear Corporation — Heavy Machinery Division, Everett, Washington 98201	SIZE A	CODE IDENT NO. 16603	A307881	REV B
	SCALE			SHEET 18

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A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 18 of 19)

DOHB SIGNALS (LOAD CELL, TACH)			CABLE NO. -	
CABLE TYPE 4 COND WITH SHIELD			UNIT A P8-3	
SPARES WIRES 2			UNIT B TB14 (J-BOX 3)	
UNIT A TERM NO.	WIRE NO.	WIRE COLOR	UNIT B TERM NO.	FUNCTION
PIN 1	201	BLK	TB14-1	SYS A LOAD CELL (+) EXCIT.
PIN 2	200	RED	TB14-3	(-) EXCIT.
PIN 3		SHLD	TB14-5	
PIN 4	202	GRN	TB14-7	(+) SIGNAL
PIN 5	203	WHT	TB14-9	(-) SIGNAL
PIN 6				
PIN 7	251	BLK	TB14-15	SYS B LOAD CELL (+) EXCIT.
PIN 8	200	RED	TB14-17	(-) EXCIT.
PIN 9		SHLD	TB14-19	
PIN 10	252	GRN	TB14-21	(+) SIGNAL
PIN 11	253	WHT	TB14-23	(-) SIGNAL
PIN 12				
PIN 13	250	BLK	TB14-22	TACH (+) SIGNAL
PIN 14	200	RED	TB14-24	(-) SIGNAL
PIN 15				
PIN 16	SP	GRN	TB14-16	SPARE
PIN 17	SP	WHT	TB14-18	SPARE
PIN 18		SHLD	TB14-20	
PIN 19				

WESTERN GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE	CODE IDENT NO.		REV
	A	16603	A307881	B
	SCALE			SHEET 19

E314

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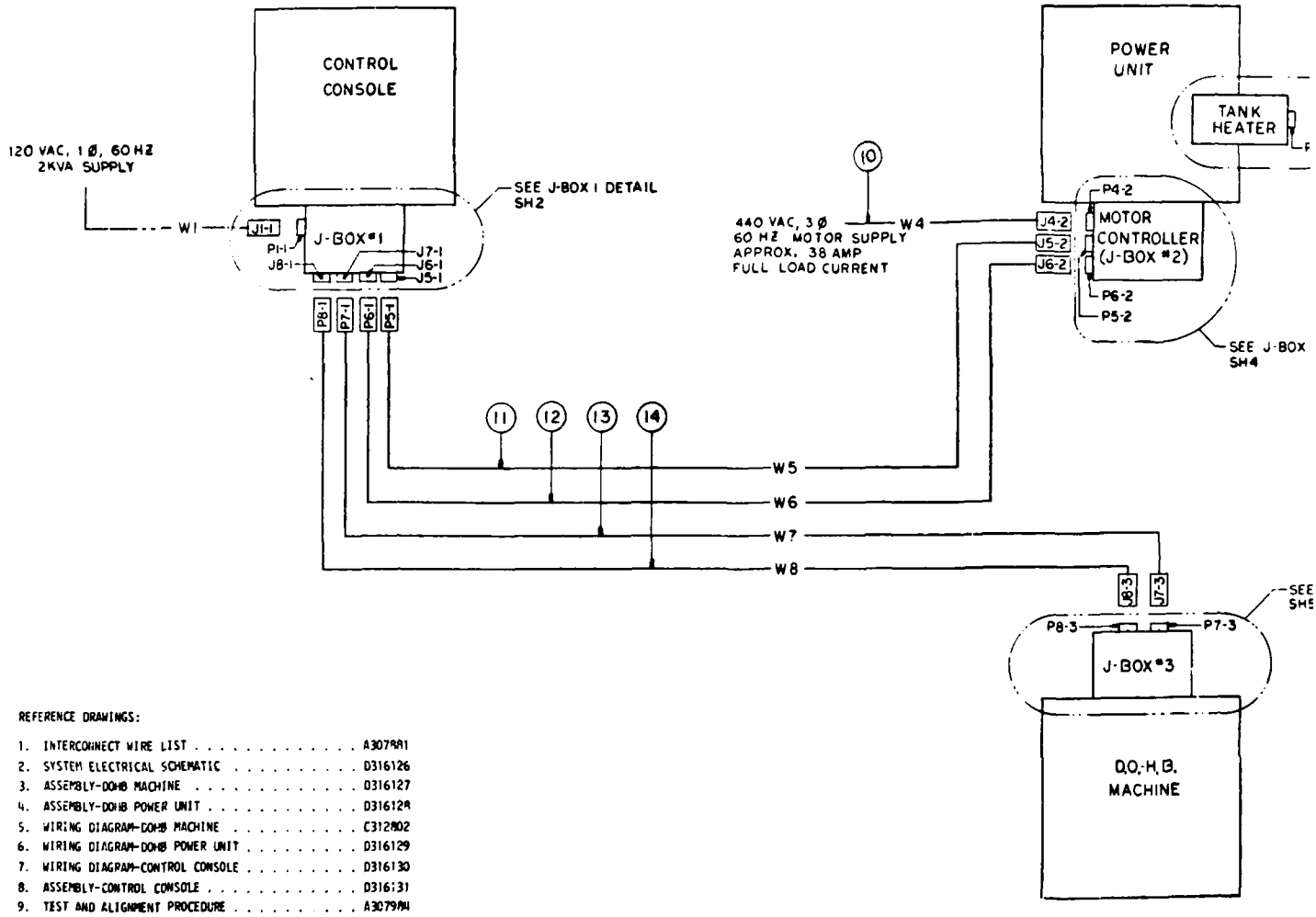
A307881B

Figure 2-3. Interconnecting Wiring List (Sheet 19 of 19)

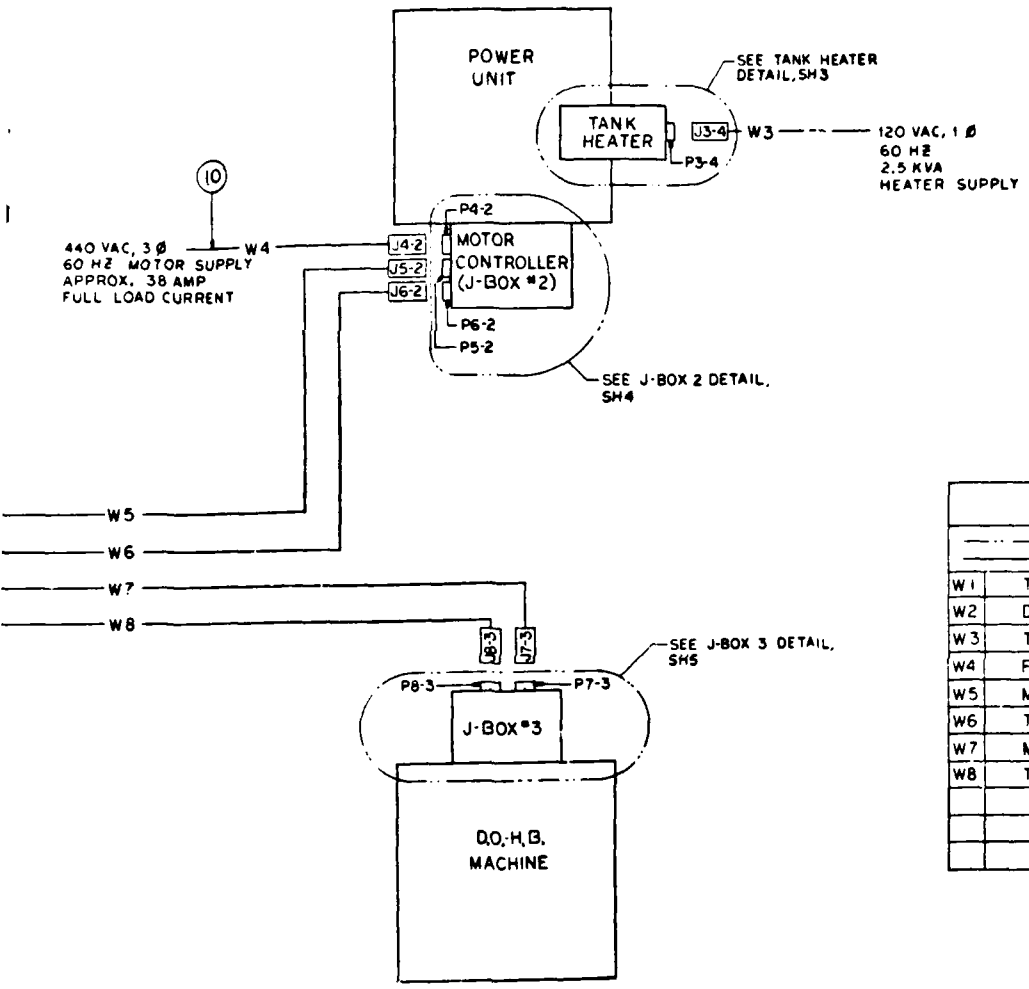


REFERENCE DRAWINGS:

1. INTERCONNECT WIRE LIST A3079A1
2. SYSTEM ELECTRICAL SCHEMATIC D316126
3. ASSEMBLY-DOHB MACHINE D316127
4. ASSEMBLY-DOHB POWER UNIT D316128
5. WIRING DIAGRAM-DOHB MACHINE C312802
6. WIRING DIAGRAM-DOHB POWER UNIT D316129
7. WIRING DIAGRAM-CONTROL CONSOLE D316130
8. ASSEMBLY-CONTROL CONSOLE D316131
9. TEST AND ALIGNMENT PROCEDURE A3079A4

REVISION STATUS

SHT	1	2	3	4	5
REV	B	B	B	B	B



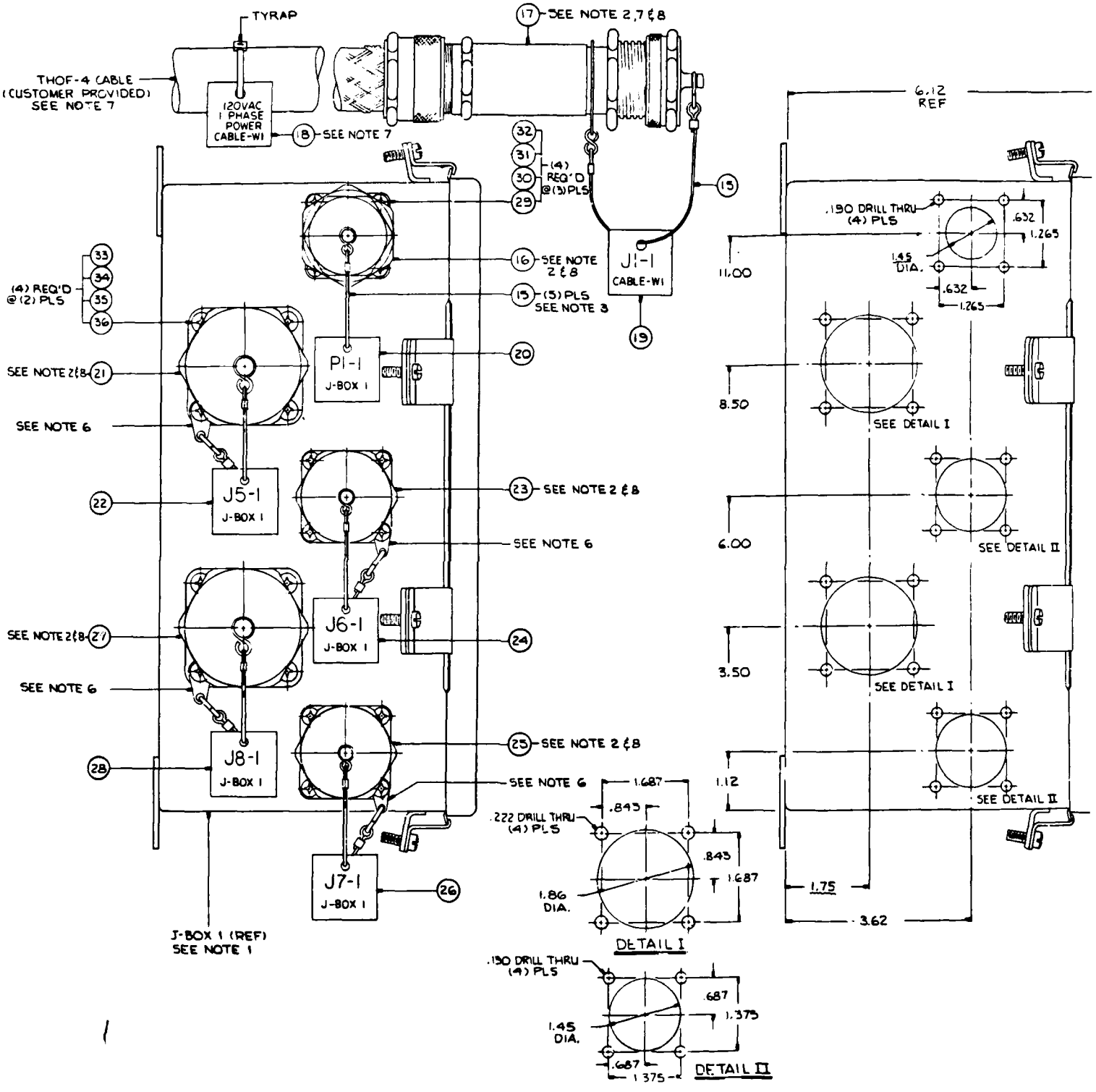
INTERCONNECT CABLES		
—·· — CUSTOMER FURNISHED ——— WGC FURNISHED		
W1	THOF-4	
W2	DELETED	
W3	THOF-4	
W4	FHOF-42	F/N 10
W5	MHOF-14	F/N 11
W6	TTRS-2	F/N 12
W7	MHOF-7	F/N 13
W8	TTRS-6	F/N 14

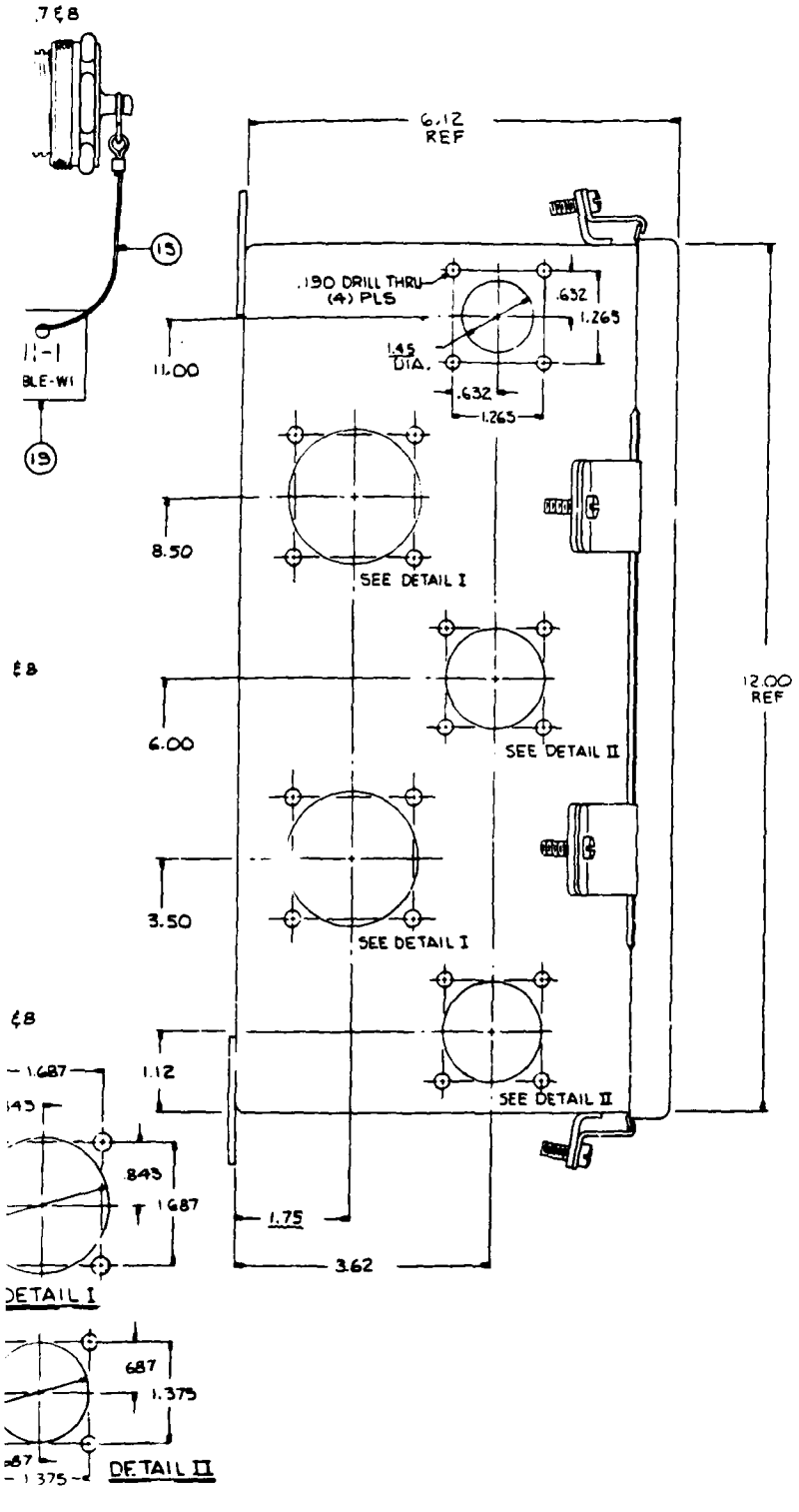
ATUS

4	5
8	8

D316125B

Figure 2-4. Electrical General Arrangement (Sheet 1 of 5)


TYRAP
THOF-4 CABLE (CUSTOMER PROVIDED) SEE NOTE 7
120VAC 1 PHASE POWER CABLE-W1
18 SEE NOTE 7
17 SEE NOTE 2,7 & 8
32
31
30
29
(4) REQ'D @(3) PLS
15
J1-1 CABLE-W1
19
16 SEE NOTE 2 & 8
15 (5) PLS SEE NOTE 3
33
34
35
36
(4) REQ'D @(2) PLS
P1-1 J-BOX 1
20
SEE NOTE 2&8 21
SEE NOTE 6
J5-1 J-BOX 1
22
23 SEE NOTE 2 & 8
SEE NOTE 6
J6-1 J-BOX 1
SEE NOTE 2&8 27
24
SEE NOTE 6
J8-1 J-BOX 1
28
25 SEE NOTE 2 & 8
SEE NOTE 6
J7-1 J-BOX 1
26
J-BOX 1 (REF) SEE NOTE 1
6.12 REF
.190 DRILL THRU (4) PLS
.632
1.265
1.45 DIA.
.632
1.265
11.00
8.50
SEE DETAIL I
6.00
SEE DETAIL II
3.50
SEE DETAIL I
1.12
SEE DETAIL II
1.75
3.62
1.687
.845
.222 DRILL THRU (4) PLS
.845
1.687
1.86 DIA.
DETAIL I
.190 DRILL THRU (4) PLS
.687
1.375
1.45 DIA.
.687
1.375
DETAIL II



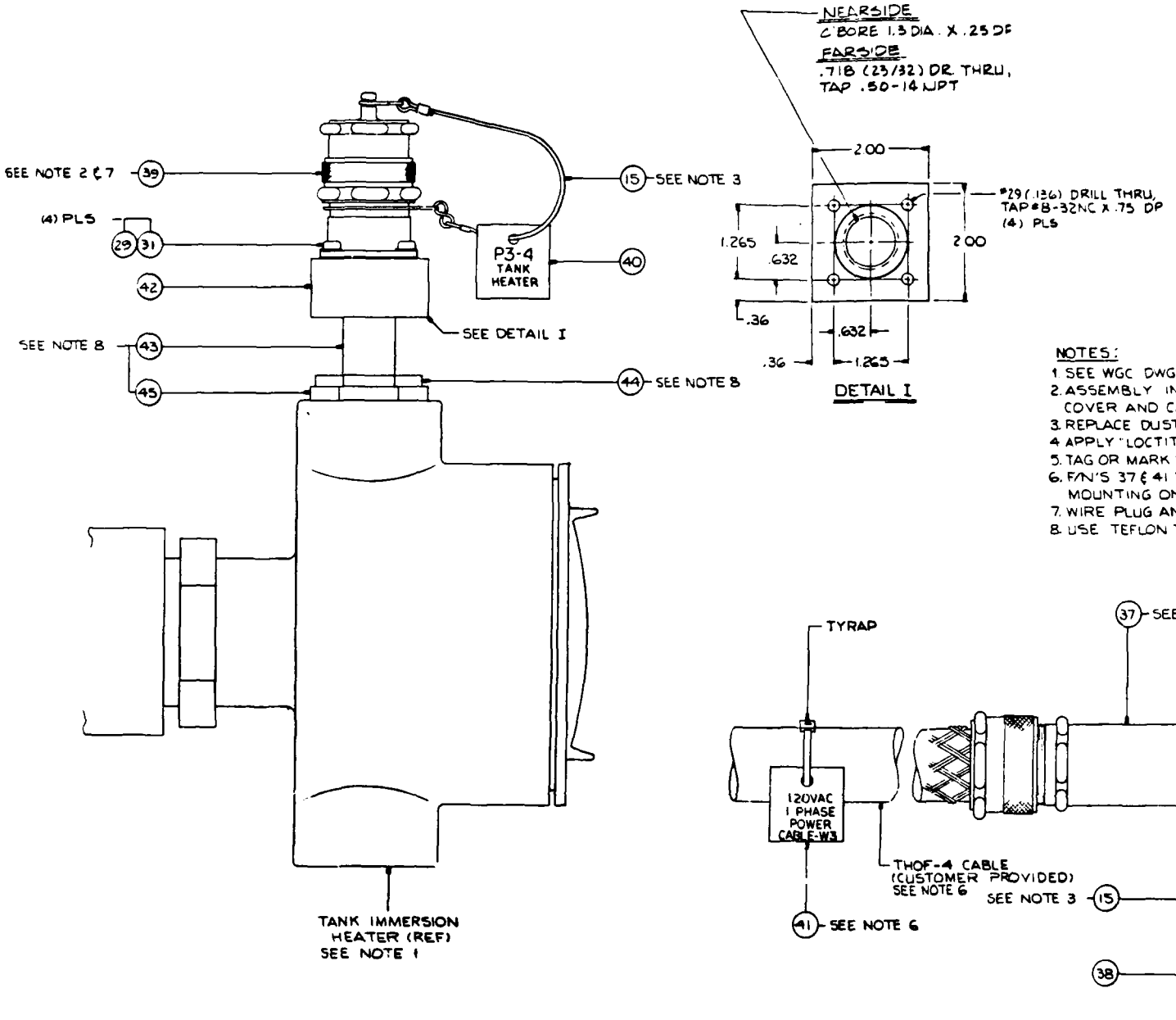
NOTES:

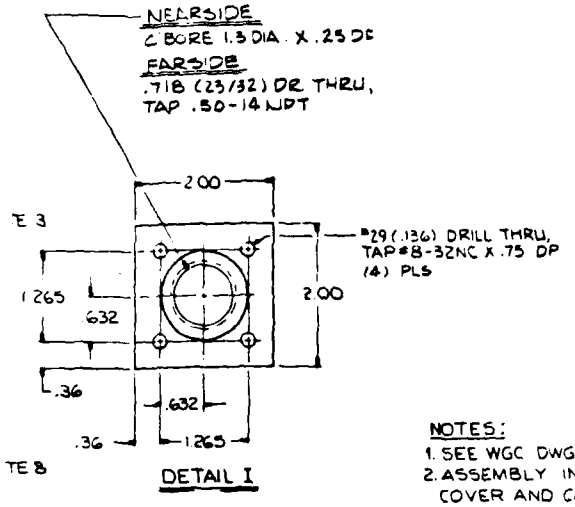
1. SEE WGC DWG NO. C312861 FOR J-BOX 1 ASSY.
2. ASSEMBLY INCLUDES PLUG, CONTACT INSERT, DUST COVER AND CABLE GRIP WHEN APPLICABLE.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSY, F/N 19.
4. APPLY "LOCTITE" 242 TO ALL THREADS AT ASSY.
5. TAG OR MARK WIRES WITH WIRE NUMBERS.
6. DUST COVER CABLE ASSY EYELET TO BE ATTACHED AT ONE FLANGE AS SHOWN USING MOUNTING HARDWARE.
7. F/N'S 17 & 18 TO BE SHIPPED LOOSE FOR CUSTOMER MOUNTING ON CUSTOMER PROVIDED CABLE.
8. WIRE PLUGS AND RECEPTACLES PER WGC DWG NO. A307881.

J-BOX 1 DETAIL

D316125B

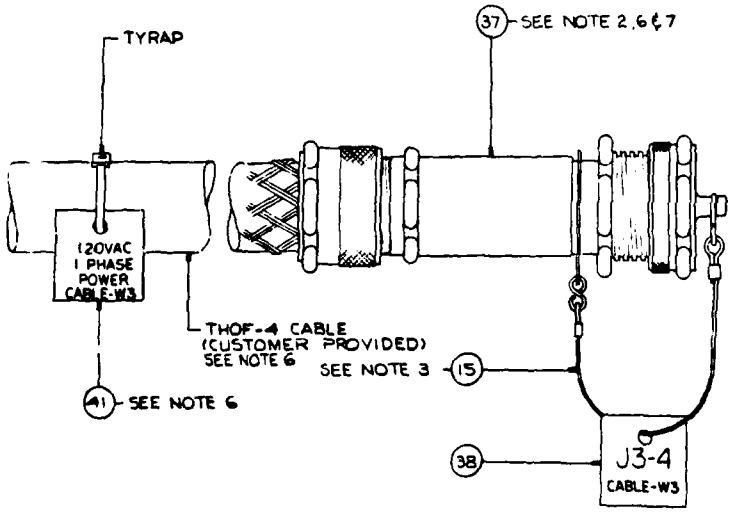
Figure 2-4. Electrical General Arrangement (Sheet 2 of 5)


NEARSIDE
C'BORE 1.5 DIA. X .25 DP
FARSIDE
.718 (23/32) DR THRU,
TAP .50-14 NPT
2.00
#29 (.136) DRILL THRU,
TAP #8-32NC X .75 DP
(4) PLS
1.265
.632
2.00
.36
.632
.36
1.265
DETAIL I
SEE NOTE 2 & 7
39
(4) PLS
29
31
42
SEE NOTE 8
43
45
15
SEE NOTE 3
P3-4
TANK
HEATER
40
SEE DETAIL I
44
SEE NOTE 8
TANK IMMERSION
HEATER (REF)
SEE NOTE 1
NOTES:
1. SEE WGC DWG NO. D316128, F/N
2. ASSEMBLY INCLUDES PLUG,
COVER AND CABLE GRIP. WHE
3. REPLACE DUST COVER CHAIN W
4. APPLY "LOCTITE" 242 TO ALL T
5. TAG OR MARK WIRES WITH W/
6. F/N'S 37 & 41 TO BE SHIPPED
MOUNTING ON CUSTOMER PR
7. WIRE PLUG AND RECEPTACLE
8. USE TEFLON TAPE ON PIPE
TYRAP
37
SEE NOTE 2, 6 & 7
120VAC
1 PHASE
POWER
CABLE-W3
THOF-4 CABLE
(CUSTOMER PROVIDED)
SEE NOTE 6
SEE NOTE 3
15
41
SEE NOTE 6
38
J3-4
CABLE-W3



NOTES:

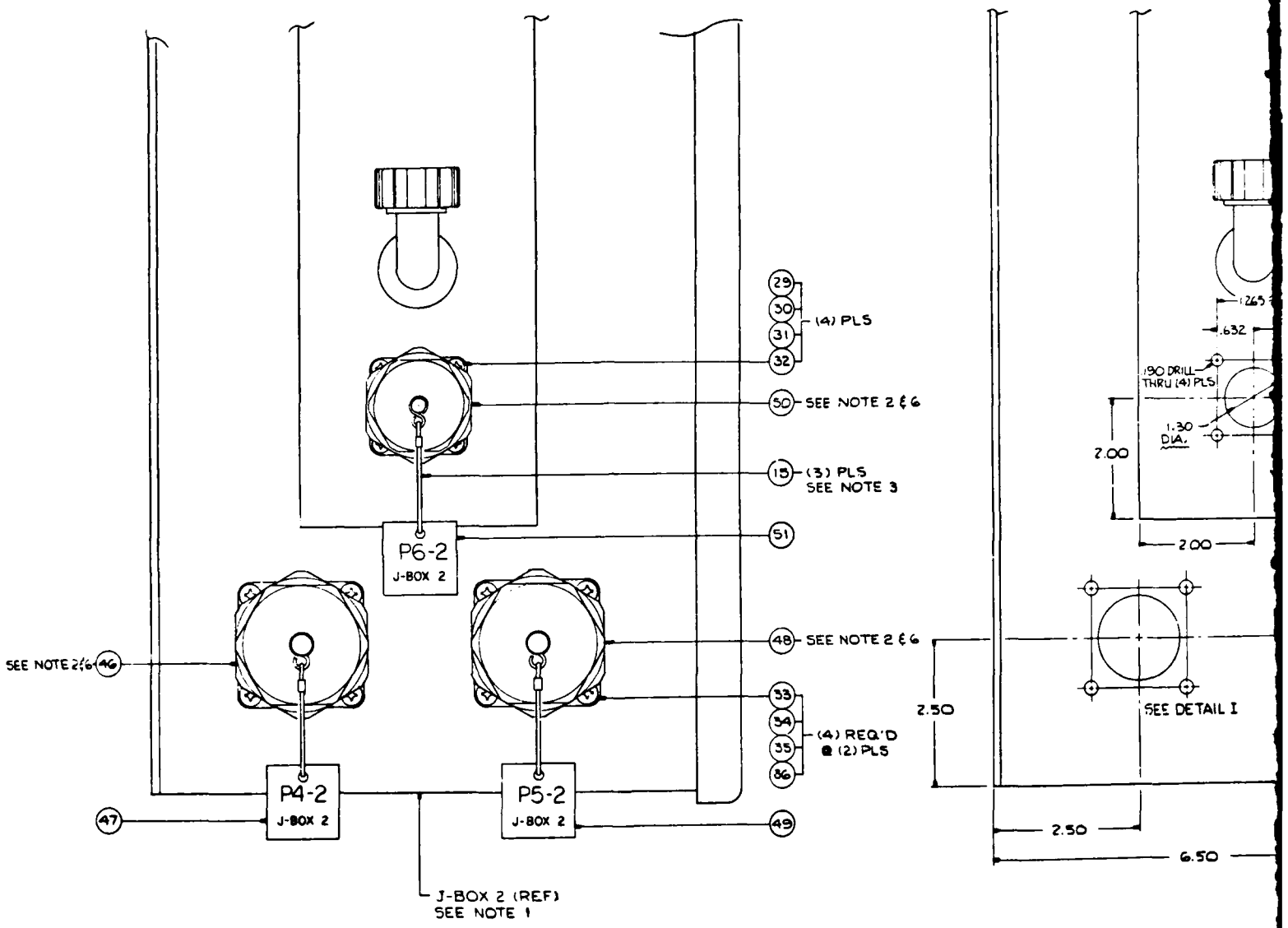
1. SEE WGC DWG NO. D316128, F/N 15, FOR TANK HEATER.
2. ASSEMBLY INCLUDES PLUG, CONTACT INSERT, DUST COVER AND CABLE GRIP, WHEN APPLICABLE.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSY, F/N 15.
4. APPLY "LOCTITE" 242 TO ALL THREADS AT ASSY.
5. TAG OR MARK WIRES WITH WIRE NUMBERS.
6. F/N'S 37 & 41 TO BE SHIPPED LOOSE FOR CUSTOMER MOUNTING ON CUSTOMER PROVIDED CABLE.
7. WIRE PLUG AND RECEPTACLE PER WGC DWG NO A507881.
8. USE TEFLON TAPE ON PIPE THREADS.

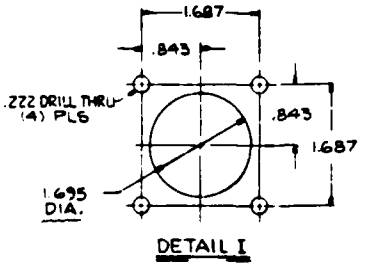


TANK HEATER DETAIL

D316125B

Figure 2-4. Electrical General Arrangement (Sheet 3 of 5)

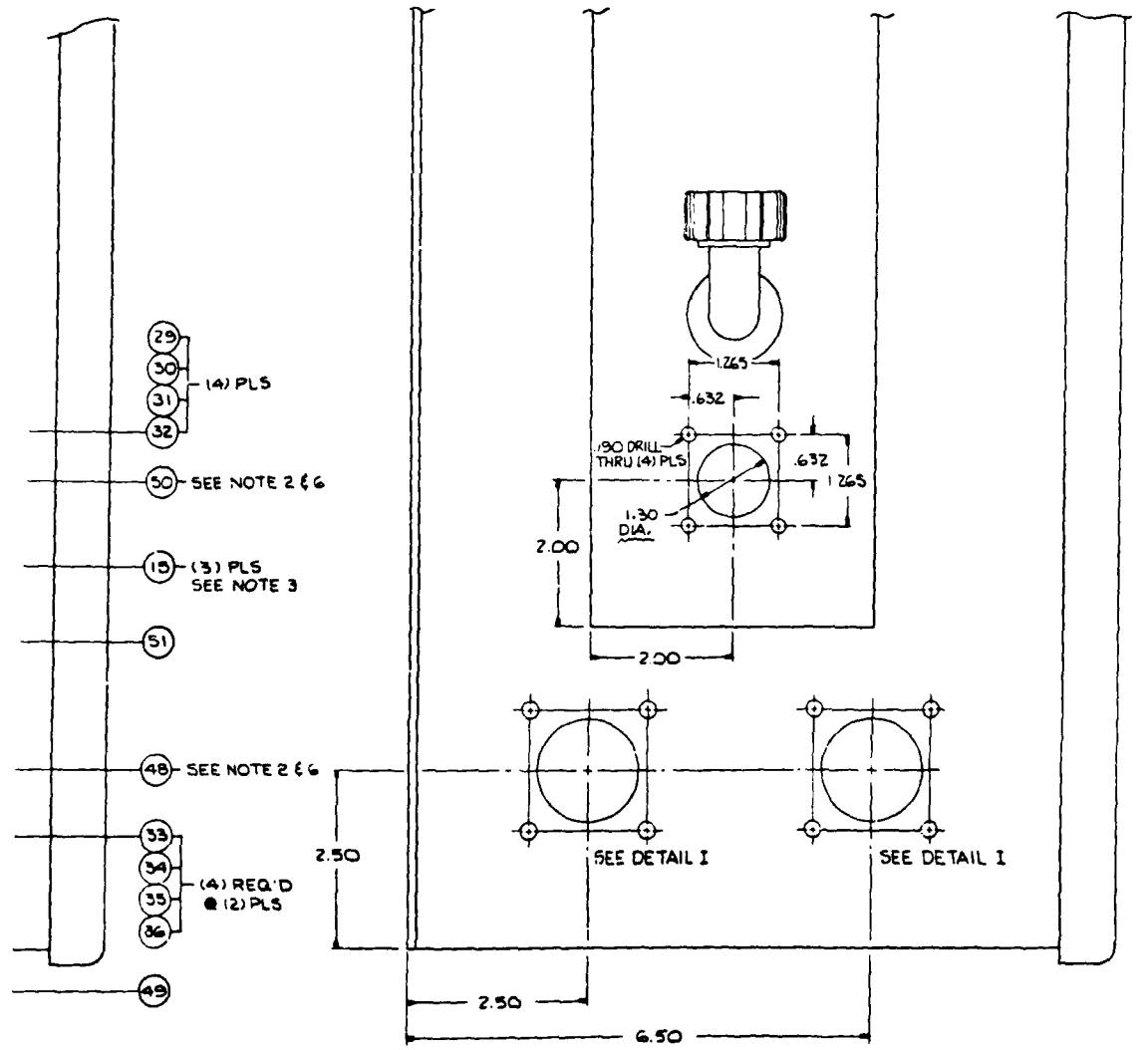




DETAIL I

NOTES:

1. SEE WGC DWG D316128,SH3 AND F/N27 J-BOX 2 ASSEMBLY.
2. ASSEMBLY INCLUDES PLUG, CONTACT INSERT AND DUST COVER.
3. REPLACE DUST COVER CHAIN WITH CABL ASSY, F/N 15.
4. APPLY "LOCTITE" 242 TO ALL THREADS AT ASSY.
5. TAG OR MARK WIRES WITH WIRE NUMBERS.
6. WIRE PLUGS PER WGC DWG NO. A30788



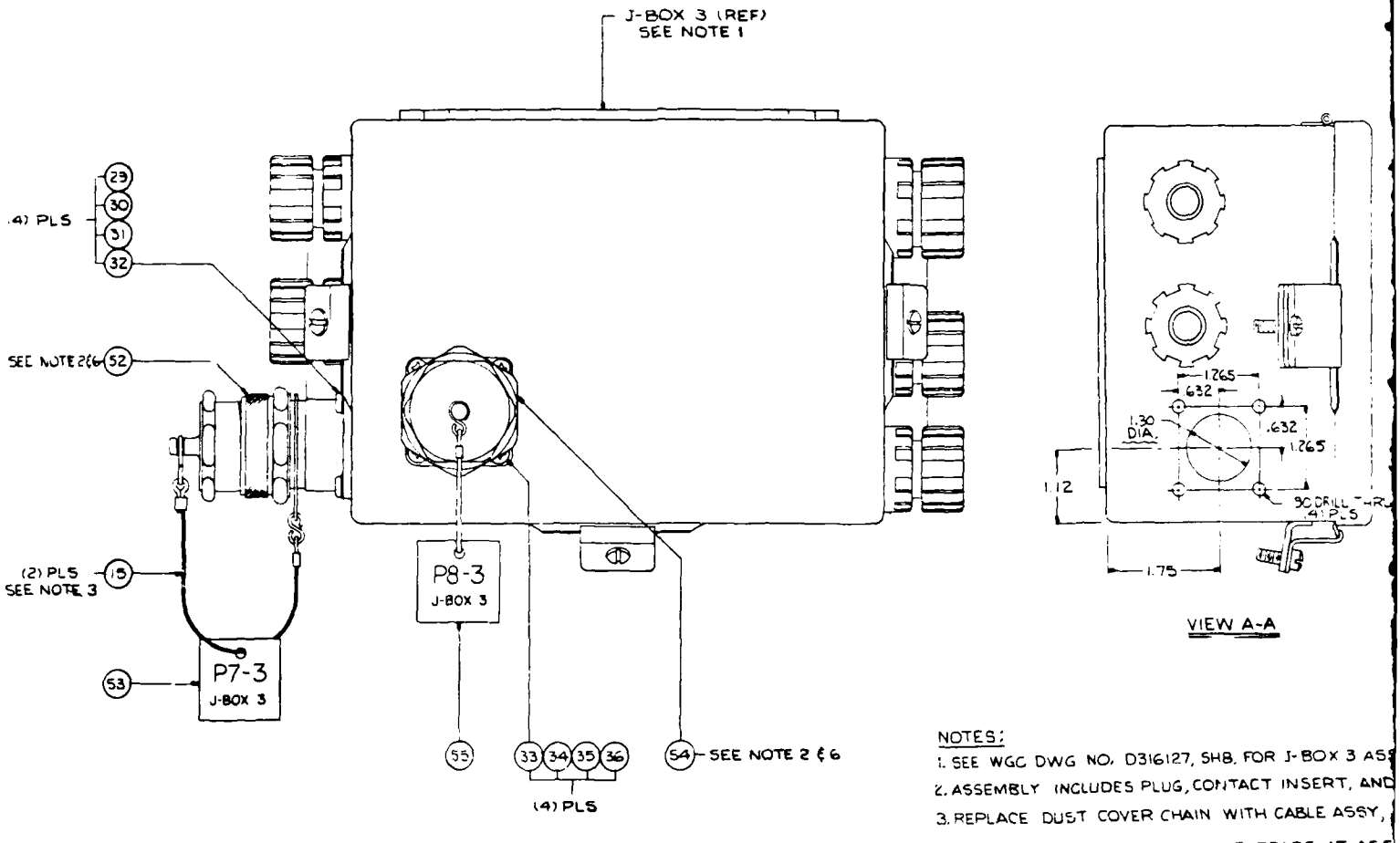
NOTES:

1. SEE WGC DWG D316128, SH3 AND F/N27, J-BOX 2 ASSEMBLY.
2. ASSEMBLY INCLUDES PLUG, CONTACT INSERT AND DUST COVER.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSY, F/N 15.
4. APPLY "LOCTITE" 24L TO ALL THREADS AT ASSY.
5. TAG OR MARK WIRES WITH WIRE NUMBERS.
6. WIRE PLUGS PER WGC DWG NO. A307881.

J-BOX 2 DETAIL

D316125B

Figure 2-4. Electrical General Arrangement (Sheet 4 of 5)

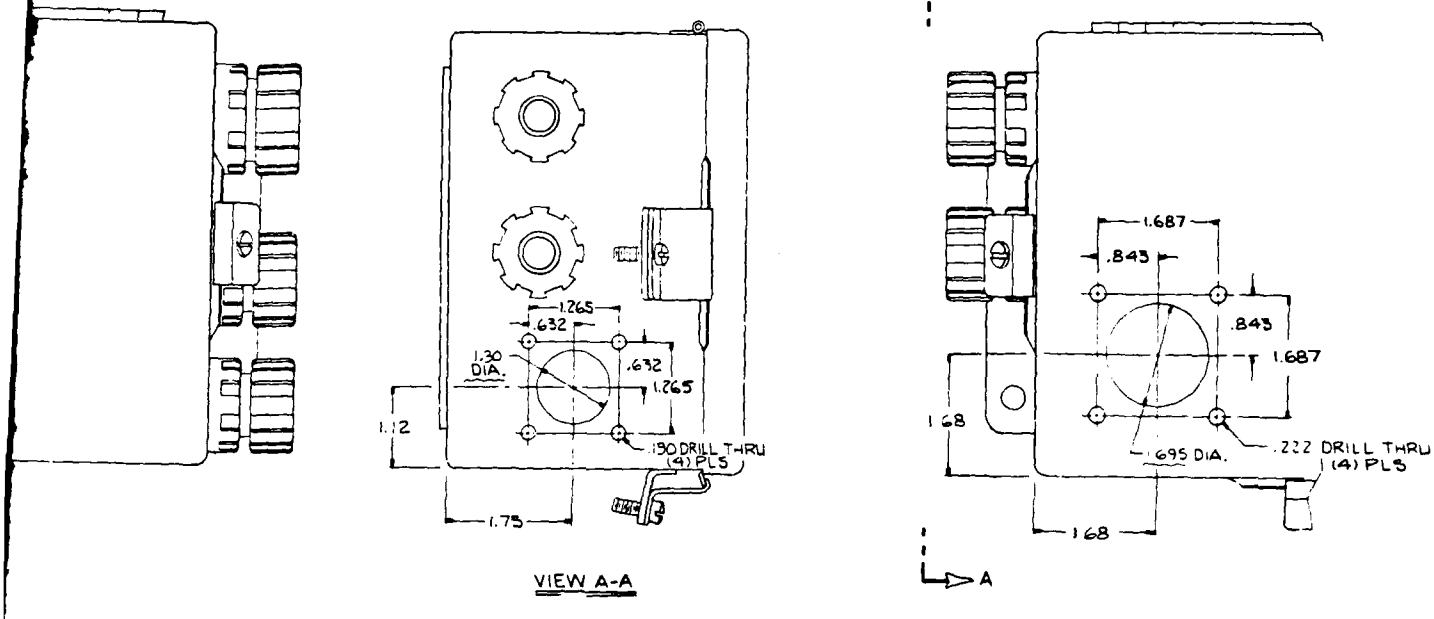


VIEW A-A

NOTES:

1. SEE WGC DWG NO. D316127, SHB. FOR J-BOX 3 ASS
2. ASSEMBLY INCLUDES PLUG, CONTACT INSERT, AND
3. REPLACE DUST COVER CHAIN WITH CABLE ASSY,
4. APPLY "LOCTITE" 242 TO ALL THREADS AT ASS
5. TAG OR MARK WIRES WITH WIRE NUMBERS.
6. WIRE PLUGS PER WGC DWG NO. A307881.

(REF)
E 1



VIEW A-A

SEE NOTE 2 & 6

NOTES:

1. SEE WGC DWG NO. D316127, SHB. FOR J-BOX 3 ASSEMBLY.
2. ASSEMBLY INCLUDES PLUG, CONTACT INSERT, AND DUST COVER.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSY, F/N 15.
4. APPLY "LOCTITE" 242 TO ALL THREADS AT ASSY.
5. TAG OR MARK WIRES WITH WIRE NUMBERS.
6. WIRE PLUGS PER WGC DWG NO. A307881.

J-BOX 3 DETAIL

D316125B

Figure 2-4. Electrical General Arrangement (Sheet 5 of 5)

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains a safety summary, a description of the controls located on the DOHB tension machine and power unit, and operator maintenance information.

3-3. SAFETY SUMMARY.

3-4. Operating personnel must observe the following safety WARNING and CAUTION when operating the DOHB tensioner.

WARNING

The power unit for this machine contains lethal voltages. Keep away from live electrical circuits. Never try to make repairs or to replace components when power is on.

CAUTION

Before operating the tension machine, look around. Make sure that no stowed equipment or other material will interfere with the operation of the machines.

3-5. CONTROLS AND INDICATORS.

3-6. The DOHB tension machines and power unit are controlled from the Machine Operator Control Console. Refer to the Operation and Maintenance Manual for Control Console for description, function, and operation of controls and indicators located on the control console.

3-7. Functions of controls located on the DOHB tension machine and power unit are described in table 3-1.

3-8. OPERATOR MAINTENANCE.

3-9. Operator maintenance includes inspecting, cleaning, and lubricating the equipment as described in table 5-1. Operators shall be alert to detect malfunctions and shall secure the equipment as soon as possible to determine the cause and to have the malfunction corrected. Section IV includes tables which give logical steps to be followed to locate and correct malfunctions.

3-10. The specific indications of trouble include:

1. Overheating of any part, smoking or discoloration of painted surfaces.
2. Excessive vibration.
3. Unusual noises.
4. Failure of machine to respond to control movements.
5. Track slippage at rated squeeze pressure.
6. Metal dust or shavings around moving parts.
7. Low pressure readings in hydraulic system.

3-11. Operators are not qualified by rating or training to repair DOHB tension machines. They shall report the exact indications they have observed but in no case shall they attempt repairs without responsible supervision. Unauthorized attempts at quick repairs may hide the true cause of malfunctions and cause severe damage.

Table 3-1. DOHB Tension Machine and Power Unit Local Controls

CONTROL AND LOCATION	POSITIONS	FUNCTION
DOHB Reducer - High/Low Speed Control Lever (14, figure 6-5)	IN	Engages gear for low speed operation.
	OUT	Engages gear for high speed operation.
		NOTE: Control levers on both reducers must be at the same position (IN or OUT) before operating the tension machine. Do not shift control levers while machine is operating.
DOHB Power Unit Motor Controller - RESET button		When pressed, mechanically resets overload relays to extinguish red OVERLOAD indicator on control console (see figure 1-1, sheet 3).
DOHB Power Unit Motor Controller - Heater Switch (figure 4-3, sheet 2)	ON/OFF	When in ON position, energizes space heaters in motor and motor controller (if space heater AC voltage if present).
		When in OFF position, deenergizes space heaters.

SECTION IV

TROUBLESHOOTING

4-1. INTRODUCTION.

4-2. This section contains a functional description of the DOHB Tension Machines and their power units. Troubleshooting tables are provided (tables 4-1 and 4-2) which contain information useful for determining the location of faults which may develop in the equipment.

4-3. FUNCTIONAL DESCRIPTION.

4-4. DOHB MACHINE GENERAL. Two kinds of force are applied to the cable in the DOHB tension machine by the tracks of the machine. Squeeze pressure applies a force perpendicular to the cable and acts to hold the cable between the tracks. Movement of the tracks by the hydraulic drive motors of each track assembly produces a longitudinal force which causes the cable to move in a plane horizontal to the tracks. Each tension machine is designed to produce a maximum longitudinal force or tension of 2,250 pounds at a speed of 315 feet per minute.

4-5. REDUCER ASSEMBLY. See figures 6-4 and 6-5. Drive power for each track assembly is supplied by a hydraulic drive motor through a gear reducer assembly. Two ranges of speed are available through the assembly. These are 0 to 315 fpm when the speed control lever on the gearbox is positioned to the IN positon and 0 to 670 fpm when the lever is in the OUT position. The reduction gear mechanism consists of high speed shaft (4), intermediate pinion shaft (5), spur pinion shaft (6), and output shaft (7). The high speed shaft is gear coupled to drive the intermediate pinion shaft through either of two gears (10 or 11) which are spline engaged to the intermediate pinion shaft by the positioning of clutch collar (20). Selection between the two gears provides the speed control. The clutch collar is shifted to engage either low speed gear (11) or high speed gear (10) when lever handle (14) is actuated. Moving the lever handle causes shift rod (16) to be repositioned and held by a detent mechanism consisting of a spring and ball and two grooves in the shift rod. When the rod is shifted, the ball is caused to be seated in a groove for the new position. Fastened to the shift rod is fork (68) which engages the clutch collar and moves it when the shift rod is moved. Output from intermediate pinion shaft (5) is coupled through helical gear (8) which is keyed to spur pinion shaft (6). Output from the spur pinion shaft is coupled through spur gear (9) keyed to output shaft (7). The ends of all shafts are supported by bearings and the entire gear mechanism is submerged in 90 weight gear oil.

4-6. BRAKE ASSEMBLY. See figure 6-5. Intermediate pinion shaft (5), which extends through reducer base (2), has brake gear (64) mounted on its end. The brake mechanism consists of brake gear (64), five separator plates (59), six friction plates (58), backing plate (62), piston (60), and ten springs (63). The brake mechanism is spring set and hydraulically released. Thus, when there is an absence of hydraulic pressure acting on the piston, the springs force the

backing plate to engage the friction plates with the separator plates of the brake gear. With contact thus established, the brake gear holds the intermediate pinion shaft and prevents it from turning and the brake is set. When hydraulic pressure acts on the piston, spring tension is overcome and the brake is released. The brake is cooled by oil from the reducer seeping through bearing (39).

4-7. TRACK ASSEMBLIES. See figure 6-1. Each track assembly consists of a welded steel box structure with a pair of sprockets (5) attached at each end. Each pair of sprockets is connected by a shaft: idle shaft (73) at the forward end and drive shaft (59) at the aft end. Looped around the sprockets and frame assembly is track (4). In the upper track assembly, the upper span of track between the two sprocket assemblies is supported by a pair of track support rollers (71) which are connected between four pillow blocks (43). Support for the lower track span of the lower track assembly is provided by another pair of track support rollers connected in a similar manner beneath the lower track span. Also, located within each track loop are three roller frame mechanisms which support four pressure rollers (111) each. The twelve pressure rollers within the upper track loop are located along the lower track span and each roller frame assembly is attached to the welded steel box structure. Squeeze pressure exerted on the upper track assembly by the MAIN PRESSURE cylinder (98) is transmitted as a holding force on the cable between the tracks by the twelve upper pressure rollers. The three roller frame assemblies located within the lower track assembly are each attached to a rod of a track cylinder (122). Each track cylinder holds its four pressure rollers along the underside of the upper span of track on the lower track assembly. The three track cylinders allow the lower track to be forced down to allow the passage of cable repeaters through the tension machine.

4-8. MAIN PRESSURE CYLINDER. Main pressure cylinder develops the force which squeezes the cable between the upper and lower tracks. This perpendicular force is controlled by the amount of air pressure applied to cylinder by the positioning of UPPER FRAME SQUEEZE control valve handle on the control console. The amount of air pressure that can be applied is variable between 0 and 80 psi. A pressure regulator limits air pressure to control valves to 80 psi. Actual movements of load force applied by the upper track assembly to the cable is determined by several factors which include the movement of the arms through which cylinder rod is connected to the upper track assembly, the effect of longitudinal force (tension) on the upper track, the direction of operation - forward or aft (the direction of movement causes tension to aid or oppose the load), and the weight of the upper track. In normal operation, squeeze pressure is set by positioning control valve handle toward DOWN and observing the operation of the tracks: when the tracks do not slip, adequate squeeze pressure is set for that tension and speed. When control valve handle is positioned toward UP, the entire upper track assembly is raised by reversing the direction of air pressure to squeeze and lift pneumatic cylinder.

4-9. TRACK SQUEEZE CYLINDERS. The TRACK SQUEEZE control valve controls both pressure and air flow for the three track squeeze cylinders. Air pressure at the outlet port may be increased or decreased by positioning the hand lever. Maximum air pressure that can be set by the valve is limited to 80 psi as set by the pressure regulator. When the TRACK SQUEEZE control valve handle is moved to

the SQUEEZE position, the track cylinders extend to press pressure rollers along the underside of the upper span of track of the lower track assembly. The track cylinders are operated at low pressure to allow the track to be forced down by cable repeaters as they pass through the tensioner machine. When the handle of the control valve is positioned to the RELEASE position, the air circuit is vented to atmosphere and the track cylinders retract.

4-10. TRACK TIGHTENER. See figure 6-1. The idler shaft (73) of both the upper and lower track frame assemblies may be moved forward or aft to loosen or tighten the track assemblies. The mechanism which permits this adjustment is called the track tightener and consists of two tightener assemblies. Each tightener assembly consists of a spring (8), a backing plate (7), a nut (36), and a screw (6) arrangement of which screw (6) is the manual track tightener adjustment. Each pair of assemblies is located within the forward end of each track frame assembly between a bearing plate and the idler shaft assembly.

4-11. POWER UNIT ASSEMBLY (figure 6-8). Each DOHB tension machine is powered by a separate electrohydraulic power unit. The power unit consists of a 30 horsepower electric drive motor (3) coupled to a variable delivery hydraulic pump (11) mounted on a 120-gallon hydraulic tank (2). A motor controller (27), mounted to the side of the hydraulic tank controls the electric motor. Pump (1) output is controlled by remote control actuator mounted on the pump.

4-12. The hydraulic tank (2) is equipped with a filter breather (20), a sump filter (47), a 10-micron replenishment filter a water to oil heat exchanger (10), and an immersion heater (15). Heater is a 2,500-watt, 120-volt unit that is thermostatically controlled to go on at 50°F (10°C) and off and 80°F (27°C).

4-13. POWER UNIT FUNCTION. See figure 4-1. The primary function of the power unit is to provide hydraulic drive power to drive the DOHB tension machine tracks by means of hydraulic motors and gear reducers. Electric motor (20) rotates variable delivery hydraulic pump (25) shaft in a constant direction. However, no hydraulic pressure is developed unless the pump is placed on stroke by the hydroelectric actuator. The replenishing pump is an integral part of pump (25) and produces an output of replenishment fluid flow whenever electric motor (20) is operating.

4-14. The hydroelectric actuator controls the amount and direction of fluid flow developed by the pump and thereby controls the speed and direction of fixed hydraulic motors (27) which drive the DOHB machine reducers. Track speed and direction is thus controlled by the actuator.

4-15. The actuator receives pressurized hydraulic fluid from replenishing pump. A dc linear motor in the actuator controls positioning of the actuator pilot spool to direct hydraulic fluid to the actuator pistons causing the actuator output rod to move in the required direction. The actuator output rod is connected to the pump control arm to control pump output. The pump control arm can be used to manually control the pump during maintenance operations.

4-16. Operation of the actuator is controlled from the control console. With MODE SELECT switch set to SPEED position, PAYOUT/HAUL IN quadrant furnishes the electrical signal input for actuator operation. Quadrant is manually positioned

by the operator to directly control track speed and direction. CABLE TENSION dial indicator provides readings of tension developed at the DOHB tension machine as sensed by load cells.

4-17. With the MODE SELECT switch set to the BRAKE position, the brake release solenoid and the brake release stroke ≠ 0 solenoid are deenergized. This closes off the flow of hydraulic fluid to the spring set/hydraulically released brake, thereby setting the brakes and stoping the DOHB.

4-18. With MODE SELECT switch set to TNSN position, the DOHB electronic tension/speed controls furnish the electrical signal input for the actuator to operate and maintain a preset tension. TENSION SET potentiometer is set to the desired tension. When TENSION SET READOUT pushbutton is depressed, CABLE TENSION indicator shows the amount of tension set by potentiometer. TNSN MACH GEAR MODE switch must be set to correspond with the gear position (HIGH or LOW) selected at the DOHB reducers for the electronic controls to function properly. The electronic controls are a redundant system (A or B) and either system may be used as selected by SYSTEM SELECT switch. Load cells provide an input signal of actual tension to the electronic controls. The electronic controls provide the electrical signal to the actuator that will result in the tension being maintained at the level set by TENSION SET potentiometer.

4-19. PNEUMATIC SYSTEM. See figure 4-2. The DOHB tension machine pneumatic system consists of an air pressure source of approximately 100 psi (supplied by the ship), a shutoff valve (10), an air filter (11), a pressure regulator (12), an air lubricator (13), and one complete set of the following items: three hand-operated, four-way directional control valves (15A, 15B and 18); a pressure regulator (17); five pressure gages (14A, B, C, D, and E); upper frame squeeze cylinder (21); three track squeeze cylinders (22); and two dragboard cylinders (20 and 23).

WARNING

Stay clear of the tension machine tracks when the equipment is operating. Shut down power unit(s) and tag controls to prevent operation when making adjustments or performing maintenance actions. Ensure that all junction box covers, coupling guards, and equipment shields are in place before operation.

Table 4-1. Tension Machine Troubleshooting

ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1	Hydraulic motor (25, figure 4-1) unusually noisy. (See also 11, figure 6-8.)	Internal damage in motor.	Disassemble motor and inspect. Refer to appendix D.
		Air leak in hydraulic piping.	Pour hydraulic fluid over piping joints while listening for change in sound of operation. Tighten flanges or replace O-rings as required.
2	Hydraulic motor (25, figure 4-1) overheating.	Internal damage.	Disassembly motor and repair. Refer to appendix D.
3	Squeeze cylinder (21, figure 4-2) inoperative.	Ships air pressure not connected.	Connect ships air to the control console.
		Defective squeeze cylinder control valve (15B, figure 4-2).	Replace defective valve.
		Defective squeeze cylinder.	Repair defective squeeze cylinder.
4	Track squeeze cylinders (22, figure 4-1) inoperative.	Ships air pressure not connected.	Connect ships air to the control console.
		Regulator (17, figure 4-2) air pressure less than 80 psi.	Adjust or replace regulator.
		Defective track cylinders control valve (18, figure 4-2).	Replace defective valve.

Table 4-1. Tension Machine Troubleshooting (Cont)

ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
5	Forward dragboard cylinder (20, figure 4-1) inoperative	Ships air pressure not connected.	Connect ships air to the control console.
		Ships air pressure less than 110 psi.	Increase ships air pressure to minimum 110 psi.
		Defective dragboard air control valve (15A, figure 4-2).	Replace defective air control valve.
		Defective forward dragboard cylinder.	Replace defective forward dragboard cylinder.
6	Aft dragboard cylinder (23, figure 4-2) inoperative.	Ships air pressure not connected.	Connect ships air to the control console.
		Ships air pressure less than 110 psi.	Increase ships air pressure to minimum 110 psi.
		Defective aft dragboard air control valve (15A, figure 4-2).	Replace air control valve.
		Defective aft dragboard cylinder.	Replace aft dragboard cylinder.
7	Hydraulic motors malfunction.	Refer to appendix D.	Refer to appendix D and troubleshoot, adjust, or repair as required.
8	Brake unit overheating.	Brake not completely released.	Disassemble brake and check piston travel; check for damaged discs.
9	Brake sets during operation.	Loss or reduction of replenish pressure.	Check the filter unit for restriction and the pump for proper operation.
		Electrical defect.	Check the electrical circuit of the solenoid operated valve of the bypass and brake valve unit. Check hydraulic operation of brake and bypass valve.

WARNING

Stay clear of the power unit when the equipment is operating. Shut down power unit and tag controls to prevent operation when making adjustments or performing maintenance actions. Ensure that all junction box covers, coupling guards, and equipment shields are in place before operation.

Table 4-2. Power Unit Troubleshooting

ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1	Electric motor does not rotate.	Power disconnected.	Check for 440 vac at motor starter; connect external power.
		POWER ON/OFF (disconnect) switch on controller enclosure set to OFF.	Set switch to ON.
		Controller enclosure door open.	Close and secure door.
		POWER OFF/ON (disconnect) switch defective.	Check and/or replace as necessary.
		Wiring defective.	Check wiring continuity and replace if defective.
		Contactor defective.	Repair or replace operating coil or contacts. Refer to appendix E.
		Electric motor is defective.	Repair or replace. Refer to appendix E.
		Drive shaft frozen.	Disconnect hydraulic pump coupling. Start motor. If motor starts, proceed to the hydraulic pump MALFUNCTION. If motor does not start, proceed to other PROBABLE CAUSES.
		Open, short or ground in motor circuits.	Test for open, shorted or grounded circuit and repair.
		Bearings stiff.	Replace bearings. Refer to appendix E.

Table 4-2. Power Unit Troubleshooting (Cont)

ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
2	Electric motor rotates but hydraulic pump does not deliver oil or delivers insufficient oil.	Intake pipe blocked.	Check filter (24, figure 4-1).
		Oil viscosity too heavy.	Drain tank and replace with proper oil. See figure 5-2.
		Drive shaft disengaged or sheared.	Check drive shaft, repair or replace as necessary.
		Pump has internal worn parts.	Repair or replace as required. Refer to appendix D.
		Pump improperly reassembled.	Correct in accordance with instructions in the appendix.
		Pump is noisy.	Check in accordance with appendix D.
		Pump actuator (B, figure 4-1) not functioning properly.	Check hydraulic and electrical inputs. Repair or replace actuator as required. Refer to appendix D.
3	Electric motor noisy.	Motor running single-phase.	Stop motor and restart. Motor should not start on single-phase. Repair the open circuit.
		Noisy bearings.	Lubricate or replace bearings as required. Refer to appendix E.
		Motor housing or mounting bolts loose.	Realign and tighten housing and mounting bolts.
		Debris caught between impeller and motor endbell.	Disassemble, clean, lubricate, and reassemble motor.
		Pump adapter coupling loose.	Check alignment and tighten coupling bolts.
4	Electric motor overheated or smoking.	Bearings binding or worn.	Replace bearings. Refer to appendix E.

Table 4-2. Power Unit Troubleshooting (Cont)

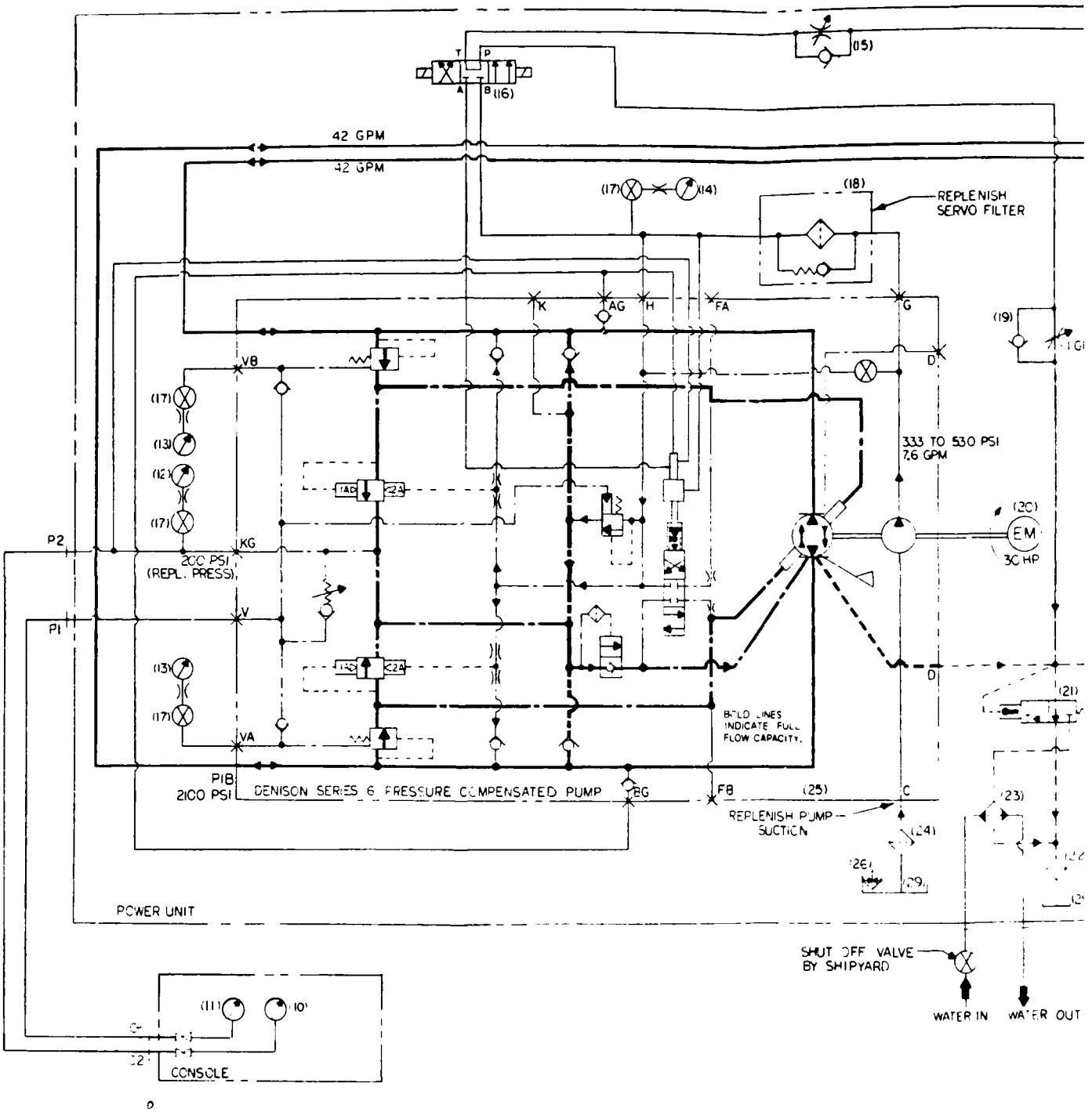
ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
4 (Cont)		Incorrect current or voltage.	Measure voltage and current values.
		Motor windings shorted or grounded.	Test for shorted or grounded circut and repair.
		Motor shaft binding.	Correct alignment with pump adapter coupling or replace bent stator shaft.
5	Electric motor bearing overheating.	Bearings improperly lubricated.	Properly lubricate or replace bearings. Refer to appendix E.
		Bearings misaligned and binding.	Replace bearings and straighten motor shaft, if required. Refer to appendix E.
		Motor drive shaft binding.	Correct drive shaft alignment or replace stator shaft. Refer to appendix E.
		Motor endbells loose.	Tighten motor housing bolts.
6	Pump making excessive noise.	Restricted or partially clogged intake line, strainer, or filter.	Inspect and clean line or replace filter elements as necessary.
		Coupling misaligned.	Realign, replace oil seals if necessary.
		Shaft oil seal leaking.	Inspect shaft for scoring, replace if necessary. Replace oil seal. Refer to appendix D.
		Air leak in intake or return line.	Locate and tighten loose connection.
		Insufficient fluid level in reservoir.	Fill reservoir to prescribed level.

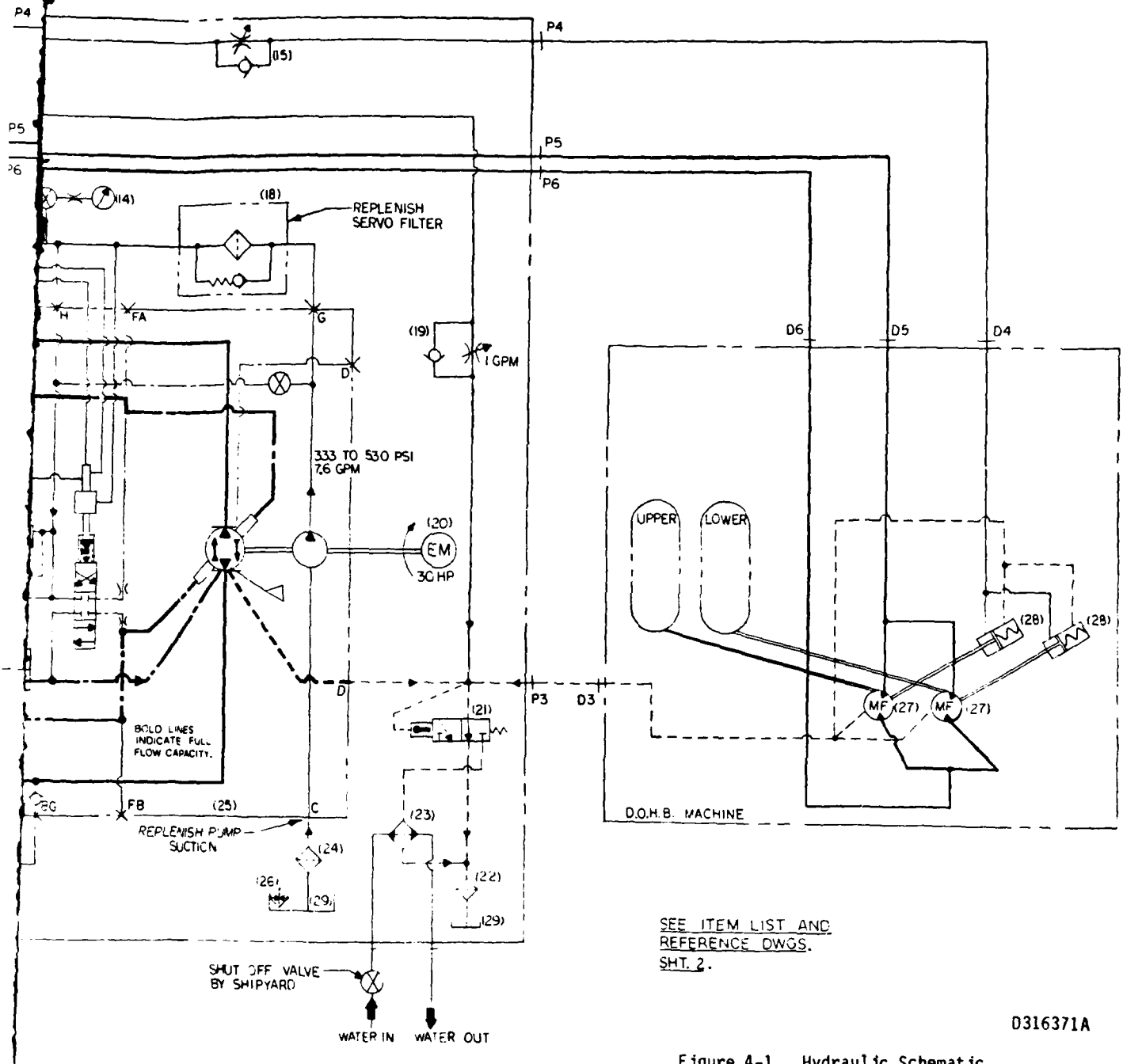
Table 4-2. Power Unit Troubleshooting (Cont)

ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
6 (Cont)		Relief valve not properly set or sticking.	Adjust to prescribed setting or repair.
		Internal pump damage.	Replace or repair. Refer to appendix D.
7	Loss of pressure from pump.	Loose connection.	Check all piping and interconnecting hoses and flanges for fluid leakage. Replace all suspected seals, O-rings, and gaskets.
8	Pump vibrates excessively.	Loose foundation bolts.	Tighten.
		Worn parts.	Locate and replace.
		Misalignment.	Realign.
9	Pump overheats.	Misalignment.	Realign.
		Incorrect level of lubricant.	Check level, correct as necessary.
		Heat exchanger malfunctioning.	Inspect for formation of oil sludge, scale, and other deposits. Clean as necessary.
		Overloading.	Reduce load.
10	Abnormal wear or scoring on moving parts of pump.	Failure to fill case with fluid before starting.	Replace or repair worn parts. Refer to appendix D.
		Contaminated fluid.	Clean fluid to 10 micron level or replace fluid. Always filter new fluid. Clean reservoir & plumbing.
		Low level in reservoir.	Fill reservoir with clean 10 micron level fluid.
		Use of unapproved fluid or of a fluid with a nonrecommended viscosity.	Drain, flush, and replace with proper fluid of 10 micron cleanliness. See figure 5-2.

Table 4-2. Power Unit Troubleshooting (Cont)

ITEM	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
10 (Cont)		Operation of pump above rated continuous operating pressure for sustained period.	Don't operate above rated pressures.
		Operation of pump with fluid at temperatures not recommended by manufacturer.	Do not operate pump under these conditions.
11	Foul odor emitted from fluid remaining in reservoir tank.	Hydraulic fluid has broken down due to moisture contamination or over heating.	Drain reservoir and replace with clean filtered fluid.


42 GPM
42 GPM
REPLENISH SERVO FILTER
333 TO 530 PSI 7.6 GPM
EM 30 HP
200 PSI (REPL. PRESS)
P2
P1
P1B 2100 PSI
DENISON SERIES 6 PRESSURE COMPENSATED PUMP
BOLD LINES INDICATE FULL FLOW CAPACITY.
REPLENISH PUMP SUCTION
POWER UNIT
SHUT OFF VALVE BY SHIPYARD
WATER IN
WATER OUT
CONSOLE



SEE ITEM LIST AND REFERENCE DWGS. SHT. 2.

D316371A

Figure 4-1. Hydraulic Schematic (Sheet 1 of 2)

ITEM NO.	NOMENCLATURE	QTY	PART OR DWG. NO.	NAME	F/N	USED ON
10	GUAGE 300 PSI	1	J7758P	MARSH	38	D316131
11	GUAGE 3000 PSI	1	J7778P	MARSH	39	D316131
12	GUAGE 100 PSI	1	J7758	MARSH	14	D316128
13	GUAGE 1000 PSI	2	J7178	MARSH	12	D316128
14	GUAGE 1500 PSI	1	J7572	MARSH	13	D316128
15	FLOW CONTROL VALVE	1	F-375-88C	WEGO M+M	1	D316464
16	DIRECTIONAL VALVE	1	DG4S4-018C-50	VICKERS	16	D316128
17	NEEDLE VALVE	4	N3432	MARSH	9	D316128
18	FILTER REPLEN.	1	A307917	WGC	6	D316128
19	FLOW CONTROL VALVE	1	F600S	PARKER	2	D316464
20	ELECTRIC MOTOR	1	A307886	WGC	3	D316128
21	THERMO VALVE	1	MODEL 3/4CM	AMOT CONTROLS	8	D316128
22	FILTER RETURN	1	A307918	WGC	5	D316128
23	HEAT EXCHANGER	1	F-302-HY-4P CNT-8	YOUNG	10	D316128
24	FILTER SUCTION	1	A307919	WGC	4	D316128
25	HYDRAULIC PUMP	1	A307924	WGC (DENISON)	11	D316128
26	HEATER	1	295528-ARMTO-2255E2T1	CHROMALOX	15	D316128
27	HYDRAULIC MOTOR	2	MF05-020-31	DENISON	140	D316127
28	HYDRAULIC BRAKE	2				D316127
29	RESERVOIR	1	D316390	WGC	2	D316128

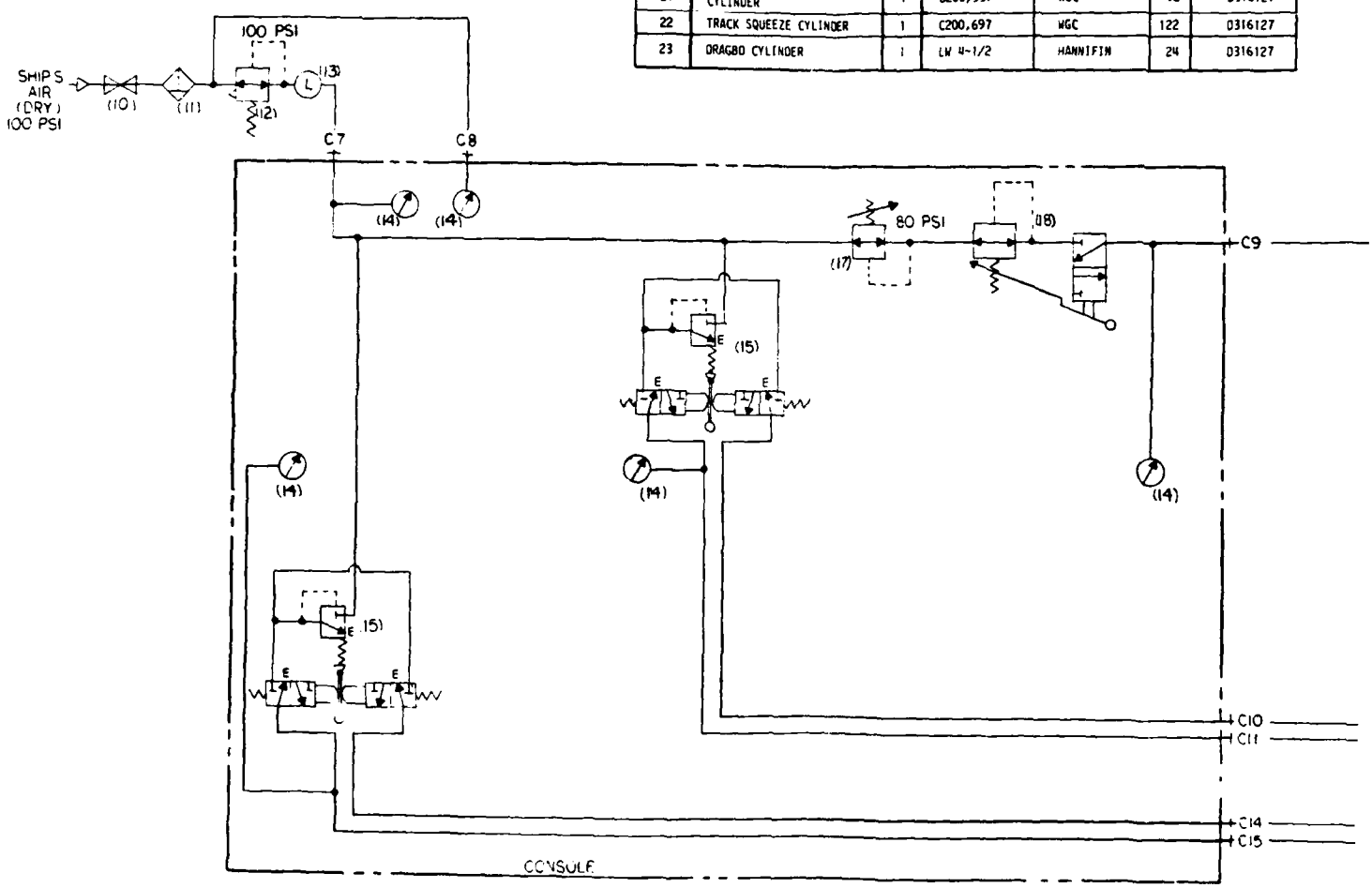
REFERENCE DRAWINGS:

1. WGC DWG. NO. D316405 OUTLINE & GENERAL ARRANGEMENT NAUBUC
2. WGC DWG. NO. D316583 PNEUMATIC SCHEMATIC NAUBUC.

D316371

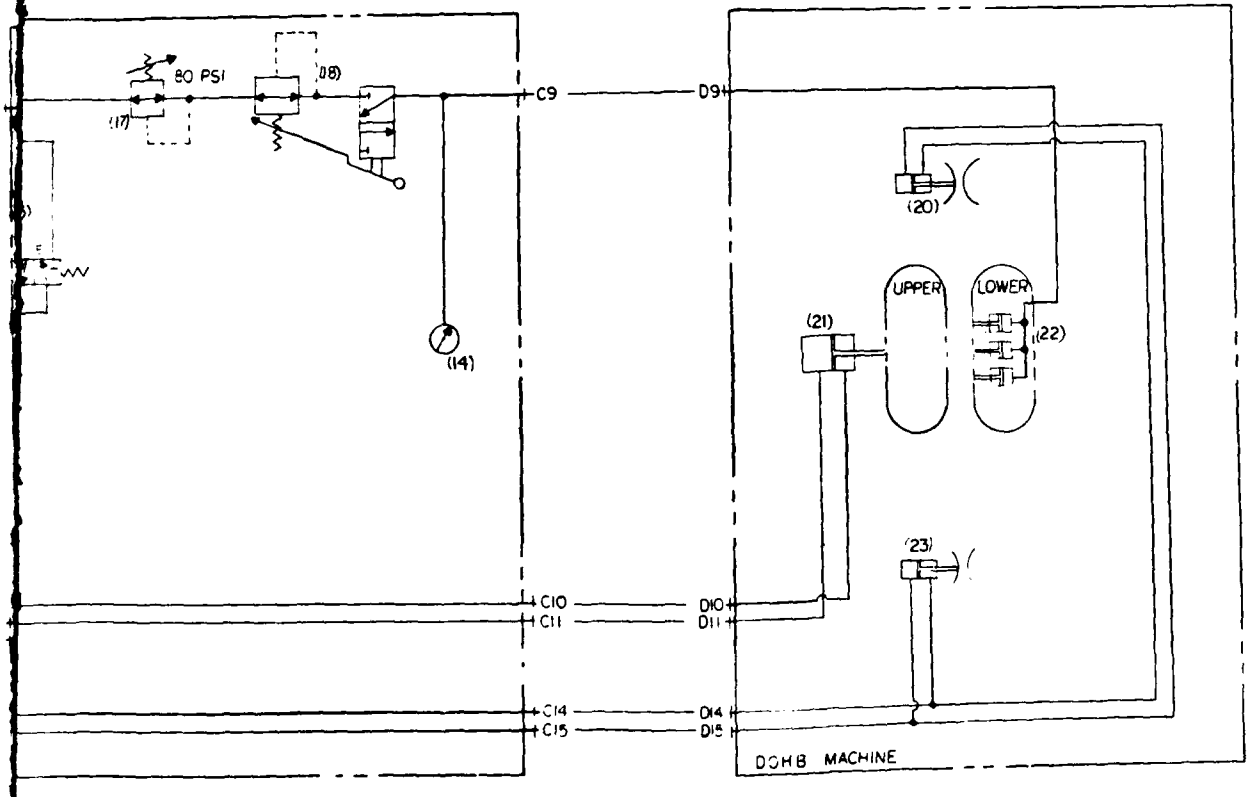
Figure 4-1. Hydraulic Schematic (Sheet 2 of 2)

ITEM NO.	NOMENCLATURE	QTY	PART OR DWG. NO.	NAME	F/N	USED ON
10	SHUT OFF VALVE	1	92598-4PP	CIRCLE SEAL	1	D316203
11	FILTER	1	PF7502-11004	WABCO	1	D316203
12	REGULATOR	1	PR7564-31004	WABCO	1	D316203
13	LUBRICATOR	1	PG7602-24004	WABCO	1	D316203
14	GUAGE	5	J775HP	MARSH	37	D316131
15	CONTROLAIR VALVE MODEL HC-2-FX	2	PS0976-0002	WABCO	14	D316131
17	REGULATOR	1	PR7564-31003	WABCO	11	D316131
18	CONTROLAIR VALVE MODEL H-2-FX	1	PS0494-0002	WABCO	13	D316131
20	DRAGBD CYLINDER	1	LW 4-1/2	HANNIFIN	24	D316127
21	UPPER FRAME SQUEEZE CYLINDER	1	D200,537	WGC	98	D316127
22	TRACK SQUEEZE CYLINDER	1	C200,697	WGC	122	D316127
23	DRAGBD CYLINDER	1	LW 4-1/2	HANNIFIN	24	D316127



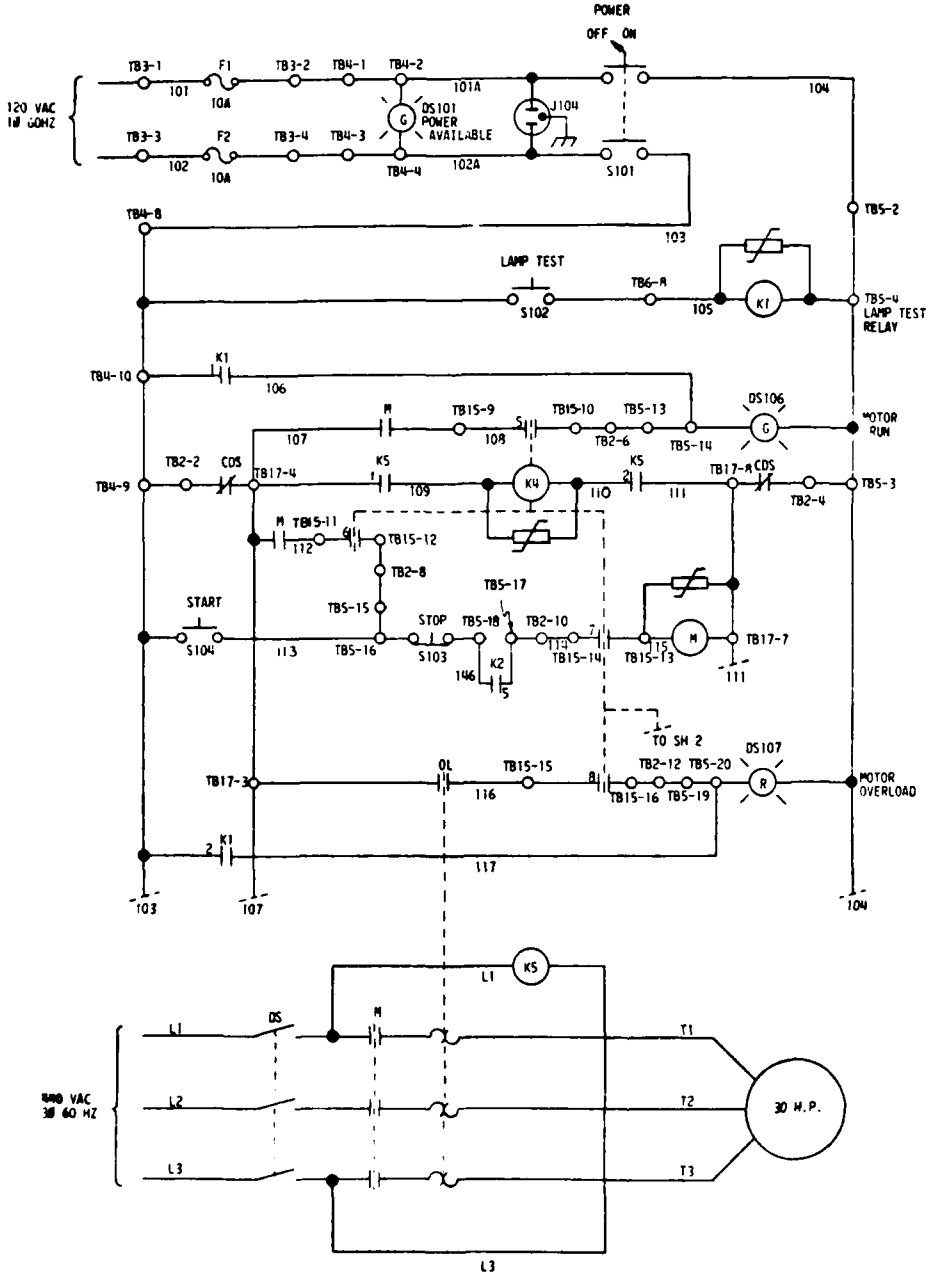
ATURE	QTY	PART OR DWG. NO.	NAME	F/N	USED ON
VALVE	1	92598-4PP	CIRCLE SEAL	1	D316203
	1	PF7502-11004	WABCO	1	D316203
R	1	PR7564-31004	WABCO	1	D316203
OR	1	PG7602-24004	WABCO	1	D316203
	5	J775HP	MARSH	37	D316131
IR VALVE -2-FX	2	P50976-0002	WABCO	14	D316131
OR	1	PR7564-31003	WABCO	11	D316131
AR VALVE 2-FX	1	P50494-0002	WABCO	13	D316131
YLINDER	1	LW 4-1/2	HANNIFIN	24	D316127
AME SQUEEZE	1	D200,537	WGC	98	D316127
EEZE CYLINDER	1	C200,697	WGC	122	D316127
YLINDER	1	LW 4-1/2	HANNIFIN	24	D316127

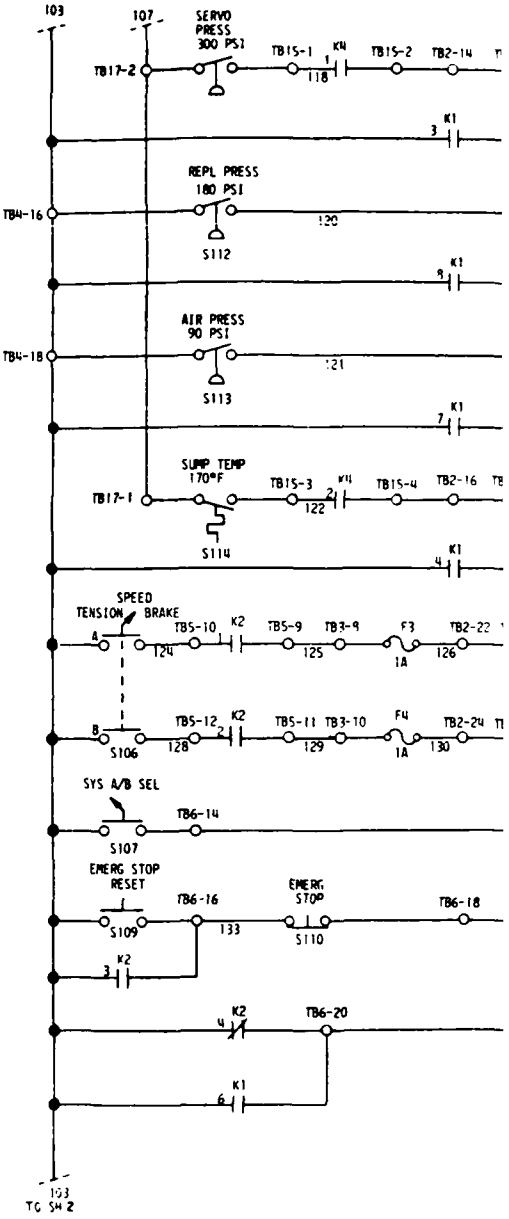
REFERENCE DRAWINGS:
1. WGC. DWG. NO. D316405 OUTLINE & GENERAL ARRANGEMENT NAUBUC
2. WGC. DWG. NO. D316371 HYDRAULIC SCHEMATIC NAUBUC



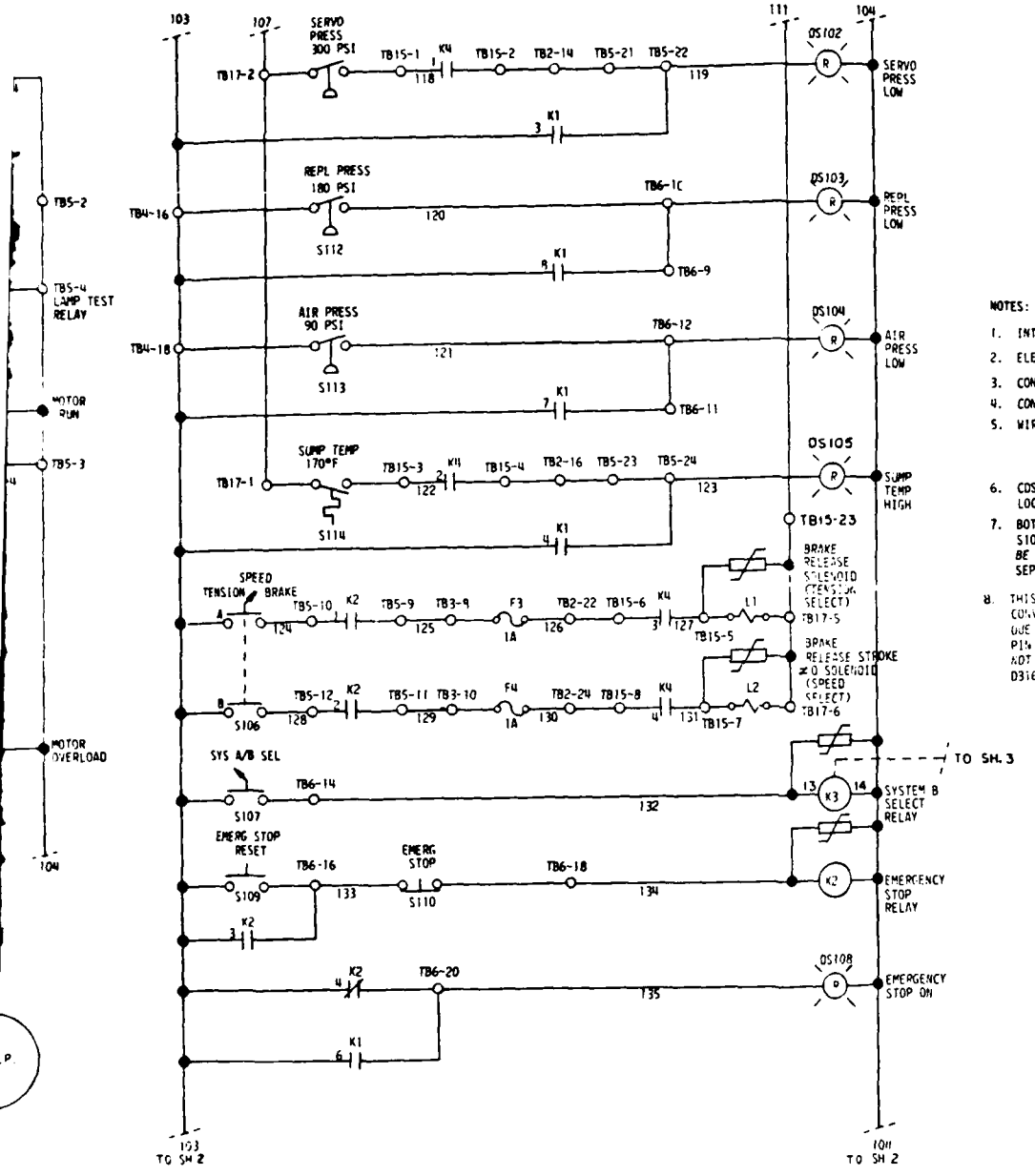
D316383

Figure 4-2. Pneumatic Schematic





REV. STATUS			
SHT	1	2	3
REV	B	A	A



NOTES:

1. INTERCONNECT WIRE LIST A307881.
2. ELECT. GENERAL ARRANGEMENT D316125.
3. CONSOLE WIRING DIAGRAM D316130.
4. CONSOLE ASSEMBLY D316131.
5. WIRE NUMBER DESIGNATIONS:
   100 SERIES - AC SIGNALS
   200 SERIES - DC SIGNALS
6. CDS CONTACTS ARE DOOR SWITCH INTERLOCKS LOCATED ON POWER UNIT MOTOR CONTROLLER.
7. BOTH AC & DC CIRCUITS ARE CONNECTED TO S106. WHEN WIRING AND TROUBLESHOOTING, *BE CAREFUL TO KEEP AC & DC CIRCUITS* SEPARATED FROM EACH OTHER.
8. THIS SYSTEM'S ELECTRICAL INTERCONNECT HAS BEEN CONVERTED TO CABLES WITH QUICK DISCONNECT FITTINGS. DUE TO SPACE LIMITATIONS PLUG, RECEPTACLE, AND PIN NUMBER IDENTIFICATION FOR THESE FITTINGS IS NOT SHOWN ON THIS DRAWING. REFER TO WGC DWGS D316125 AND A307881 FOR THESE IDENTITIES.

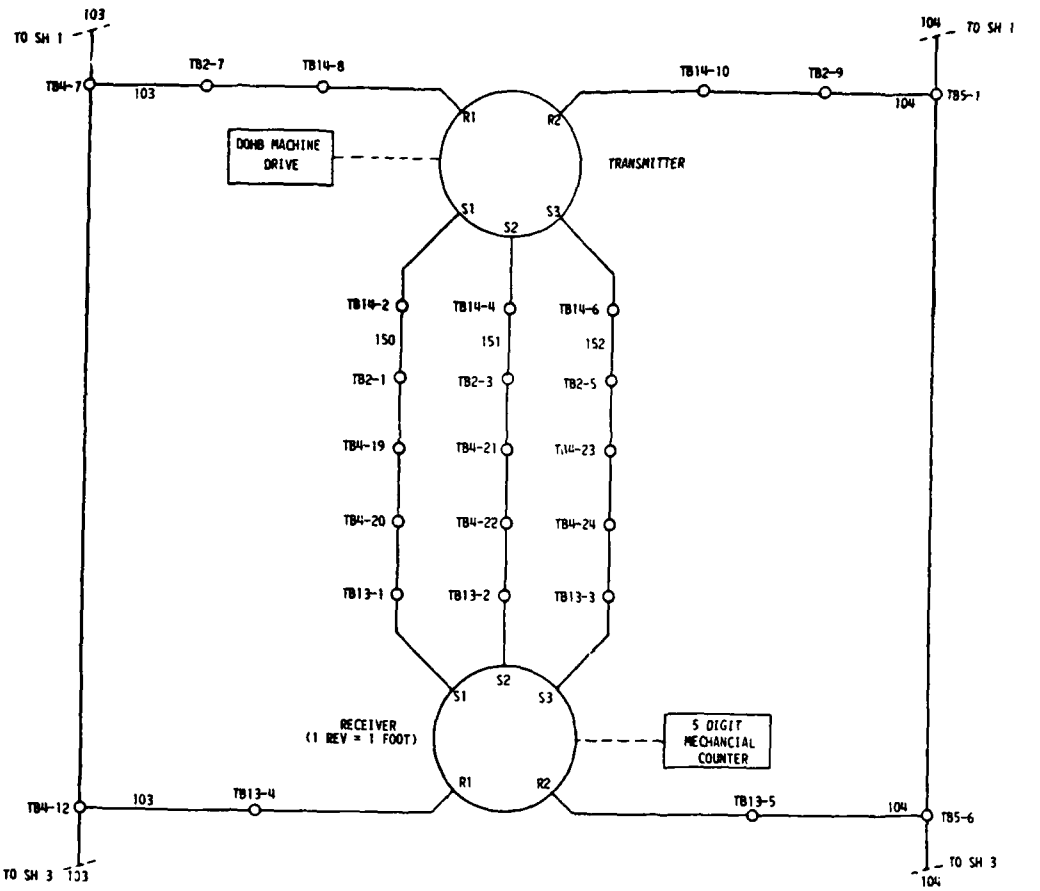
SEE NOTE 7

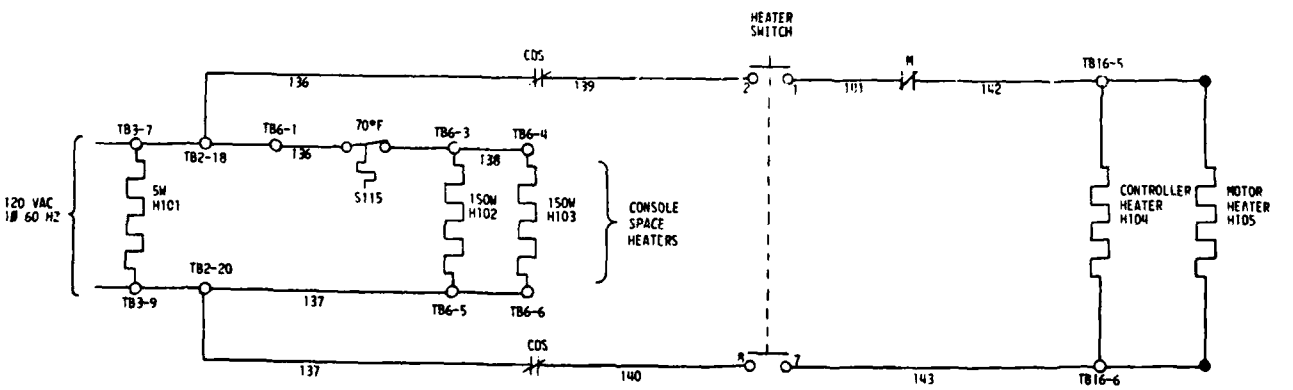
S106		
MODE	CONTACTS	
	A	B
TENSION	X	
SPEED		X
BRAKE		

REV. STATUS			
SHT	1	2	3
REV	B	A	A

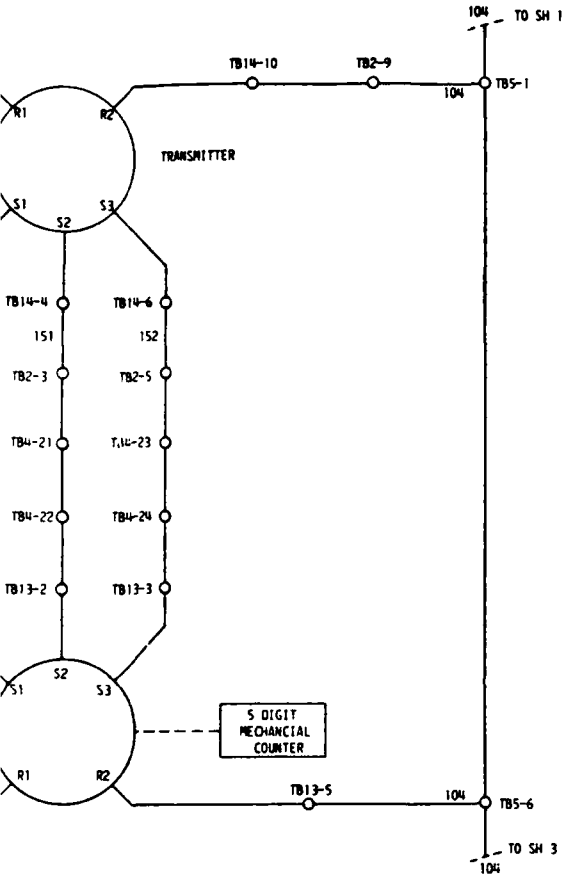
D316126B

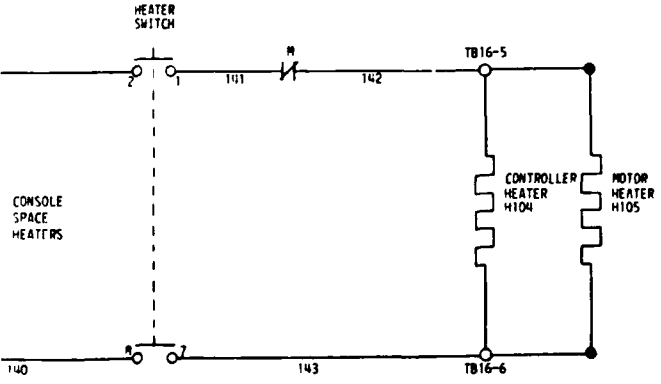
Figure 4-3. Electrical System Schematic (Sheet 1 of 3)

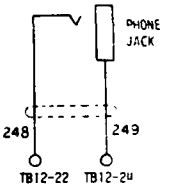

103
TO SH 1
TB4-7
TB2-7
TB14-8
103
DOHB MACHINE DRIVE
R1
R2
TRANSMITTER
S1
S2
S3
TB14-2
TB14-4
TB14-6
150
151
152
TB2-1
TB2-3
TB2-5
TB4-19
TB4-21
TB4-23
TB4-20
TB4-22
TB4-24
TB13-1
TB13-2
TB13-3
S1
S2
S3
RECEIVER
(1 REV = 1 FOOT)
5 DIGIT MECHANICAL COUNTER
R1
R2
TB4-12
103
TB13-4
TB13-5
104
TB5-6
TO SH 3
103
TO SH 3
104
104
TO SH 1
TB14-10
TB2-9
104
TB5-1


HEATER SWITCH
COS
136
139
2
1
M
101
142
TB16-5
TB3-7
TB2-18
TB6-1
136
70°F
TB6-3
TB6-4
138
120 VAC 1Ø 60 HZ
5W H1C1
S115
150W H102
150W H103
CONSOLE SPACE HEATERS
TB2-20
TB3-9
137
TB6-5
TB6-6
CONTROLLER HEATER H104
MOTOR HEATER H105
COS
137
140
8
7
143
TB16-6

Figur
(Shee







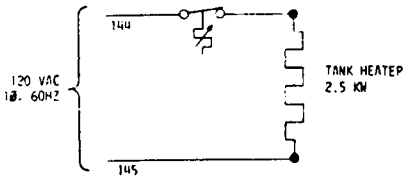


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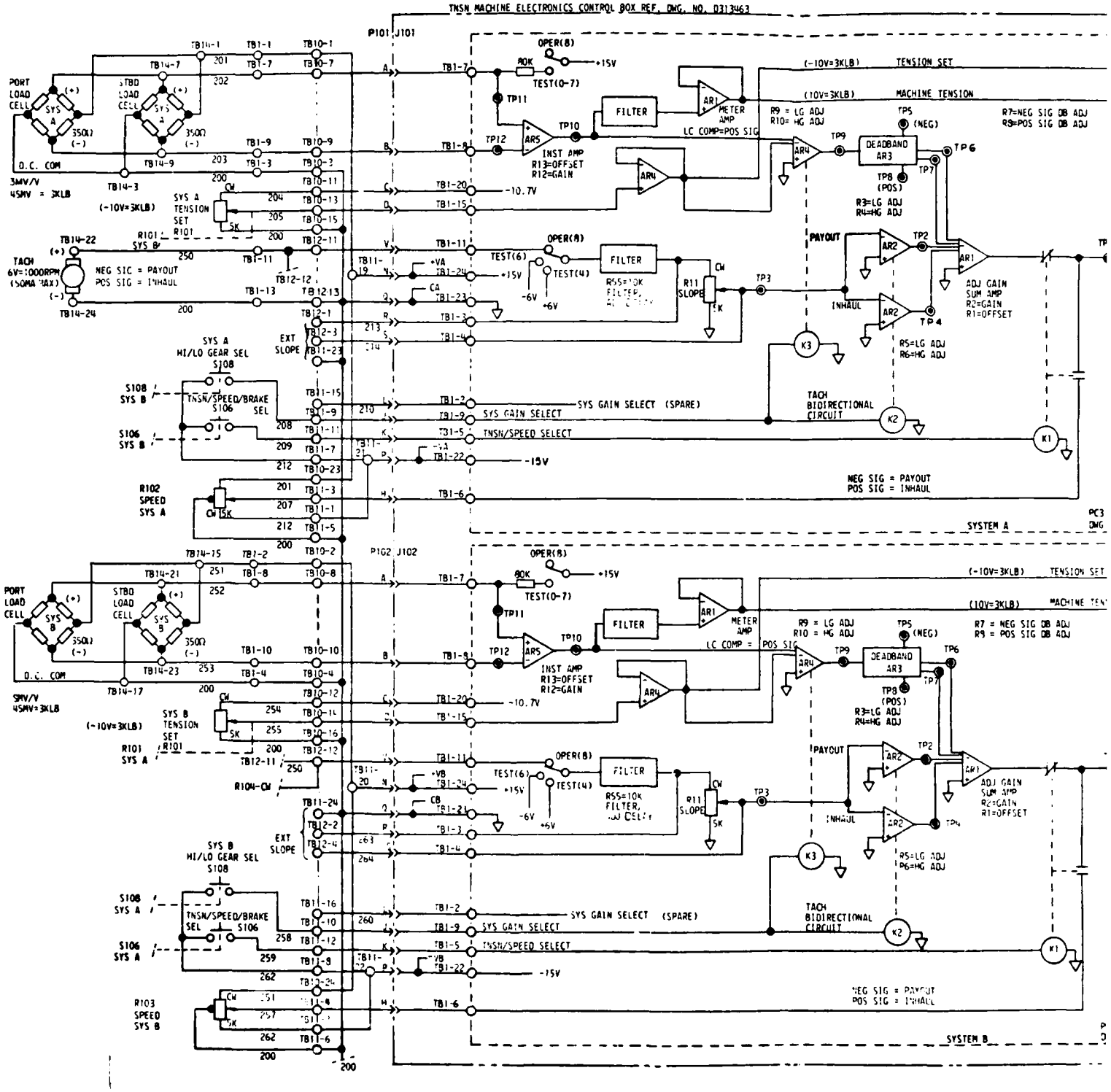
Figure 4-3. Electrical System Schematic (Sheet 2 of 3)


TNSN MACHINE ELECTRONICS CONTROL BOX REF. DWG. NO. D313463
P101 J101
P102 J102
PORT LOAD CELL
STBD LOAD CELL
SYS A
SYS B
350Ω
O.C. COM
3MV/V 45MV = 3KLB
(-10V=3KLB)
SYS A TENSION SET R101
SYS B TENSION SET R101
TACH 6V=1000RPM (50MA MAX)
NEG SIG = PAYOUT
POS SIG = INHAUL
SYS A HI/LO GEAR SEL S108
SYS B HI/LO GEAR SEL S108
TNSN/SPEED/BRAKE SEL S106
EXT SLOPE
R102 SPEED SYS A
R103 SPEED SYS B
OPER(B)
TEST(0-7)
TEST(6)
TEST(4)
FILTER
INST AMP R13=OFFSET R12=GAIN
METER AMP
LC COMP=POS SIG
LC COMP = POS SIG
(-10V=3KLB) TENSION SET
(10V=3KLB) MACHINE TENSION
R9 = LG ADJ R10= HG ADJ
R7=NEG SIG DB ADJ R8=POS SIG DB ADJ
DEADBAND AR3
R3=LG ADJ R4=HG ADJ
PAYOUT
INHAUL
ADJ GAIN SUM AMP R2=GAIN R1=OFFSET
R5=LG ADJ R6=HG ADJ
TACH BIDIRECTIONAL CIRCUIT
SYS GAIN SELECT (SPARE)
SYS GAIN SELECT
TNSN/SPEED SELECT
-10.7V
-15V
+15V
-6V
+6V
SYSTEM A
SYSTEM B

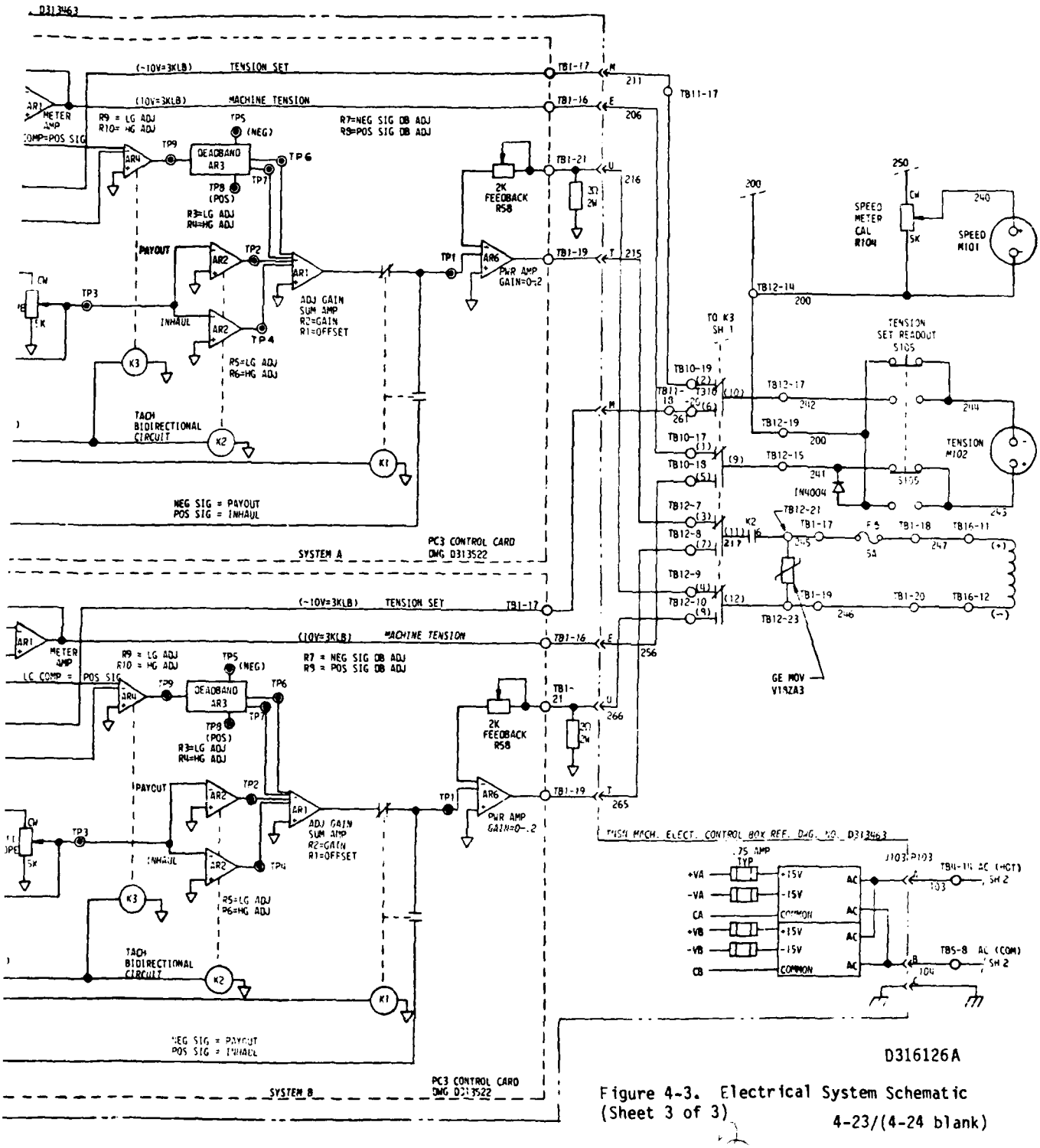


Figure 4-3. Electrical System Schematic (Sheet 3 of 3)

SECTION V

MAINTENANCE

5-1. INTRODUCTION.

5-2. This section of the manual contains instructions for preventive and corrective maintenance of the DOHB tension machines and power unit. Major components of the tension machine are identified in figure 1-1. Refer to the appendix at the back of the manual for maintenance procedures relating to vendor supplied equipment.

5-3. SAFETY PRECAUTIONS.

WARNING

High voltage in the DOHB tension machine power unit is sufficient to cause death.

1. Follow standard safety precautions when working on electrical, pneumatic, hydraulic, and mechanical equipment.

2. Before repairing electrical components, ensure that electrical power source is OFF and tagged. If absolutely necessary to have the power applied, use instruments rated for high voltage.

3. Tag the control panel, motor controller, and equipment DO NOT ENERGIZE when performing maintenance.

4. Ensure that the work area is safe and clear of unnecessary personnel and equipment.

5. Before disconnecting hydraulic or pneumatic lines, depressurize the system and slowly bleed pressure from the lines.

5-4. PREVENTIVE MAINTENANCE.

5-5. Preventive maintenance consists of maintaining the equipment in clean, ready-to-operate condition. A good preventive maintenance program can reduce the frequency of unscheduled repairs and down time caused by equipment failure. Therefore, to ensure trouble-free service of the DOHB tension machines and power unit, a scheduled maintenance procedure shall be followed in accordance with table 5-1. Thus potential malfunctions and defective parts can be found before they cause trouble and/or equipment breakdown. Also, a lubrication and maintenance log shall be kept with entries made of all lubrications and maintenance actions performed.

5-6. INSPECTION. Periodically inspect the tension machines and power unit in accordance with table 5-2. Inspect internal parts whenever disassembly is required for repair or replacement. Disassembly is not required unless there is a known malfunction or a suspicion of one.

Table 5-1. Preventive Maintenance Schedule

TIME SCHEDULE	PROCEDURE
Prior to initial startup.	Fill hydraulic motor and hydrulic pump housings in accordance with figures 5-1 and 5-2.
Prior to every operation.	INSPECT: a. Tension machines and power unit surfaces for dirt. b. Tension machine and power unit for excess buildup of grease. c. Tension machine and power unit for foreign objects. d. Tension machine and power unit for security of mounting. e. Tension machine and power unit components for security of mounting. f. Gear reducers oil level. g. Electric motors for blockage of cooling air and evidence of misalignment, bearing wear, or overheating. Clean and repair as necessary. h. Pneumatic and hydraulic lines, fittings, and connections for leaks, abrasions, cracks, and other damage and deterioration. j. Hydraulic tanks fluid level. k. Controls for ease of movement.
During operation.	INSPECT: a. Cable for proper lay. b. Hydraulic and electric motors for signs of overheating.
After operation.	INSPECT: a. Tension machine and power unit components mount bolts for security. b. Gear reducers oil level. c. Hydraulic tanks fluid level.
Every 100 hours of operation.	INSPECT: a. Machinery outer surfaces for rust, corrosion, paint scaling. b. Bare exposed surfaces for proper coating of grease (completely covered). c. Machinery for excessive buildup of dirt.

Table 5-1. Preventive Maintenance Schedule (Cont)

TIME SCHEDULE	PROCEDURE
Every 100 hours of operation. (Cont)	INSPECT: d. Mount bolts for security. e. Condition and tension of tracks. Take up tension where required and maintain sprocket alignment. Keep these parts clean and well lubricated. f. For loose connections or clamps and damaged wiring. Repair or replace as necessary. g. The electric motor for blockage of cooling air and evidence of misalignment, bearing wear, or overheating. Clean and repair as necessary. h. Components for visible structural damage. j. Controller enclosure for mechanical and electrical integrity. If dust, lint, or other foreign matter is present, deenergize the equipment and remove the foreign matter. Use a vacuum cleaner if available. LUBRICATE: Tension machine components as required in accordance with figure 5-1.
After first 150 hours of operation.	Drain and refill reducers in accordance with figure 5-1.
Every 6 months.	Replace system suction filter element (D, figure 5-2 and 58, figure 6-8).
As required by operating conditions (see appendix).	Lubricate electric drive motor.
Annually.	Drain and clean hydraulic system. Replace hydraulic fluid in accordance with figure 5-2.
Every 2,500 hours of operation.	Drain reducers and check for the presence of metal particles. If metal particles are found, inspect to determine the source. Disassemble and repair as required. Refill reducers in accordance with figure 5-1.
Every three years.	Disassemble, clean, and repack the power unit coupling in accordance with figure 5-2.

Table 5-2. Inspection Guide

1. DOHB tension machines.	Inspect for rust and chipped paint. Remove rust and scale and touch up paint where required. Periodically clean and lubricate. Check for overall security of subassemblies, mounting fasteners, and adjustments. Tighten all loose nuts and bolts and ensure that track adjustments are secure.
2. Power unit.	Inspect for rust and chipped paint. Remove rust and scale and touch up paint where required. Check for accumulated dirt, grease, and oil, especially around moving parts. Remove excess lubricant and foreign material.
3. Hydraulic and pneumatic piping, flanges, and connections.	Check for leakage. Depressurize the system and check leaking connections for security. Tighten loose fittings. Replace O-rings and/or fittings where necessary.
4. Hydraulic pumps and motors shaft seals.	Inspect for evidence of leakage. Replace shaft seals if leaking.
5. Hydraulic pump and motor.	Check for unusual noises, vibration, and overheating. Check mounting bolts to ensure that units are secured. Check areas around shaft bearings for overheating by feeling with your hand. Unusual noises from a pump or motor may be caused by air in the system or by cavitation.

WARNING

To prevent injury to personnel or damage to the equipment, stay away from machine moving parts when the equipment is in operation. Shut down the power unit(s), switch off electrical power, and attach tags to controls to prevent operation when making adjustments and repairs.

5-7. CLEANING AND PARTS INSPECTION. Observe the following precautions when cleaning machinery components and detail parts.

WARNING

Do not breathe cleaning solvent vapors. The toxic effect of some solvents is cumulative. Continued inhalation may lead to permanent disability or death.

When using flammable cleaning solvents, take all appropriate fire safety precautions to prevent injury to personnel and damage to equipment.

Do not direct compressed air against any part of the body. High pressure air can cause injuries. Do not rotate ball or roller bearings with compressed air. Do not direct compressed air against a fire; this will spread the fire and increase the rate of burning.

5-8. Clean all metal parts using a treated or refined solvent which has a boiling range of 310 to 400°F (160 to 205°C) and a flash point above 100°F (38°C) (Shellsol 345, Stoddard solvent, Federal Specification P-D-680 or equivalent). Use a fiber bristle brush where necessary. Dry parts with a clean, dry cloth or clean, dry compressed air. Turn ball and roller bearings by hand only. When parts are exposed during disassembly, perform the following:

1. In gears and shafts, check the fit of all keys in respective keyways. Replace worn keys. Oversize keyways may be fitted with oversize keys and should be machined if necessary.

2. Inspect pistons, cylinders, and rods of hydraulic components for scored areas, scratches, cracks, and evidence of foreign material. Remove all scratches and nicks in cylinders, pistons, and rods of hydraulic equipment only if the repaired area will not interfere with operation of equipment or cause leakage. Otherwise, damaged parts must be replaced.

3. Inspect all ball and roller bearings and races for cracks, chips, corrosion, brinneling, and other signs of fatigue and abnormal wear. Bearings should rotate freely and smoothly by hand. *Bearings are not reparable and must* be replaced if defective in any way.

4. Check bushings for damage and excessive wear. Minor damage may be repaired by filing and burnishing to a finish equal in smoothness to the original.

5. Check gears and shafts for broken teeth, nicks, cracks, and abnormal wear. Repair damaged areas by filing or grinding smooth and sanding to a finish

equal in smoothness to the original. If damage cannot be removed without affecting the strength, reliability, or safety of the part, or the subassembly as a whole, the damaged part must be replaced.

6. Replace all gaskets and O-rings of components which are disassembled.

5-9. LUBRICATION. Lubricate the DOHB tension machine and power unit components in accordance with figures 5-1 and 5-2.

5-10. FLUID MAINTENANCE.

5-11. INTRODUCTION. Optimum life from the hydraulic equipment supplied by Western Gear Corporation to its customers can be obtained only with proper hydraulic fluid maintenance. This includes checking the fluid at the time of installation and at properly determined intervals thereafter. The fluid should be evaluated for: (1) particle contamination, (2) water contamination, (3) pH value, and (4) viscosity. Of all of the fluid qualities which must be evaluated in a properly maintained hydraulic system, control and detection of particle contamination can be the most critical. Most hydraulic fluids are expensive and changing the fluid in a system and flushing or cleaning an improperly maintained system is costly and time consuming. Therefore, it is very important to ensure proper fluid cleanliness levels. Keeping fluid clean and free from particle contamination can be achieved in a properly executed fluid maintenance program.

5-12. FLUID STORAGE AND HANDLING. To prevent contamination of hydraulic fluid during storage and handling, follow these simple rules:

1. Store drums on their sides and, if possible, keep them inside or under a roof.

2. Before opening a drum, clean the top and bung thoroughly so that no dirt can get into the fluid.

3. Use only clean containers, hoses, and other equipment to transfer fluid from a drum to a hydraulic reservoir. Use a transfer pump equipped with a proper micron filter (nominally 10 microns or finer). The hose between filter and reservoir must be given special attention.

5-13. IN-OPERATION CARE. Proper hydraulic fluid maintenance includes the following:

1. Keep the reservoir filled to the proper level to prevent moisture from condensing on inside walls and to take advantage of a full reservoir's heat dissipating characteristics.

2. Repair all leaks immediately. Prevent contamination by keeping the system tight.

3. Establish a fluid sampling interval in accordance with the procedures given in paragraph 5-14.

4. Establish a fluid change interval so as to replace fluid before it breaks down. Use the fluid sampling data as a guide to establishing change intervals.

5. Establish a filter maintenance schedule which is compatible with the conditions under which the equipment is operated.

6. Do not operate the system unless all filtration devices are installed and properly serviced.

7. When changing filter elements, inspect the elements and filter housings for particles (size, material, or quantity) which may indicate impending component failure.

8. Watch and listen to the system operate. Investigate unusual actions or sounds that could indicate problems.

5-14. HYDRAULIC FLUID SAMPLING. System hydraulic fluid must be sampled periodically during operation to determine that the fluid meets cleanliness levels specified for the system. When taking samples, observe the following procedure:

1. Take the sample from the system's main loop and sufficiently down stream from the power unit(s) to ensure that a true sample is acquired. Use only surgically clean sample bottles (bottles can be obtained from WGC or drug supply house).

2. Allow enough fluid to run out at the sampling point to thoroughly flush the valve and piping before the sample is taken.

3. Take the first sample before operation under load is begun. If the cleanliness level does not meet the required level specified, refilter the fluid to the required cleanliness level before proceeding with operation under load. When refiltering the fluid, use the equipment's filtration system or an auxiliary filtration system. Use a centrifuge, if necessary, to remove excess moisture.

4. Take another sample within one hour of starting operation under load. Again, filter the fluid if necessary.

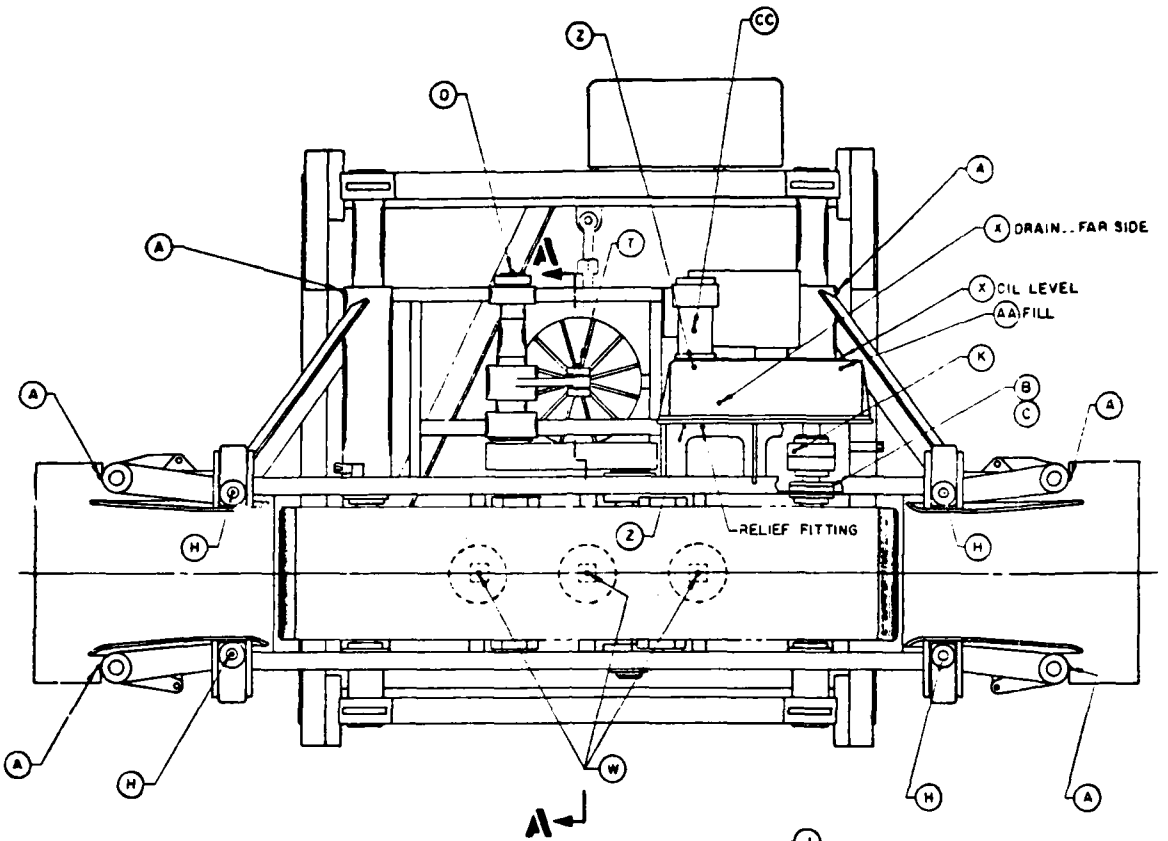
5. Take another sample after four hours of operation under load. If this sample is satisfactory the system can be considered acceptable for service.

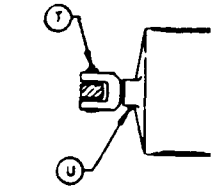
6. Take samples at weekly intervals for three or four weeks to verify that the system is continuing to remain in satisfactory condition.

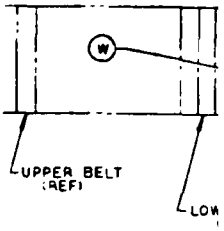
7. If the weekly samples are satisfactory, check the cleanliness level on a monthly basis to assure that the system fluid remains in satisfactory condition.

8. At yearly intervals (6 months if the oil operating temperature exceeds 160°F/71.1°C), make a complete laboratory analysis of the fluid to verify that viscosity, pH value, and strength of additives (if any) remain within the supplier's tolerances.

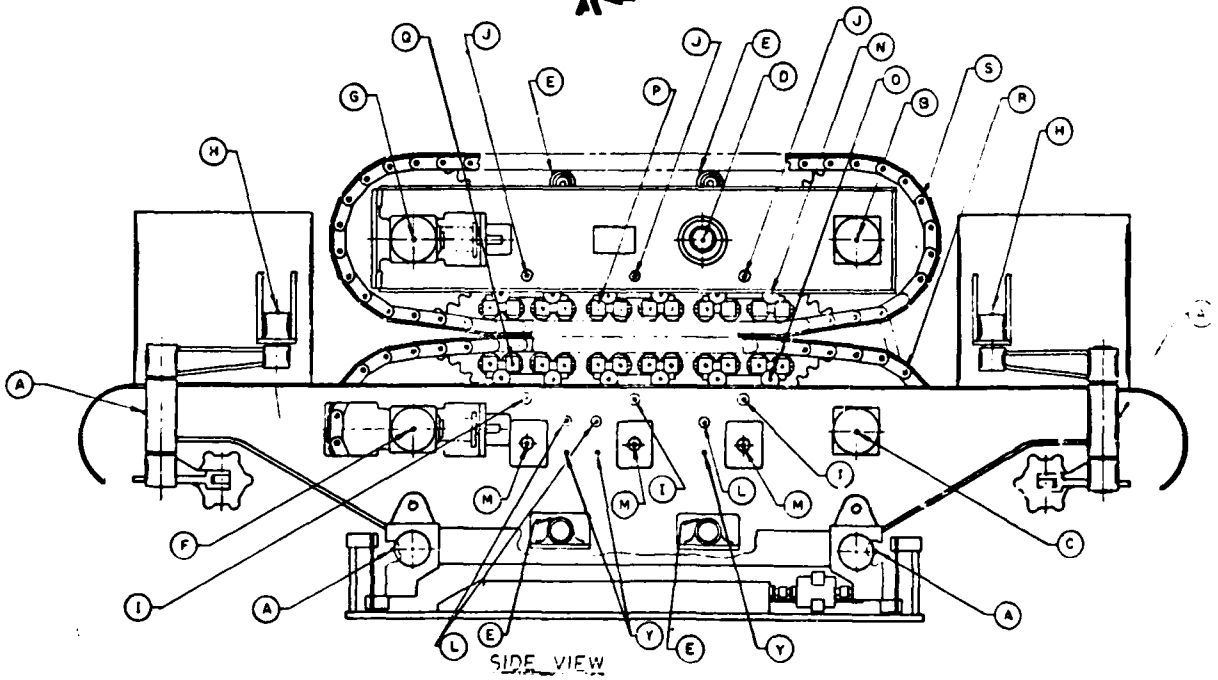
9. See table 2-1 for the maximum contamination limits allowable for the hydraulic fluid to meet various classes of NAS 1638.

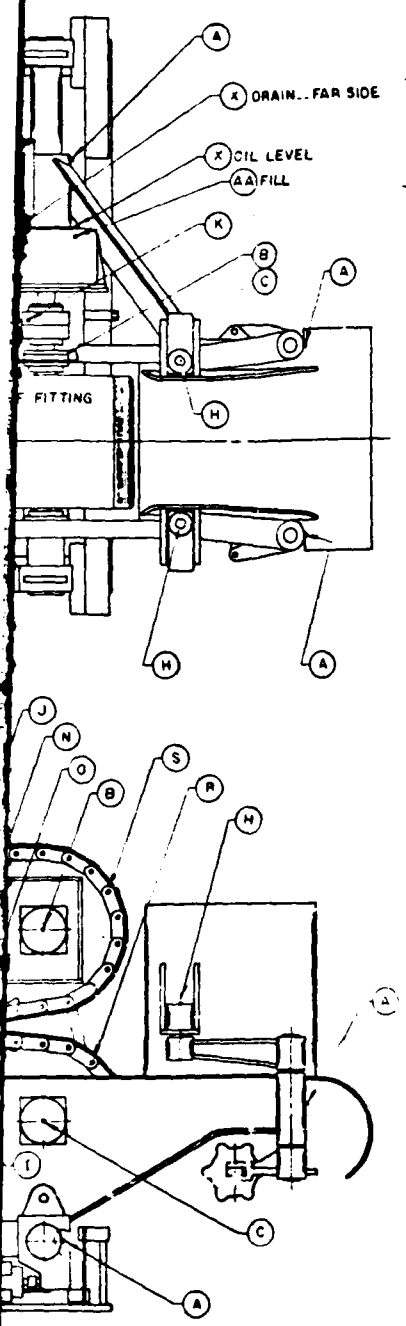


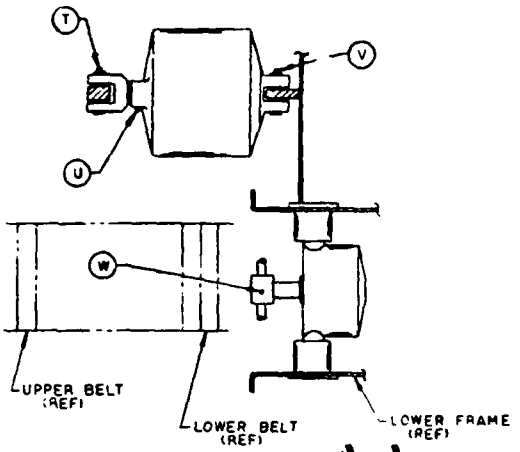




APP AT	UNIT NAME
A	LOWER FRAME
B	UPPER DRIVE SHAFT
C	LOWER DRIVE SHAFT
D	LEVER SHAFT
E	PRESS ROLL SHAFT
F	LOWER IDLER SHAFT
G	UPPER IDLER SHAFT
H	CARRIER
I	LOWER EQUIL. SHAFT
J	UPPER EQUIL. SHAFT
K	COUPLING
L	ROCKER SHAFT
M	CARTRIDGE
N	UPPER ROLL FRAME SHAFT
O	LWR ROLL FRAME SHAFT
P	UPPER ROLLER SHAFT
Q	LOWER ROLLER SHAFT
R	LOWER BELT TAK P.N.
S	UPPER BELT TAK P.N.
T	PRESS CYL P.N.
U	PISTON ROD
V	LOWER PRESS CYL P.N.
W	CYLINDER ROD
X	REDUCER
Y	CYLINDER SHAFT
Z	REDUCER
AA	REDUCER
BB	
CC	HYD MOTOR HOUSING







SECTION A-A

NOTES:

1. ONE (1) FITTING ON EACH SIDE OF FRAME.
2. TWO (2) COUPLINGS. ONE FITTING ON EACH.
3. SIX (6) FITTINGS ON EACH SIDE OF FRAME.
4. TWELVE (12) FITTINGS ON EACH SIDE OF FRAME.
5. 104 FITTINGS ON EACH SIDE OF BELT.
6. PACK SPACE BETWEEN BEARINGS AT ASSEMBLY. (TYP 3 CYLINDERS)
7. FILL AND MAINTAIN OIL LEVEL WITHIN .25 INCH OF OIL LEVEL PORT. CHANGE OIL AFTER FIRST 150 HRS. OF OPERATION AND EVERY 2500 HRS. THEREAFTER.
8. REFILL ALL BEARING GREASE RESERVOIRS AND COAT [illegible] WITH GREASE EACH TIME THE MACHINE IS [illegible] AFTER EXTENDED USE.

LUBRICATION INSTRUCTIONS

APPAT	UNIT NAME	FITTING TYPE	FITTING QTY	LUBRICATION KIND	LUBRICATION QTY	SPEC	SYMBOL	FREQUENCY OF LUBE
A	LOWER FRAME	ALEMITE	8	GREASE	AS REQD		MIL-G-4037	100 HRS OF SERVICE
B	UPPER DRIVE SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
C	LOWER DRIVE SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
D	LEVER SHAFT	ALEMITE	2	GREASE	AS REQD			
E	PRESS ROLL SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
F	LOWER IDLER SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
G	UPPER IDLER SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
H	CARRIER	ALEMITE	4	GREASE	AS REQD			
I	LOWER EQUAL. SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
J	UPPER EQUAL. SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
K	COUPLING	ALEMITE	NOTE 2	GREASE	AS REQD			
L	ROLLER SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
M	CARTRIDGE	ALEMITE	NOTE 1	GREASE	AS REQD			
N	UPR ROLL FRAME SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
O	LWR ROLL FRAME SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
P	UPPER ROLLER SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
Q	LOWER ROLLER SHAFT	ALEMITE	NOTE 1	GREASE	AS REQD			
R	LOWER BELT LINK PIN	ALEMITE	NOTE 1	GREASE	AS REQD			
S	UPPER BELT LINK PIN	ALEMITE	NOTE 1	GREASE	AS REQD			
T	PRESS CYL PIN	ALEMITE	1	GREASE	AS REQD			
U	PISTON ROD	ALEMITE	1	GREASE	AS REQD			
V	LOWER PRESS CYL PIN	ALEMITE	1	GREASE	AS REQD		MIL-G-4037	100 HRS OF SERVICE
W	CYLINDER ROD	NONE	NOTE 5	GREASE	AS REQD		MIL-G-4037	AT MACHINE OVERHAUL
X	REDUCER	PLUG	2	OIL	SEE NOTE 7		SAE 80	NOTE 7
Y	CYLINDER SHAFT	ALEMITE	3	GREASE	AS REQD		MIL-G-4037	50 HRS OF SERVICE
Z	REDUCER	ALEMITE	2	GREASE	AS REQD		MIL-G-4037	100 HRS OF SERVICE
AA	REDUCER	AIR VALVE	1	OIL	NOTE 7		SAE 80	NOTE 7
BB								
CC	HYD MOTOR HOUSING	PLUG	2	HYD FLUID	AS REQD	MIL-L-17672	21 C TH	FILL PRIOR TO START

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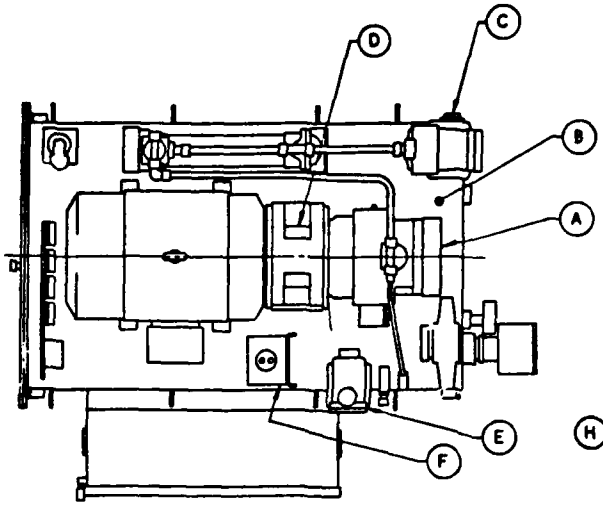
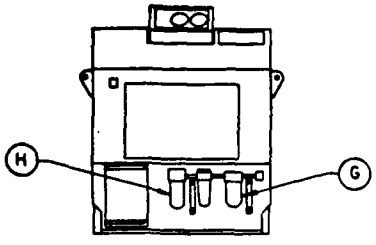
Figure 5-1. Lubrication Diagram - DOHB Machine



PLAN VIEW-POWER UNIT



END VIEW - CONTROL CONSOLE

NOTES:

1. FILL HYDRAULIC PUMP BEFORE INITIAL START. CHECK LEVEL BEFORE STARTING AFTER EXTENDED SHUTDOWNS. DRAIN AND REFILL EACH TIME OIL IN HYDRAULIC RESERVOIR IS CHANGED.
2. REPLACE FILTER ELEMENT SEMI-ANNUALLY OR WHEN INDICATED ON FILTER.
3. CLEAN ELEMENT WITH MINERAL SPIRITS EVERY 100 HRS OF SERVICE.
4. EVERY 100 HRS OF SERVICE REMOVE BOTH PLUGS AND LOCATE LUBE HOLES HORIZONTALLY. PUMP GREASE IN ONE HOLE UNTIL CLEAN GREASE APPEARS IN THE OTHER HOLE. DISASSEMBLE, CLEAN AND REPACK EVERY THREE (3) YEARS.

LUBRICATION INSTRUCTIONS								
APPAT	NAME OF PART	FITTINGS QTY	FITTINGS TYPE	KIND	QTY	SPEC	SYMBOL	FREQUENCY OF LUBE
A	HYDRAULIC PUMP	1	DRAIN PIPE	OIL	AS REQD	MIL-L-17672	2110 TH	NOTE 1
B	HYDRAULIC RESERVOIR	1	FILLER CAP	OIL	120 GAL	MIL-L-17672	2110 TH	MAINTAIN OIL LEVEL
C	RETURN FILTER	1	FILTER					NOTE 2
D	COUPLING	2	PIPE PLUG	GREASE	AS REQD		HI MELT 4037	NOTE 4
E	SUCTION FILTER	1	FILTER					NOTE 2
F	SERVO FILTER	1	FILTER					NOTE 2
G	AIR LINE FILTER		NONE					NOTE 3
H	AIR LINE LUBRICATOR		NONE	OIL	AS REQD		SAE 10W	AS REQD

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Figure 5-2. Lubrication Diagram - DOHB Power Unit

10. Refer to appendix B for procedures to perform the particle count.

5-15. CORRECTIVE MAINTENANCE.

5-16. INTRODUCTION. Remove and disassemble only to the extent necessary to perform required maintenance actions, repair, or replacement procedures. Before disassembling a component suspected of malfunctioning, operate it under load if possible and determine the trouble. Refer to the troubleshooting tables in section IV for additional information. When disassembling hydraulic components, prevent contamination and loss of fluid by capping all open lines and fittings after disconnection. Assembly procedures are, with few exceptions, the reverse of disassembly procedures. Tighten all fittings and fasteners in accordance with standard tightening procedures unless otherwise noted.

WARNING

Before removing hydraulic and pneumatic components, remove electrical power and pneumatic/hydraulic pressure and tag system controls to prevent operation. Depressurize the hydraulic and pneumatic systems and slowly bleed pressure from the lines before disconnecting.

5-17. UPPER OR LOWER TRACK REMOVAL. See figure 6-2. Some repair actions will require the removal of the track from the upper and/or lower track assembly. Remove a track as follows:

NOTE

To remove the lower track, raise the upper frame and secure in the raised position.

1. Loosen the track by adjusting the track tightener adjusting screw (6), figure 6-1.

2. Unfasten two hex head bolts and jam nuts (1 and 2, figure 6-2), securing pad (7) on two adjacent links.

3. Remove both pads (7) and support plates (10).

4. Remove a pipe plug (3) and insert a special tool with an 1/8-27 NPT male threaded end. Attach tool to track pin (6) and pull out.

5. Remove other pipe plug (3) and track pin (6).

6. Separate track links (9) and remove the track.

7. Reinstall the track in the reverse order of removal.

5-18. IDLER SHAFT DISASSEMBLY. See figure 6-1. Remove either idler shaft (73) as follows:

1. Remove the track in accordance with paragraph 5-17.

2. Remove six capscrews (33) and lockwashers (34) securing each bearing cap (60 and 74) and remove the bearing caps. This exposes bearings (61).

3. Unfasten snapring (79).

4. If upper idler shaft (73) is being removed, remove two nuts (39), lockwashers (38), and bolts (37) securing each end plate (9) and remove the end plates.

5. Support idler shaft (73) and slide the idler assembly forward until bearing housings (72 and 78) are free. Take care not to lose compression springs (8).

6. Remove bearing housings (72 and 78) along with bearings (61) and seals (53).

7. Use a bearing puller to extract bearing (61) from the bearing housing (72 or 78) when necessary for replacement.

8. Press out seals (53) from bearing housings (72 or 78) when necessary for replacement.

9. Remove idler shaft (73) with sprockets (5), and sprocket hub (55) attached.

10. Remove bolts (88), nut (39), and lockwashers (38) securing sprockets (5). Remove both sprockets (5) and keys (56) from idler sprocket hub (55).

11. Press idler shaft (73) from sprocket hub (55).

12. Inspect and replace or repair damaged or worn idler shaft components. Then reassemble the idler shaft in the reverse sequence of disassembly.

5-19. DRIVE SHAFT DISASSEMBLY. See figure 6-1. Remove either drive shaft (59) as follows:

1. Remove the track in accordance with paragraph 5-17.

2. Unfasten the capscrews and separate coupling (47) halves.

3. Remove six capscrews (33) and lockwashers (34) securing bearing cap (60) and remove the bearing cap. Remove snapring (79).

4. Support the drive shaft assembly.

5. Remove four capscrews (151), nuts (80), and lockwashers (22) securing bearing housing (58). Remove bearing housing (58) with bearing (61) and seal (53). When necessary for replacement, use a bearing puller to extract the bearings; and press the seal out of the housing.

6. Remove six capscrews (33) and lockwashers (34) securing cover (49). Remove four capscrews (151), nuts (80), and lockwashers (22) securing bearing housing (52).

7. Carefully move drive shaft (59) outboard and remove coupling (47) half, key (48), bearing cover (49), and bearing housing (52) from drive shaft (59). Seal (50) may be pressed from cover (49) when necessary for replacement. When necessary for replacement, use a bearing puller to extract bearing (61) and press seal (53) out of bearing housing (52).

8. Remove drive shaft (59), sprockets (5), and sprocket hub (55).

9. Remove bolts (88), nuts (39), and lockwashers (38) securing sprockets (5). Remove both sprockets (5) from sprocket hub (55).

10. Press drive shaft (59) from sprocket hub (55).

11. Inspect and replace or repair damaged or worn drive shaft components. Then reassemble the drive shaft in the reverse sequence of disassembly.

5-20. UPPER SUPPORT ROLLERS DISASSEMBLY. See figure 6-1. Remove and disassemble upper support rollers as follows:

1. Remove the upper track in accordance with paragraph 5-17.

2. Remove two bolts (44), lockwashers (34), and nuts (42) securing each upper pillow block (43). Remove pillow blocks (43) and pressure rollers (71).

3. Remove retainers (170) and remove pillow blocks (43) from pressure roller (71).

4. Repair or replace any damaged components. Reassemble the pressure roller in the reverse sequence of disassembly.

5-21. UPPER PRESSURE ROLLERS REMOVAL AND DISASSEMBLY. See figure 6-1. Remove and disassemble the upper pressure rollers as follows:

1. Remove the upper track in accordance with paragraph 5-17.

2. Remove snapring (66) and washer (65) from each end of rocker shaft (64).

3. Remove a grease fitting (45) from either end of shaft (64) and tap out the shaft from upper roller frames (19).

4. Remove the upper pressure roller assembly.

5. Flange bushings (67) and bushings (68) are exposed.

6. Disassemble the upper pressure rollers in accordance with paragraph 5-24.

7. Reassemble the upper pressure roller assembly in the reverse sequence of disassembly.

5-22. TRACK CYLINDERS DISASSEMBLY. See figure 6-1. Remove and disassemble the track cylinders as follows:

1. Remove the lower track in accordance with paragraph 5-17.

2. Refer to paragraph 5-23 and remove the lower pressure roller assemblies.

3. Disconnect lubricator hose (155) to cylinder head (119).

4. Disconnect connector (156) and tubing (157) to cylinder head (119).

5. Support the cylinder before continuing disassembly.

6. Remove four capscrews (35) and lockwashers (22) securing each cartridge (130). Carefully remove cartridges (130) from cylinder head (119). Removal of the cartridges exposes bushings (132) for replacement.

7. Remove the track cylinder from lower frame (2).

8. Remove eight nuts (42) and lockwashers (34) from studs (41) and separate cylinder heads (119 and 123). This releases cylinder (122) with O-rings (128) and exposes the internal cylinder components.

9. Remove cotter pin (102) and slotted nut (101). Then remove lockwire (169) and capscrews (168) from spacer (164) and remove along with piston (121). O-ring (129) may be replaced when required.

10. Piston rod (120) may be removed from cylinder head (119) to expose flange bushing (131) and seal (127) for replacement when worn or damaged.

11. Inspect and repair or replace damaged or worn cylinder components. Then reassemble the cylinder in the reverse sequence of disassembly.

5-23. LOWER PRESSURE ROLLERS REMOVAL. See figure 6-1. Remove the lower pressure rollers as follows:

1. Remove the lower track in accordance with paragraph 5-17.

2. Support equalizer frame (18).

3. Remove snapring (66) and washer (65) from each end of roller frame shaft (69).

4. Remove a grease fitting (45) from either end of shaft (69) and tap the shaft out of frame (18), drag link (118) and cylinder shaft connection.

5. Remove equalizer frame (18) and roller assemblies.

6. Flange bushings (70) and flange bushings (67) are exposed for replacement.

7. Disassemble the lower pressure rollers in accordance with paragraph 5-24.

8. Remove snapring (66) and washer (65) from each end of rocker shaft (64).

9. Support drag link (118). Remove a grease fitting (45) from either end of shaft (64) and tap the shaft out of lower frame (2) and drag link (118).

10. Remove drag link (118). Flange bushing (67) and bushing (68) are exposed for replacement.

11. Inspect and replace or repair damaged or worn shaft components. Then reassemble in the reverse sequence of disassembly.

5-24. PRESSURE ROLLER DISASSEMBLY. See figure 6-1. With roller frame removed from machine, disassemble each pressure roller assembly as follows:

1. Remove four capscrews (115) and lockwashers (116) securing each retainer (113). Remove retainers (113) and shims (145).

2. Remove four capscrews (91), four lockwashers (116), one capscrew (153), and one lockwasher (34) securing each bearing cap (112) and remove the bearing caps. This releases rollers (111) with associated components.

3. Remove rollers (111) from equalizer frame (18).

4. Remove bearings (108) and seals (110).

5. Sleeves (109) are secured to rollers (111) with loctite sealing compound and, if worn, must be removed by grinding.

6. Inspect and replace or repair damaged or worn roller assembly components. Then reassemble the rollers in the reverse sequence of disassembly.

5-25. LOWER ROCKER SHAFT REMOVAL. See figure 6-1. Remove the lower rocker shafts as follows:

1. Remove the lower track in accordance with paragraph 5-17.

2. Support equalizer frame (18) assembly.

3. Remove snapring (66) and washer (65) from each end of rocker shaft (64).

4. Remove a grease fitting (45) at either end of rocker shaft (64) and tap out the shaft from lower frame (2) and drag link (118).

5. Flange bushings (67) and bushings (68) are now exposed.

6. Inspect and replace or repair damaged or worn rocker shaft components. Then reinstall the rocker shaft in the reverse order of disassembly.

5-26. SQUEEZE AND LIFT CYLINDER DISASSEMBLY. See figure 6-1. Disassemble the squeeze and lift cylinder as follows:

1. Remove plumbing to squeeze and lift cylinder (98).

2. Remove snapring (104) and plain washer (103) securing pin (106) to clevis (92) at top of cylinder. Tap out pin (106). This releases clevis (92) and lever (82). Bushing (105) and flange bushings (107) are exposed for replacement as necessary.

3. Unscrew clevis (92) from piston rod (97).

4. Support cylinder (98). Remove snapring (104) and plain washer (103) securing pin (106) at bottom of cylinder. Tap out pin (106). This releases main pressure cylinder (98). Bushing (105) and flange bushings (107) are exposed for replacement as necessary.

5. Remove main pressure cylinder (98) to a convenient work area.

6. Remove 12 capscrews (154) and lockwashers (34) securing cylinder head (94). Remove cylinder head (94) and piston rod (97) from main pressure cylinder (98). This exposes O-rings (100 and 95) for replacement when necessary.

7. Remove cylinder head (94) from piston rod (97). Bushings (93) and seal (96) are exposed for replacement as necessary.

8. Unfasten cotter pin (102), unscrew slotted nut (101) and remove piston (99) from piston rod (97).

9. Inspect and replace or repair damaged or worn squeeze cylinder components. Then reassemble the squeeze cylinder in the reverse sequence of disassembly.

5-27. FORWARD OR AFT DRAGBOARD POWER CYLINDER REMOVAL. See figure 6-1. Remove the forward or aft dragboard power cylinder as follows:

1. Disconnect the plumbing to air power cylinder (24).

2. Unfasten the snaprings (23) and remove the pins (12) to release rod end knuckle (25). Swing lever (75) out of the way.

3. Remove air power cylinder (24). Inspect, replace, or repair damaged or worn power cylinder components. Refer to appendix C for maintenance information.

4. Install the power cylinder in the reverse order of removal.

5-28. DRAGBOARD REMOVAL. See figure 6-1. Remove aft dragboard as follows:

1. Remove snapring (32) and washer (31) securing each dragboard (54 and 57) to pin (17), and remove the dragboards. This exposes flange bushings (30) for replacement when necessary.

2. Remove air power cylinder (24) in accordance with paragraph 5-27.

3. Remove lower snapring (29) from lever shafts (15) and remove levers (75 and 77) and stabilizer (76) as a unit.

4. Remove upper snapring (29) from lever shafts (15) and remove levers (14 and 16). Take care not to lose keys (28).

5. Tap out lever shafts (15). Flange bushings (26) are now accessible for replacement if necessary.

6. Replace or repair dragboard components and reassemble in the reverse order of disassembly.

5-29. UPPER AND LOWER REDUCER REMOVAL. See figures 6-1 and 6-5. Maintenance actions which require disassembly of a reducer or brake assembly, require the removal of the reducer from the tension machine. Remove a reducer assembly as follows:

1. Drain the lubricating oil from the reducer housing (140, figure 6-1).

2. Disconnect all interconnecting hydraulic lines at the reducer. Cap open fittings and ports.

3. Separate coupling (47) halves.

4. Attach a sling to the reducer assembly for support and movement.

5. Remove six capscrews (82, figure 6-5) and lockwashers (85), two nuts (92), capscrews (83), and lockwashers (94).

6. Remove the reducer to a convenient work area.

7. Installation of the reducer assembly is the reverse order of removal.

5-30. REDUCER DISASSEMBLY. See figure 6-5. After the reducer has been removed from the tension machine to a convenient work area, disassemble as follows:

1. Remove speed control lever (14) by removing cotter pin (53), washers (54), pin (28), retainer ring (52), and pin (27). Remove eight capscrews (75), lockwasher (86), and bracket (15).

2. Remove hydraulic motor (73) by removing four capscrews (80) and lockwashers (88). Remove coupling (66) and key (31) from motor shaft. Refer to appendix D for motor repair information.

3. Remove eight capscrews (90) and lockwashers (89) and remove adapter housing (3). Remove male coupling (65) and key (31) from high speed shaft (4).

4. Invert the reducer assembly and remove the brake assembly in accordance with paragraph 5-31.

5. Remove eight capscrews (76), lockwashers (86) and nuts (93). Tap out two dowels (101) and remove reducer base (2).

6. Remove spur pinion shaft (6) from housing (1).

7. Use a bearing puller to remove bearings (40) from shaft (6).

8. Press off helical gear (8) from shaft (6) and remove key (33).

9. Inspect and repair or replace any worn or damaged spur pinion shaft components. Then reassemble the shaft in the reverse sequence of disassembly.

10. Remove four capscrews (75) and lockwashers (86) securing each retainer (24) and remove the retainers and shims (44). Remove the bearing cups for bearings (40).

11. Remove output shaft (7) from housing (1).

12. Use a bearing puller to remove bearings (41) from shaft (7).

13. Press off spur gear (9) from shaft (7) and remove key (30).

14. Inspect and replace or repair any damaged or worn output shaft components. Then reassemble the shaft in the reverse order of disassembly.

15. Remove four capscrews (74) and lockwashers (85) securing each retainer (12 and 13) and remove the retainers and shims (45). This exposes seal (46) and bearing cups for bearings (41).

16. Remove four capscrews (75) and lockwashers (86) securing retainer (23) and remove retainer and shims (43). This exposes the bearing cup for bearing (38).

17. Loosen jam nut (95) and setscrew (51) to release spring (50) tension on detent ball (49). Remove jam nut (96) and capscrew (26). The ball and spring may than be removed.

18. Remove four capscrews (75) and lockwashers (86) securing retainer (25) and remove the retainer with seal (47) from shift rod (16).

19. Unfasten lockwire (97) and four capscrews (84) to release fork (68).

20. Tap out shift rod (16) from reducer housing (1) and remove fork (68). This exposes bushings (48).

21. Inspect and replace or repair any damaged or worn clutch components.

22. Remove intermediate pinion shaft (5) from reducer housing (1) along with high speed shaft (4) and associated parts.

23. Use a bearing puller to remove bearings (38 and 39) from pinion shaft (5).

24. Remove gear (11) and clutch collar (20) from shaft (5). This exposes bushing (18).

25. Press off clutch spline (21) from shaft (5) and remove key (35).

26. Remove gear (10) from shaft (5). This exposes bushing (19).

27. Inspect and replace or repair any damaged or worn intermediate pinion shaft component parts. Then reassemble the shaft in the reverse sequence of disassembly.

28. Use a bearing puller to remove bearings (37) and grease rings (29) from high speed shaft (4).

29. Press off gear (17) from shaft (4) and remove key (32).

30. Inspect and replace or repair damaged or worn components of the high speed gear shaft. Then reassemble the shaft in the reverse sequence of disassembly.

31. After all internal components of the reducer have been inspected and repaired or replaced, reassemble the reducer in the reverse order of disassembly.

5-31. HYDRAULIC BRAKE DISASSEMBLY. See figure 6-5. Disassemble the hydraulic brake as follows:

1. Unfasten union nuts (98) and remove tubing (100).

2. Remove six capscrews (77) and lockwashers (86) and remove spring housing (57) and cylinder cap (61).

3. Unfasten four capscrews (78) evenly and slowly release the spring load on cylinder cap (61). Remove cpascrews (78) and lockwashers (86).

4. Remove cylinder cap (61) from spring housing (57). This exposes O-ring (70) for replacement when necessary. Note location of ten springs (63) in spring housing (61) and remove the springs.

5. Remove lockwire (97) and three capscrews (79) and remove piston (60) from backing plate (62) and spring housing (57). This exposes O-rings (69 and 71) for replacement as necessary.

6. Remove brake gear housing (56). Remove six friction plates (58) and five separator plates (59). Unfasten snapring (72) and remove brake gear (64) and key (36) from intermediate pinion shaft (5).

7. Remove four capscrews (91) and lockwashers (88) and remove brake adapter (55) and shims (44). This exposes intermediate pinion shaft (5) and bearing (39).

8. Inspect and replace or repair any damaged or worn hydraulic brake components. Then reassemble the hydraulic brake in the reverse sequence of disassembly.

5-32. HYDRAULIC PUMP AND ACTUATOR REMOVAL. See figure 6-8. Remove hydraulic pump (11) as follows:

1. Disconnect all external hydraulic lines at pump (11). Cap all open lines and fittings.

2. Separate coupling (1) halves.

3. Support pump (11) with a sling or other device. Remove two hex nuts (53), hex head capscrews (48) and lockwashers (58) securing pump (11) to adapter (30). Carefully remove pump.

4. Move pump to a clean work area.

5. Repair pump and/or actuator in accordance with maintenance instructions contained in appendix D.

6. Reinstall pump (5) by carefully reversing removal procedure. Fill pump with clean, filtered hydraulic fluid before operating.

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section comprises illustrations and parts list for replaceable parts for the equipment covered by this manual.

6-3. ILLUSTRATED PARTS LIST.

5-4. ILLUSTRATIONS. Each major assembly or component is illustrated. A figure number and title is assigned each illustration. The drawing (part) number for each illustrated assembly or component is shown in the lower right corner of the illustration. If applicable, the revision letter of the drawing is shown as a letter suffix to the drawing number.

6-5. PARTS LIST. Each illustration is preceded by a table listing each part identified in the illustration. Each parts list table is captioned at the top to identify the corresponding illustration. The parts list table comes in two variations. One table consists of six columns and the other of four columns. The following descriptions pertain to both variations with the four column table headings and additional information in parentheses.

6-6. ITEM (FIND NO.) Column. The item numbers correspond to the find numbers in the corresponding illustration.

6-7. DESCRIPTION (ITEM NOMENCLATURE) Column. This column contains the noun nomenclature of the assembly or part followed by descriptive or limited information. (This column may also contain lengths, diameters, thread information, type material, tempering, and manufacture name.)

6-8. QTY (QUANTITY PER ASSEMBLY) Column. This column lists the total quantity of the individual parts used in the assembly or component listed on the first line of the parts list.

6-9. MANUFACTURER P/N (ITEM NUMBER) Column. This column lists the part number as assigned by the manufacturer. Assemblies or parts modified by Western Gear Corporation are assigned Western Gear part numbers.

6-10. MANUFACTURER VENDOR CODE Column. This column lists the Federal Supply Code for Manufacturers (FSCM), as listed in Defense Supply Agency Catalog Handbooks H4-1 and H4-2, for the manufacturer of the assembly or part. The word Coml in this column indicates that the part is a common commercially available item. The code numbers used in the parts list are listed in table 6-1 in numerical sequence with the corresponding manufacturer's name and address.

6-11. REMARKS Column. This column contains additional descriptive information such as indicator markings, sizes of threaded fasteners, reference to other figures for further breakdown, etc. All dimensions are in inches unless specified otherwise. PB means Parts Breakdown and NHA means Next Higher Assembly.

6-12. HOW TO USE THE PARTS LIST.

6-13. Following are procedures for finding a specific part in the parts list.

1. Figure 6-1 is the top drawing for the equipment covered in the manual. Refer to this figure and locate the specific part desired, or the assembly/component containing the part desired. Note the index number for the part or assembly/component.

2. Refer to the parts list for figure 6-1. Locate the index number in the ITEM column. The adjacent columns provide the description, quantity per assembly, part number, manufacturer's vendor code, and any other pertinent information. If the item so identified is an assembly or component, the REMARKS column will contain a cross-reference to another figure for the parts breakdown of the assembly or component.

NOTE

If the assembly or component is not manufactured by Western Gear Corporation and is deemed economically repairable, the REMARKS column will refer to an appendix for further breakdown. The first page of each appendix lists the contents of that appendix.

3. To identify a part within an assembly or component, turn to the referenced figure and locate the specific part desired. Note the index number for the part.

4. Refer to the parts list for the figure being used. Locate the index number in the ITEM column. The adjacent columns provide all pertinent information for the item.

NOTE

If the item so identified is a subassembly or repairable component, the REMARKS column will contain a cross-reference to another figure for the parts breakdown of the subassembly or repairable component. In such cases, repeat steps 3 and 4 to identify a part within the subassembly or repairable component.

6-14. HOW TO ORDER PARTS.

6-15. Western Gear Corporation recognizes the need for expeditious service and endeavors to provide the best possible service in filling your order. To avoid error and possible delay in your receipt of parts, it is important that we receive complete and accurate identification of the ordered part.

6-16. Parts may be ordered by mail, telephone, or Telex. An order form is provided for ordering by mail. If the order is placed by telephone or Telex, use the order form as a guide to help ensure that adequate information is provided. When possible, orders placed by telephone or Telex should be confirmed (to avoid error) by mailing an order form as a followup.

6-17. The following instructions for completing the order form are keyed to the numbered blocks in the sample Customer Parts Order form. Copies of the Customer Parts Order form, for use in ordering parts, are provided immediately after the sample.

1.	ORDERED BY:	Name, title, and phone number of individual placing the order. This must be legible.
2.	DATE:	Date the order is written.
3.	FROM:	Name and address of ordering firm.
4.	P.O. NO.:	Your purchase order number.
5.	SHIP TO:	Give complete address for shipment of parts.
6.	SHIP VIA:	Specify preferred method of shipment; i.e., air freight, UPS, most economical method, etc.
7.	EQUIPMENT NOMENCLATURE:	Provide complete nomenclature of the basic equipment as provided on the title page (first page inside the front cover) of the manual. (Include model number, type number, part number, etc., if given.)
8.	MANUAL NO. AND DATE:	The manual number is shown in the lower left corner of the title page. The manual date is shown in the lower right corner of the title page.
9.	MANUAL CHANGE NO. AND DATE:	The manual change number and change date are shown in the lower right corner of the title page.
10.	FIG NO.:	Enter number of the figure that the part is illustrated on.
11.	PAGE NO.:	Enter the page number of the table that lists the part.
12.	ITEM NO.:	Enter the item number for the part from the ITEM NO. column of the parts list table.
13.	DESCRIPTION:	Enter the complete description as shown in the DESCRIPTION column of the parts list table.
14.	PART NO.:	Enter the part number as shown in the PART NO. column of the parts list table.
15.	VENDOR CODE:	Enter the five-digit number as shown in the VENDOR CODE column of the parts list table.
16.	QUANTITY ORDERED:	Enter the total quantity ordered.

NOTE

For those items covered by vendor data (located in the appendix(es), provide as complete identification of the item as possible in accordance with the preceding.

western Heavy Machinery Division

CUSTOMER PARTS ORDER

ADDRESS ORDER TO:
WESTERN GEAR CORPORATION
HEAVY MACHINERY DIVISION
2100 NORTON AVENUE
EVERETT, WASHINGTON 98201

TELEPHONE (206) 258-8822
TELEX 32-8872
TWX 910-445-2937

ORDERED BY (1) _____ NAME _____ TITLE _____ PHONE _____ DATE (2) _____

FROM (3) _____ SHIP TO: (5) _____ SHIP VIA: (6) _____

P. O. NO. (4) _____

EQUIPMENT NOMENCLATURE (7) _____ MANUAL NO. AND DATE (8) _____ MANUAL CHANGE NO. AND DATE (9) _____

FIG NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER PART NO	MANUFACTURER VENDOR CODE	QUANTITY ORDERED
(10)	(11)	(12)	(13)	(14)	(15)	(16)

CONTINUED ON REVERSE SIDE

E 797 10-74

PAGE _____ OF _____

Western Gear Corporation — Heavy Machinery Division

CUSTOMER PARTS ORDER

ADDRESS ORDER TO:
WESTERN GEAR CORPORATION
HEAVY MACHINERY DIVISION
2100 NORTON AVENUE
EVERETT, WASHINGTON 98201

TELEPHONE: (206) 259-0822
TELEX: 32-0872
TWX: 910-445-2837

ORDERED BY ______________________ DATE ________
NAME TITLE PHONE

FROM: ______________ SHIP TO: ______________ SHIP VIA: ______________

P. O. NO. ______________

EQUIPMENT NOMENCLATURE ______________ MANUAL NO. AND DATE ______________ MANUAL CHANGE NO. AND DATE ______________

FIG. NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

CONTINUED ON REVERSE SIDE

702 10/74

PAGE ______ OF ______

CUSTOMER PARTS ORDER
(Continued)

CONTINUED FROM REVERSE SIDE

FIG. NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

Western Gear Machinery Co.
A Subsidiary of Western Gear Corporation

CUSTOMER PARTS ORDER

ADDRESS ORDER TO:

WESTERN GEAR MACHINERY CO.
2100 NORTON AVENUE
EVERETT, WASHINGTON 98201

TELEPHONE: (206) 259-0922
TELEX: 32-8872
TWX: 910-445-2937

ORDERED BY _____ DATE _____
NAME TITLE PHONE

FROM _____ SHIP TO: _____ SHIP VIA: _____

P. O. NO. _____

EQUIPMENT NOMENCLATURE _____ MANUAL NO. AND DATE _____ MANUAL CHANGE NO. AND DATE _____

FIG. NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

E792-10-74 (Revised 3-82)

CONTINUED ON REVERSE SIDE

PAGE _____ OF _____

CUSTOMER PARTS ORDER
(Continued)

CONTINUED FROM REVERSE SIDE

FIG. NO.	PAGE NO.	ITEM NO	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

western GEAR CORPORATION **Western Gear Machinery Co.**
A Subsidiary of Western Gear Corporation

CUSTOMER PARTS ORDER

ADDRESS ORDER TO:

WESTERN GEAR MACHINERY CO.
2100 NORTON AVENUE
EVERETT, WASHINGTON 98201

TELEPHONE: (206) 259-0922
TELEX: 32-8872
TWX: 910-445-2937

ORDERED BY _____ DATE _____
NAME TITLE PHONE

FROM _____ SHIP TO: _____ SHIP VIA: _____

P. O. NO. _____

EQUIPMENT NOMENCLATURE _____ MANUAL NO. AND DATE _____ MANUAL CHANGE NO. AND DATE _____

FIG. NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

E792/10-74 (Revised 3-82)

CONTINUED ON REVERSE SIDE

CUSTOMER PARTS ORDER
(Continued)

CONTINUED FROM REVERSE SIDE

FIG. NO.	PAGE NO.	ITEM NO	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

WESTERN GEAR CORPORATION

Western Gear Machinery Co.
A Subsidiary of Western Gear Corporation

CUSTOMER PARTS ORDER

ADDRESS ORDER TO:

WESTERN GEAR MACHINERY CO.
2100 NORTON AVENUE
EVERETT, WASHINGTON 98201

TELEPHONE: (206) 259-0922
TELEX: 32-8872
TWX: 910-445-2937

ORDERED BY _____ DATE _____
NAME TITLE PHONE

FROM: _____ SHIP TO: _____ SHIP VIA: _____

P. O. NO. _____

EQUIPMENT NOMENCLATURE _____ MANUAL NO. AND DATE _____ MANUAL CHANGE NO. AND DATE _____

FIG. NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	

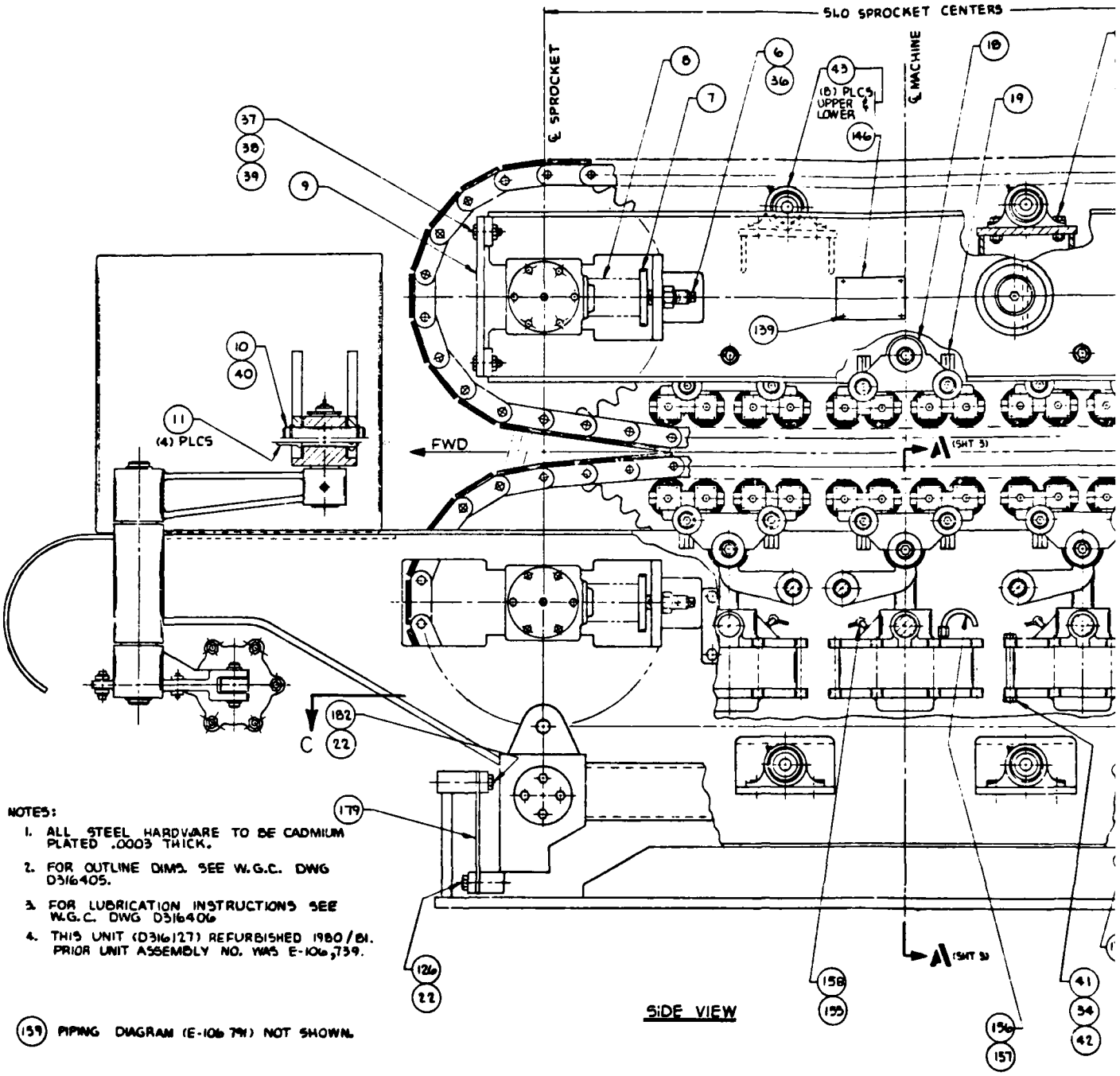
E792/10-74 (Revised 3-82)

CONTINUED ON REVERSE SIDE

CUSTOMER PARTS ORDER
(Continued)

CONTINUED FROM REVERSE SIDE

FIG. NO.	PAGE NO.	ITEM NO.	DESCRIPTION	MANUFACTURER		QUANTITY ORDERED
				PART NO.	VENDOR CODE	



NOTES:

1. ALL STEEL HARDWARE TO BE CADMIUM PLATED .0003 THICK.
2. FOR OUTLINE DIMS. SEE W.G.C. DWG D316405.
3. FOR LUBRICATION INSTRUCTIONS SEE W.G.C. DWG D316406
4. THIS UNIT (D316127) REFURBISHED 1980/81. PRIOR UNIT ASSEMBLY NO. WAS E-106,739.

(139) PIPING DIAGRAM (E-106 791) NOT SHOWN.

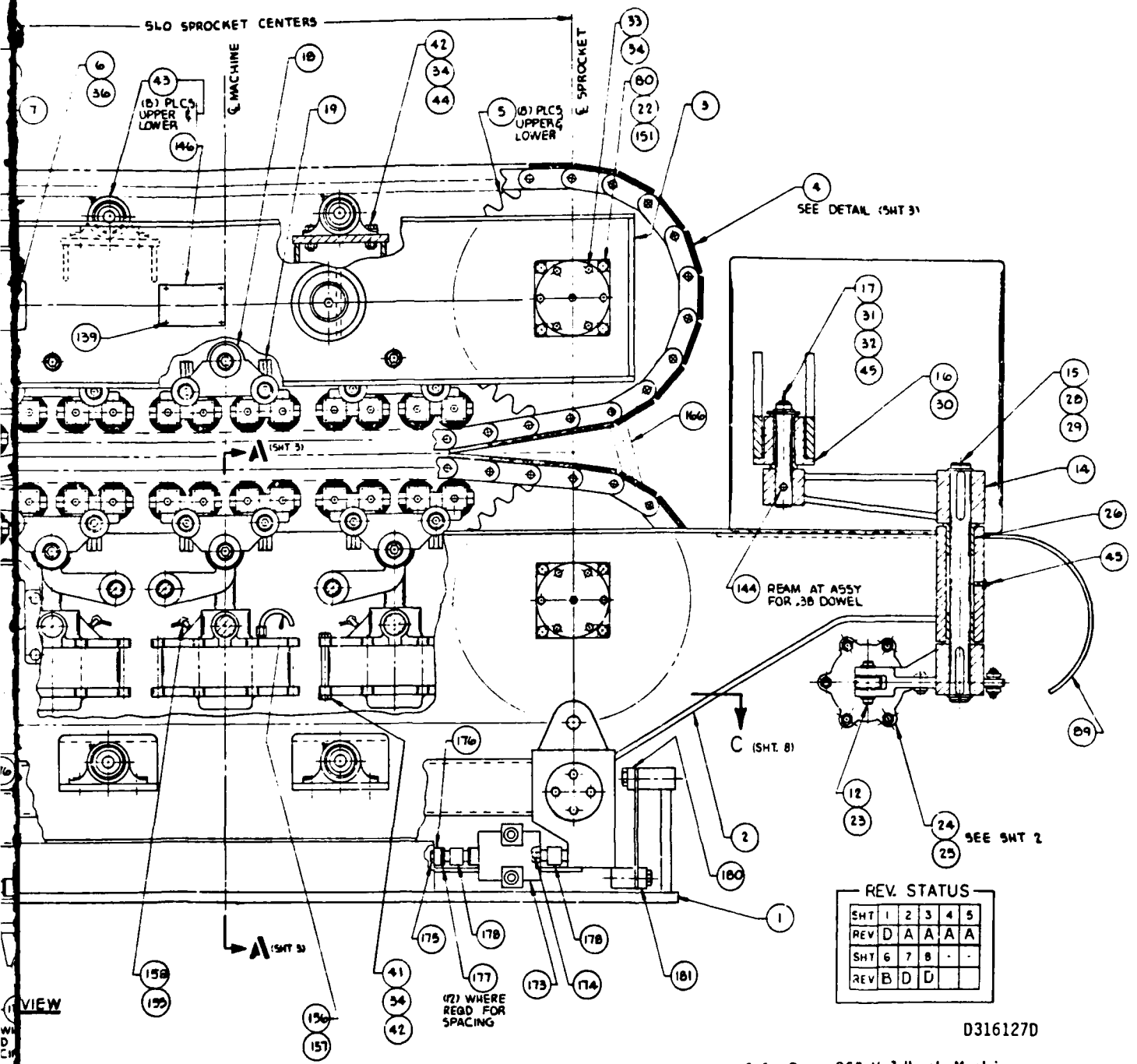
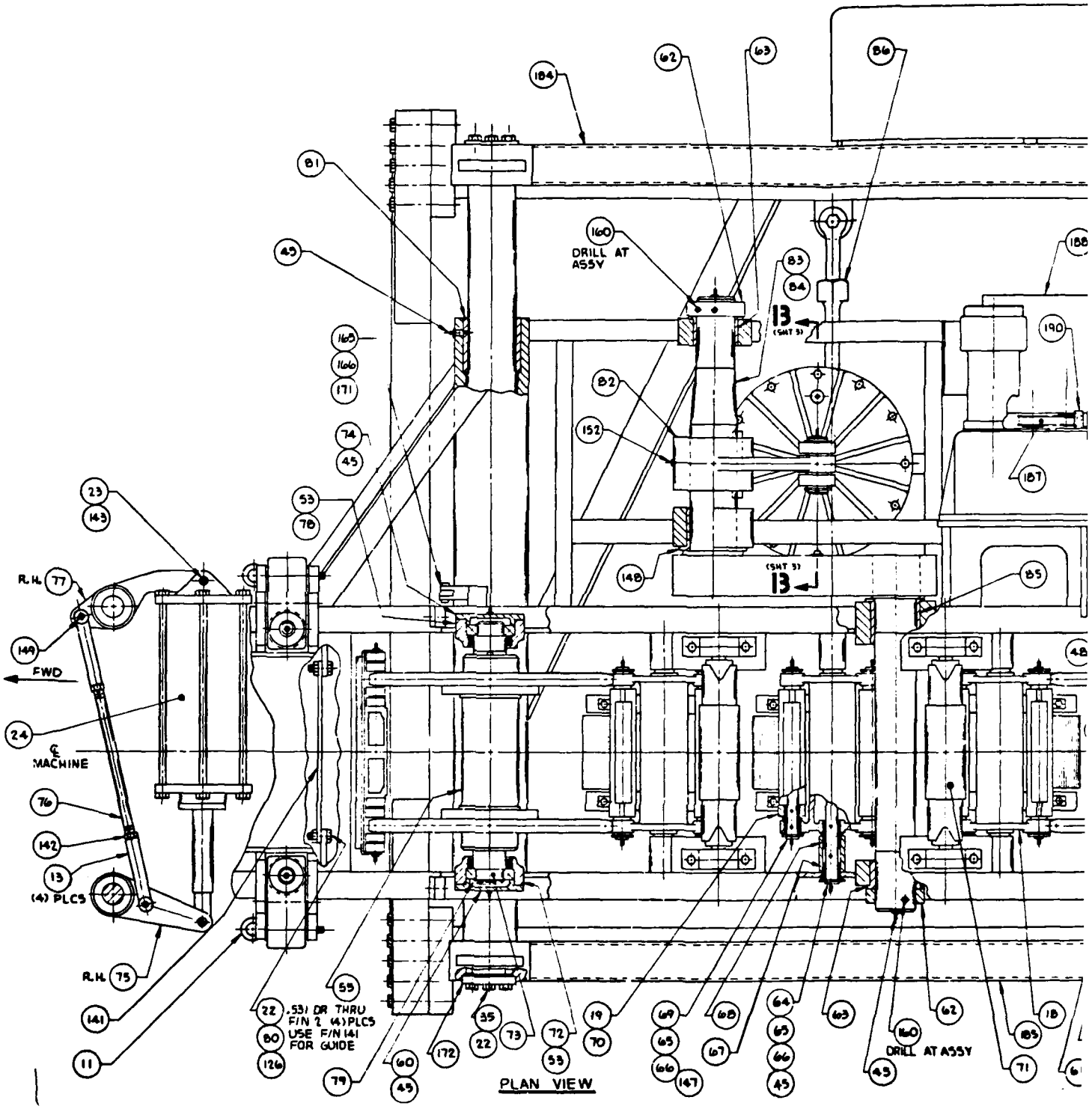


Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 1 of 8)


DRILL AT ASSY
(SHT 3)
13
R.H.
FWD
℄ MACHINE
(4) PLCS
.531 DR THRU F/N 2 (4) PLCS USE F/N 141 FOR GUIDE
PLAN VIEW

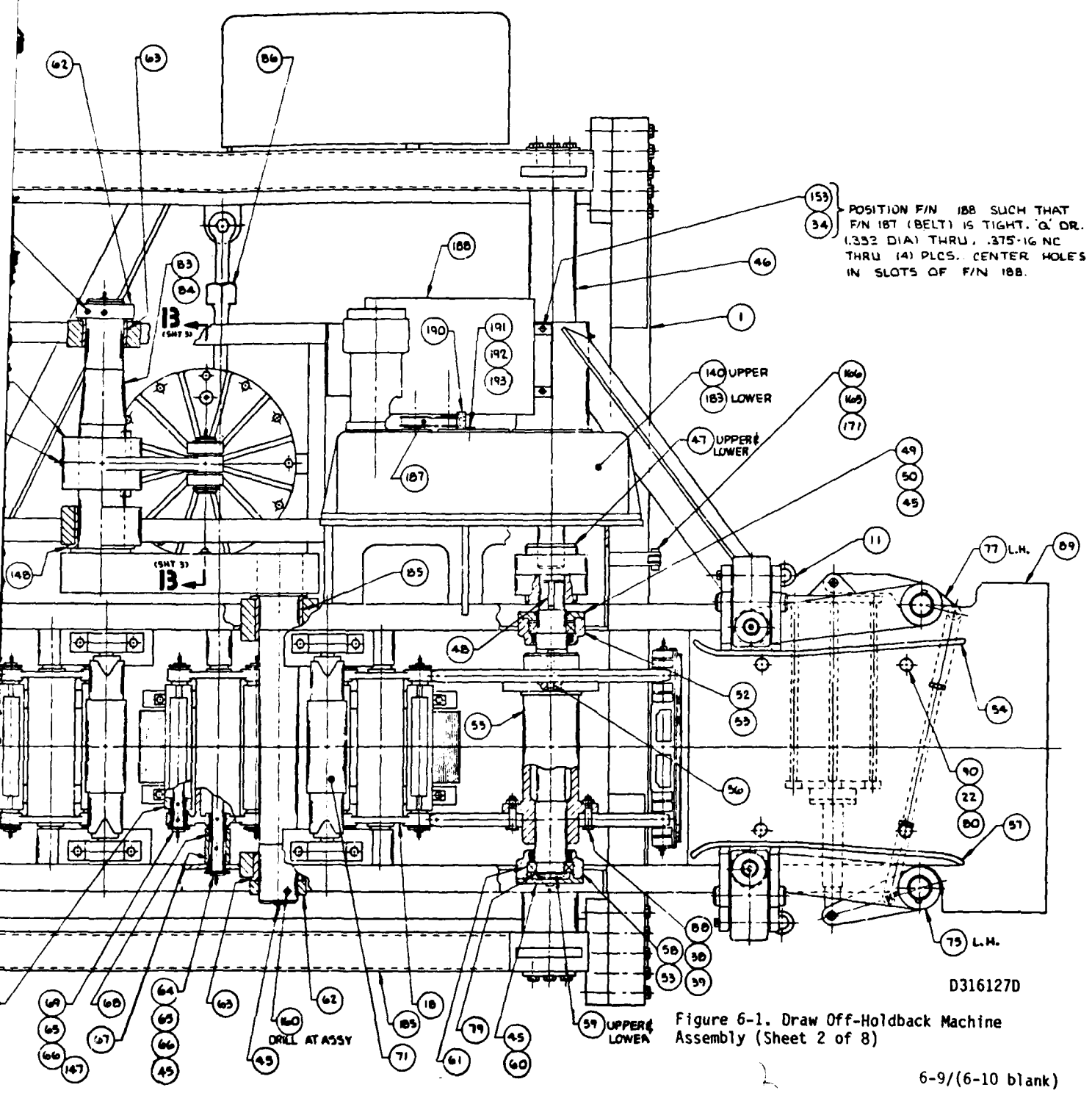
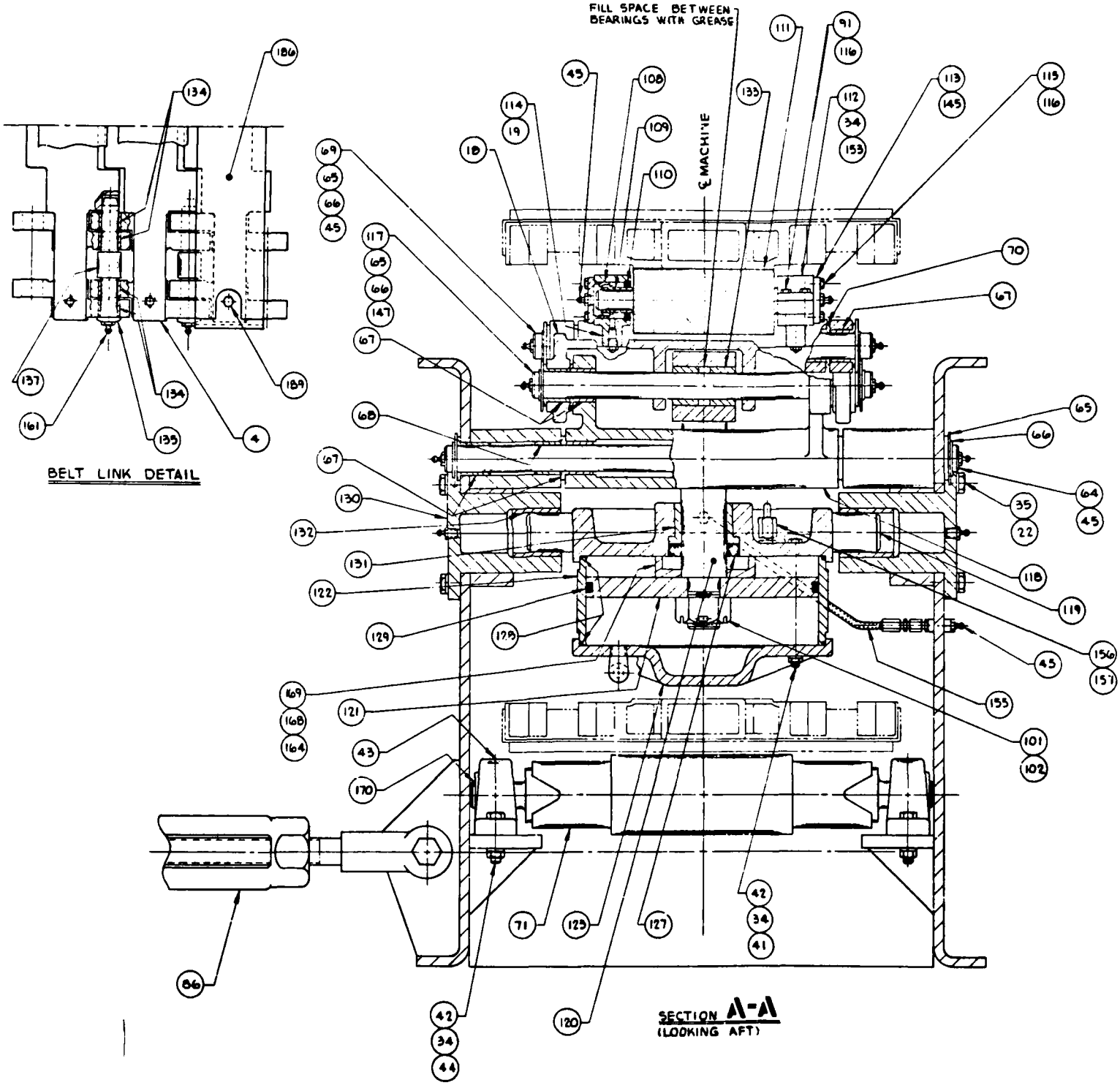
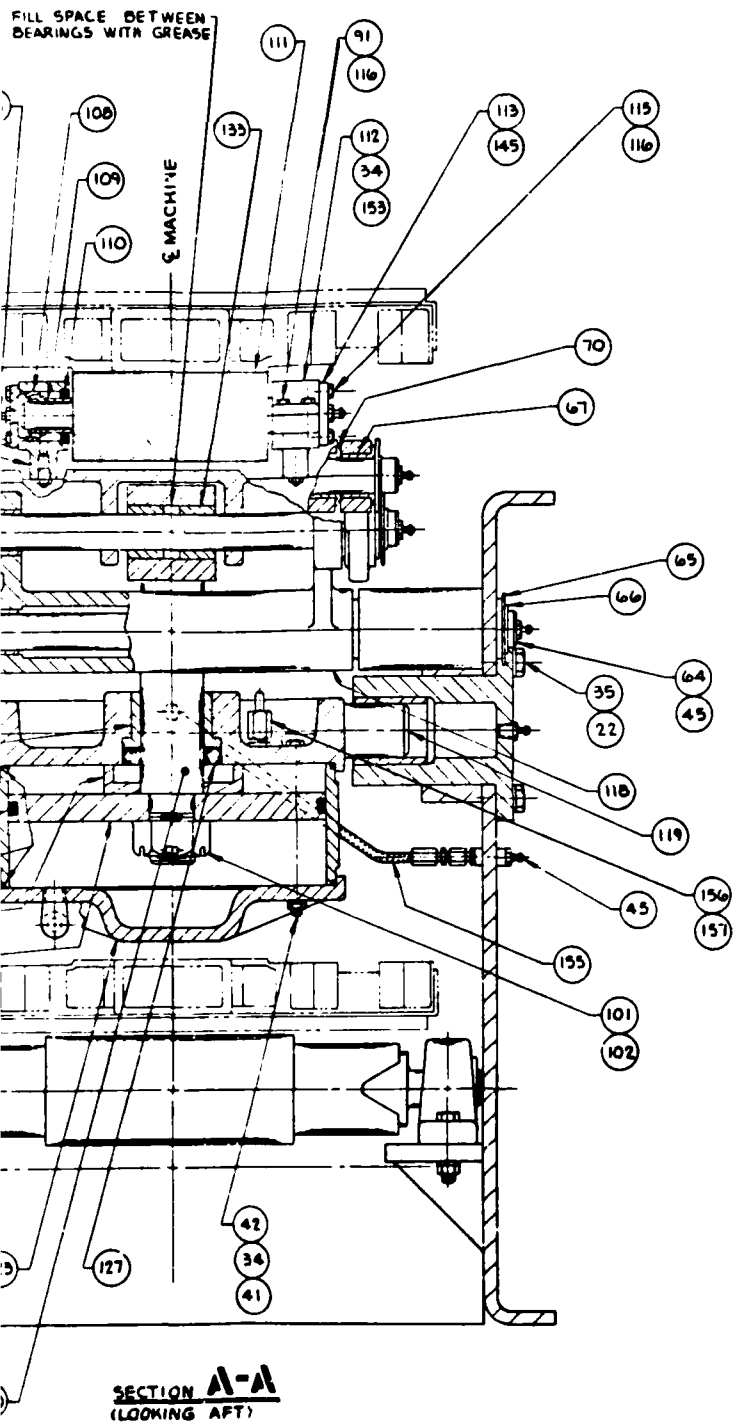
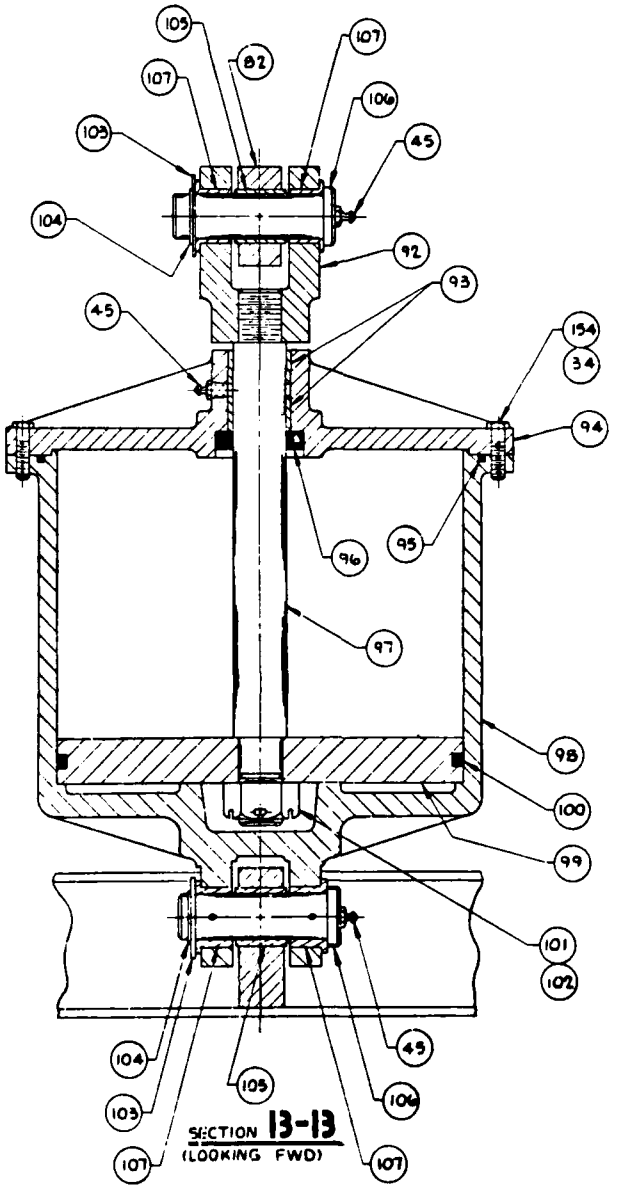


Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 2 of 8)


FILL SPACE BETWEEN BEARINGS WITH GREASE
℄ MACHINE
BELT LINK DETAIL
SECTION A-A
(LOOKING AFT)



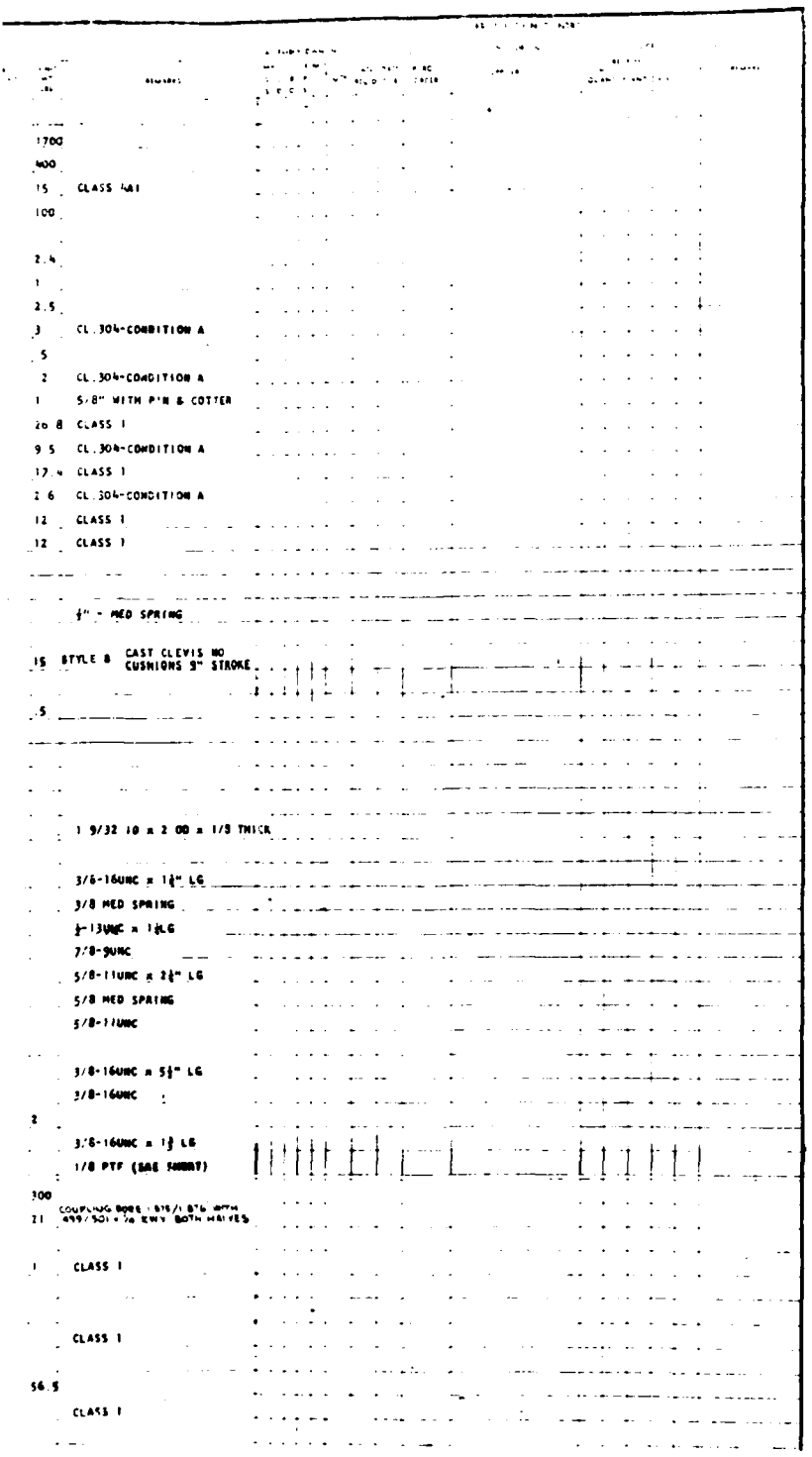


D316127D

Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 3 of 8)

LIST OF MATERIALS

Item	Name of Part	No. Req.	Part / Drawing No.	Manufacturer	Material	Material Spec.	Unit Wt. Lbs.	Remarks
1	[illegible] PLATE [illegible]		[illegible]13278	WGC	STEEL	SEE DWG.		
2	LOWER FRAME [illegible]	1	[illegible]6387	WGC	STEEL	SEE DWG.	1700	
3	UPPER FRAME [illegible]	1	[illegible]	WGC	STEEL	SEE DWG.	400	
4	BELT LINK	[illegible]	[illegible]	WGC	C.STEEL	QQ-S-681	15	CLASS [illegible]
5	SPROCKET	8	C-200,696	WGC	STEEL	AISI 1060	100	
6	ADJUSTING SCREW	4	B-200,468	WGC	STEEL	AISI 1018		
7	BACKING PLATE	4	C-200,701	WGC	STEEL	ASTM A7	2.4	
8	COMPR. SPRING	4	B-200,469	WGC	STEEL	AISI 6150	1	
9	END PLATE	2	C-200,700	WGC	STEEL	ASTM A7	2.5	
10	PIN	4	B-200,466	WGC	ST. STEEL	QQ-S-763b	3	CL.304-CONDITION A
11	TOGGLE PIN	4	C-200,945	WGC	ST.STEEL	COMML	.5	
12	PIN	2	B-200,470	WGC	ST.STEEL	QQ-S-763b	.2	CL.304-CONDITION A
13	HEAVY FORK ROD END	4	SAE STD.	COMML	STEEL	COMML	1	5/8" WITH PIN & COTTER
14	LEVER	4	C-200,690	WGC	C.STEEL	QQ-S-681b	26.8	CLASS 1
15	LEVER SHAFT	4	C-200,719	WGC	ST. STEEL	QQ-S-763b	9.5	CL.304-CONDITION A
16	CARRIER	4	C-200,717	WGC	C.STEEL	QQ-S-681b	17.4	CLASS 1
17	PIN	4	B-200,471	WGC	ST. STEEL	QQ-S-763b	2.6	CL.304-CONDITION A
18	EQUALIZER FRAME	6	E-200,335	WGC	C.STEEL	QQ-S-681b	12	CLASS 1
19	ROLLER FRAME	12	E-200,337	WGC	C.STEEL	QQ-S-681b	12	CLASS 1
20								
21								
22	LOCKWASHER	108		COMML	STEEL	COMML		½" - MED SPRING
23	SNAP RING	8	5100-62	TRUARC	STEEL	COMML		
24	AIR POWER CYLINDER	2	LW-4½	HANNIFIN	VARIOUS	COMML	15	STYLE B CAST CLEVIS NO CUSHIONS 5" STROKE
25	ROD CAP KNUCKLE	2	27518	HANNIFIN	STEEL	COMML		
26	FLANGE BUSHING	8	FF-2008	KINGWELL	OILITE	COMML	.5	
27								
28	SQ. KEY	8	B-200,472	WGC	STEEL	AISI 1020		
29	SNAP RING	8	5100-162	TRUARC	STEEL	COMML		
30	FLANGE BUSHING	8	FF-1506-4	KINGWELL	OILITE	COMML		
31	PLAIN WASHER	4		COMML	STEEL	COMML		1 9/32 ID x 2.00 x 1/8 THICK
32	SNAP RING	4	5100-125	TRUARC	STEEL	COMML		
33	HEX HD CAPSCREW	48		COMML	STEEL	COMML		3/8-16UNC x 1¼" LG
34	LOCKWASHER	154		COMML	STEEL	COMML		3/8 MED SPRING
35	HEX HD CAPSCREW	40		COMML	STEEL	COMML		½-13UNC x 1¼LG
36	HEX NUT	4		COMML	STEEL	COMML		7/8-9UNC
37	HEX HD BOLT	4		COMML	STEEL	COMML		5/8-11UNC x 2¼" LG
38	LOCKWASHER	36		COMML	STEEL	COMML		5/8 MED SPRING
39	HEX NUT	[illegible]		COMML	STEEL	COMML		5/8-11UNC
40	SNAP RING	8	5100-150	TRUARC	STEEL	COMML		
41	STUD	24		COMML	STEEL	COMML		3/8-16UNC x 5¼" LG
42	HEX NUT	70		COMML	STEEL	COMML		3/8-16UNC
43	PILLOW BLOCK	8	P216	LINK-BELT	VARIOUS	COMML	2	
44	HEX HD BOLT	[illegible]		COMML	STEEL	COMML		3/8-16UNC x 1¾ LG
45	GREASE FITTING	101	1961-B	ALEMITE	MONEL	COMML		1/8 PTF (SQE SHORT)
46	SLIDE SHAFT	2	C311148	WGC	ST STL	AISI 304	300	
47	COUPLING	1	SIZE 1½	STER-BATH	STEEL	COMML	21	COUPLING BORE 1.875/1.876 WITH .499/.501 x ¼ KWY. BOTH HALVES
48	SQ KEY	2	B-200,453	WGC	STEEL	AISI 1020		
49	COVER	2	C-200,708	WGC	C.STEEL	QQ-S-681b	1	CLASS 1
50	SEAL	2	50300-S	NATIONAL	SYNTH.	COMML		
51								
52	BEARING HOUSING	2	B-200,510	WGC	C.STEEL	QQ-S-681b		CLASS 1
53	SEAL	8	50316-S	NATIONAL	SYNTH	COMML		
54	SHOE (B.H.)	2	C-200,723	WGC	STEEL	ASTM-A7	56.5	
55	SPROCKET HUB	4	B-200,495	WGC	C.STEEL	QQ-S-681		CLASS 1
56	SQ KEY	4	B-200,474	WGC	STEEL	AISI 1020		



CERTIFICATION LEGEND

C CHEMICAL

P PHYSICAL

H HARDNESS

F CERTIFICATION OF CONFORMANCE TO BE USED FOR COMMERCIAL PRODUCTS (SUCH AS BRAKE LINING BUSHINGS ETC)

N D NONDESTRUCTIVE TEST CONSISTING OF

PT LIQUID PENETRANT INSPECTION
MT MAGNETIC PARTICLE INSPECTION
RT RADIOGRAPHIC INSPECTION
P PRESSURE TEST
UT ULTRASONIC TEST

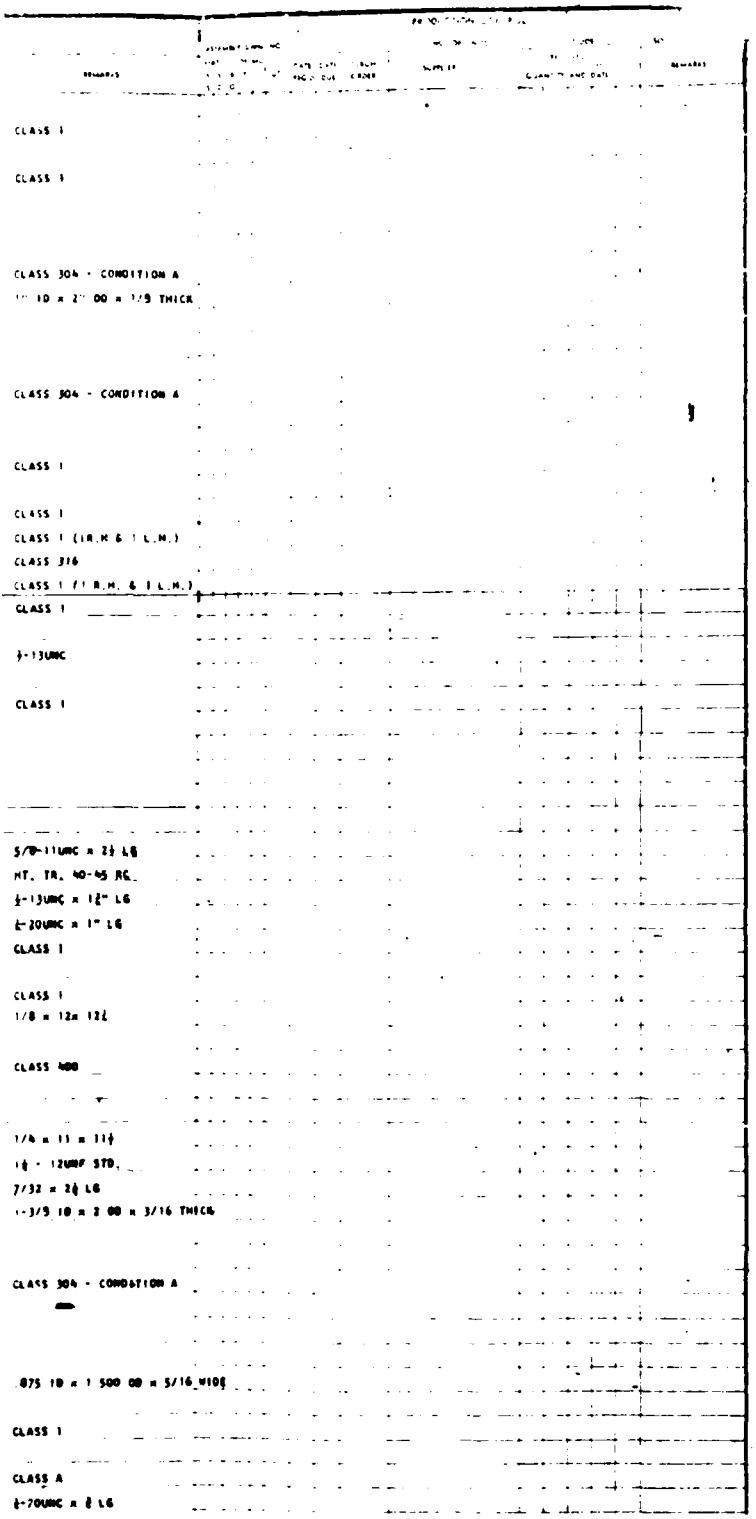
N NO CERTIFICATION REQUIRED

D316127D

Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 4 of 8)

LIST OF MATERIALS

PART NO.	NAME OF PART	NO. REQ'D	MANUFACTURER PART NO.	MANUFACTURER NAME	MATERIAL	MATERIAL SPEC	UNIT WT LBS	REMARKS
57	SHOE (L.H.)	2	C-200,723	WGC	STEEL	ASTM-A7	56.5	
58	BEARING HOUSING	2	D-200,519	WGC	C.STEEL	QQ-S-681b		CLASS 1
59	DRIVE SHAFT	2	D-200,545	WGC	STEEL	AISI-4140	26	
60	BEARING CAP	4	C-200,709	WGC	C.STEEL	QQ-S-681b	4.5	CLASS 1
61	BALL BEARING	8	1210	SKF	STEEL	COMML		
62	SET COLLAR	2	SC-300	BOSTON	STEEL	COMML		
63	FLANGE BUSHING	2	FF-3500	KINGWELL	OILITE	COMML		
64	ROCKER SHAFT	6	C-200,713	WGC	ST.STEEL	QQ-S-763b	4	CLASS 304 - CONDITION A
65	PLAIN WASHER	42		COMML	STEEL	COMML		1" ID x 2" OD x 1/9 THICK
66	SNAP RING	42	5100-100	TRUARC	STEEL	COMML		
67	FLANGE BUSHING	60	FF1202-3	KINGWELL	OILITE	COMML		
68	BUSHING	12	AA-1213-3	KINGWELL	OILITE	COMML		
69	ROLLER FRAME SHAFT	12	C-200,714	WGC	ST.STEEL	QQ-S-763b	2	CLASS 304 - CONDITION A
70	FLANGE BUSHING	24	FF-1207	KINGWELL	OILITE	COMML		
71	PRESSURE ROLL	4	C-200,720	WGC	VARIOUS	SEE DWG.	10.5	
72	BEARING HOUSING	2	B-200,516	WGC	C.STEEL	QQ-S-681b		CLASS 1
73	IDLE SHAFT	2	D-200,488	WGC	STEEL	AISI-1018	22	
74	BEARING CAP	2	C-200,710	WGC	C.STEEL	QQ-S-681b	2	CLASS 1
75	LEVER	2	C-200,718	WGC	C.STEEL	QQ-S-681b	10.2	CLASS 1 (1R.H & 1 L.H.)
76	STABILIZER	2	B-200,478	WGC	ST.STEEL	QQ-S-763b		CLASS 316
77	LEVER	2	C-200,716	WGC	C.STEEL	QQ-S-681b	11	CLASS 1 (1 R.H. & 1 L.H.)
78	BEARING HOUSING	2	D-200,508	WGC	C.STEEL	QQ-S-681b	3	CLASS 1
79	SNAP RING	4	5100-196	TRUARC	STEEL	COMML		
80	HEX NUT	28		COMML	STEEL	COMML		½-13UNC
81	BUSHING	4	B-200,479	WGC	BRZE.	SAE 660		
82	LEVER	1	C-200,721	WGC	C.STEEL	QQ-S-681b	8	CLASS 1
83	LEVER SHAFT	1	D-200,540	WGC	STEEL	SEE DWG.	180	
84	SQ KEY	1	B-200,475	WGC	STEEL	AISI 1020		
85	FLANGE BUSHING	1	B-200,480	WGC	OILITE	COMML		
86	TURNBUCKLE (MOD)	1	C312-23	WGC		SEE DWG		
87								
88	HEX HD BOLT	32		COMML	STEEL	COMML		5/8-11UNC x 2½ LG
89	SHOE	2	C-200,724	WGC	STEEL	AISI E-4130	107	HT. TR. 40-45 RC
90	114° C'SUNK SQ. NECKBOLT	8		COMML	STEEL	COMML		½-13UNC x 1½" LG
91	HEX HD CAPSCREW	96		COMML	STEEL	COMML		¼-20UNC x 1" LG
92	CLEVIS	1	C-200,711	WGC	C.STEEL	QQ-S-681b	6	CLASS 1
93	BUSHING	2	AA-1224-15	KINGWELL	OILITE	COMML		
94	CYLINDER HEAD	1	D-200,536	WGC	C.STEEL	QQ-S-681b	38	CLASS 1
95	O-RING	1	2-278	PARKER	NEO.	COMML		1/8 x 12 x 12¼
96	SEAL	1	51065-S	NATIONAL	SYNTH	COMML		
97	PISTON ROD	1	C-201,072	WGC	ST.STL	QQ-S-763b	7	CLASS 400
98	MAIN PRESSURE CYLINDER	1	D-200,537	WGC	C.BRZE	SAE 660	55	
99	PISTON	1	C-200,707	WGC	STEEL	ASTM A7	28	
100	O-RING	1	6227-78	NATIONAL	NEO.	COMML		1/4 x 11 x 11½
101	HEX SLOTTED NUT	4			STEEL	COMML		1½ - 12UNF STD.
102	COTTER PIN	4			STEEL	COMML		7/32 x 2½ LG
103	PLAIN WASHER	2			STEEL	COMML		1-3/9 ID x 2 () x 3/16 THICK
104	SNAP RING	2	5100-137	TRUARC	STEEL	COMML		
105	BUSHING	2	AA-1608-12	KINGWELL	OILITE	COMML		
106	PIN	2	B-200,481	WGC	ST.STL	QQ-S-763b	1.7	CLASS 304 - CONDATION A
107	FLANGE BUSHING	4	F-1618-1	KINGWELL	OILITE	COMML		
108	BEARING	48	A5069/ A5144	TIMKEN	STEEL	COMML		
109	SLEEVE	48	B-200,218	WGC	ST.STL	QQ-S-763b		
110	SEAL	48	94 x 0215	GARLOCK	SYNTH	COMML		.875 ID x 1.500 OD x 5/16 WIDE
111	ROLLER ASSEMBLY	24	D-200,109	WGC	VARIOUS	SEE DWG.		
112	BEARING CAP	24	B-200,511	WGC	C.STEEL	QQ-S-681b		CLASS 1
113	RETAINER	48	C-200,702	WGC	STEEL	ASTM A7		
114	RELIEF FITTING	48	C-200,321	WGC	MONEL	QQ-N-281		CLASS A
115	HEX HD CAPSCREW	192			STEEL	COMML		¼-20UNF x ⅝ LG



CERTIFICATION LEGEND

C CHEMICAL

P PHYSICAL

H HARDNESS

C C CERTIFICATION OF CONFORMANCE (TO BE USED FOR COMMERCIAL PRODUCTS SUCH AS BRAKE LINING BUSHINGS ETC.)

N D NONDESTRUCTIVE TEST CONSISTING OF

PT LIQUID PENETRANT INSPECTION
MT MAGNETIC PARTICLE INSPECTION
RT RADIOGRAPHIC INSPECTION
P PRESSURE TEST
UT ULTRASONIC TEST

N NO CERTIFICATION REQUIRED

D316127D

Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 5 of 8)

LIST OF MATERIALS

PART NO.	NAME OF PART	NO. REQD	MANUFACTURER'S DRAWING OR PART NO.	MANUFACTURER'S CODE NAME	MATERIAL	MATERIAL SPEC	REMARKS
116	LOCKWASHER	288			STEEL	COMML	⅜ MED SPRING
117	EQUALIZER SHAFT	3	C-200,712	WGC	ST.STL	QQ-S-763b	CLASS 304-CONDITION A
118	DRAG LINK	3	D-200,493	WGC	C.STEEL	QQ-S-681b	CLASS 1
119	CYLINDER HEAD	3	D-200,535	WGC	C.STEEL	QQ-S-681b	
120	PISTON ROD	3	C-200,704	WGC	ST.STL	QQ-S-763b	CLASS 302
121	PISTON	3	C-200,722	WGC	STEEL	ASTM A7	
122	CYLINDER	3	C-200,697	WGC	BRZ.PIPE	COMML	
123	CYLINDER HEAD	3	C-200,705	WGC	C.STEEL	QQ-S-681b	
124							
125							
126	HEX CAP SCREW	24		COMML	STEEL	COMML	½-13UNC×1½ LG
127	SEAL	3	S0183-S	NATIONAL	SYNTH	COMML	
128	O-RING	6	6430-49	NATIONAL	NEO.	COMML	
129	O-RING	3	6247-73	NATIONAL	NEO.	COMML	⅛ × 8½ × 9
130	CARTRIDGE	6	C-200,698	WGC	C.STL	QQ-S-681b	CLASS 1
131	FLANGE BUSHING	3	B-200,476	WGC	BRZ.	COMML	
132	BUSHING	6	AA-1807-10	KINGWELL	OILITE	COMML	
133	BUSHING	6	AA-1511-7	KINGWELL	OILITE	COMML	
134	BUSHING	232	A30?935	WGC		COMML	
135	BELT PIN	208	3 2939	WGC			
136							
137	ROLLER	208	B-200,467	WGC	MONEL	QQ-N-281	CLASS A
138							
139	DRIVE SCREW	4		COMML	ST.STL	COMML	SIZE #0
140	REDUCER	1	E-[illegible]787	WGC	VARIOUS	SEE DWG.	200
141	PLATE	1	B-112 300	WGC	STEEL	ASTM-A7	⅜ × 9×15 LG
142	HEX JAM NUTS	4		COMML	STEEL	COMML	2/8-16UNF
143	PIN	2	B-200,483	WGC	ST.STL	QQ-S-763b	TYPE 304-CONDITION A
144	DOWEL	4		COMML	STEEL	COMML	3/8 x 2½ LG
145	SHIM	48	B-200,482	WGC	BRASS	COMML	
146	NAMEPLATE	1	C-105,773	WGC	ST. STL	COMML	
147	GREASE FITTING	24	#1922	ALEMITE	MONEL	COMML	1/8 P.T.F. (SAE SHORT)
148	FLANGE BUSHING	1	B-200,473	WGC	OILITE	COMML	
149	FLANGE BUSHING	4	FF-843-4	KINGWELL	OILITE	COMML	
150							
151	HEX HD CAPSCREW	16		COMML	STEEL	COMML	½-13UNC x 1¾ LG
152	SETSCREW	1		COMML	STEEL	COMML	½-10UNC x 1½ LG
153	HEX HD CAPSCREW	8		COMML	STEEL	COMML	3/8-16UNC x 1 LG
154	HEX HD CAPSCREW	12		COMML	STEEL	COMML	3/8-16UNC x 1¼ LG
155	LUBRICATE HOSE	3	01712-12	LINCOLN	VAR	COMML	
156	CONNECTOR	3	6FBN-S	PARKER	STEEL	COMML	
157	SEAMLESS TUBING	3		COMML	STEEL	COMML	BEND 180° at 1" RADIUS 3/8 OD x 1/16 WALL x 43" LG
158	STREET ELBOW	3	MPCD-S	PARKER	STEEL	COMML	⅜ ASST
159	PISTON DIAGRAM		E-106,791	WGC			
160	DOWEL	2			STEEL	COMML	⅛ x 4" LG. AMER STD GROOVED PIN
161	GREASE FITTING	208	1710-B	ALEMITE	STEEL	COMML	⅛-24 NF
162							
163							
164	SPACER	3	B-200,825	WGC	STEEL	SAE 1020	
165	PIN	4	B-200,820	WGC	BRZ	SAE 660	
166	SPRING	2	C-201,071	WGC	ST.STL	TYPE 18-8	
167							
168	SOC HD CAPSCREW	6 AS REQ'D			STEEL	COMML	DRILLED HEAD ¼-20 x ½ LG
169	LOCKWIRE				STEEL	COMML	1/16 DIA
170	RETAINER	8	3100-100	IND.	STEEL	COMML	
171	COTTER PIN	4			ST.STL	COMML	1/8 x 1¼ LG

PRODUCTION CONTROL

REMARKS

½ MED SPRING

2 CLASS 304-CONDITION A

CLASS 1

20

6 CLASS [illegible]

13

11 .5

13

½-13UNC × 1½ LG

¼ × 8½ × 9

11 CLASS 1

CLASS A

SIZE #0

200

⅜ × 5 × 15 LG

3/8-16UNF

TYPE 304-CONDITION A

3/8 × 2½ LG

1/8 P.T.F. (SAE SHORT)

½-13UNC × 1½ LG

¼-10UNC × 1½ LG

3/8-16UNC × 1 LG

3/8-16UNC × 1½ LG

BEND 180° at 1" RADIUS

3/8 OD × 1/16 WALL × 53" LG

¼ NPT

⅛ × ½" LG. AMER STD GROOVED PIN

⅜-24 NF

¼-20 × ½ LG DRILLED HEAD

1/16 DIA

1/8 × 1½ LG

CERTIFICATION LEGEND

C CHEMICAL

P PHYSICAL

H HARDNESS

CC CERTIFICATION OF CONFORMANCE (TO BE USED FOR COMMERCIAL PRODUCTS SUCH AS STAKES, WIRE, BUSHINGS ETC.)

NT NONDESTRUCTIVE TEST CONSISTING OF:

- PT DYE PENETRANT INSPECTION
- MT MAGNETIC PARTICLE INSPECTION
- RT RADIOGRAPHIC INSPECTION
- P PRESSURE TEST
- UT ULTRASONIC TEST

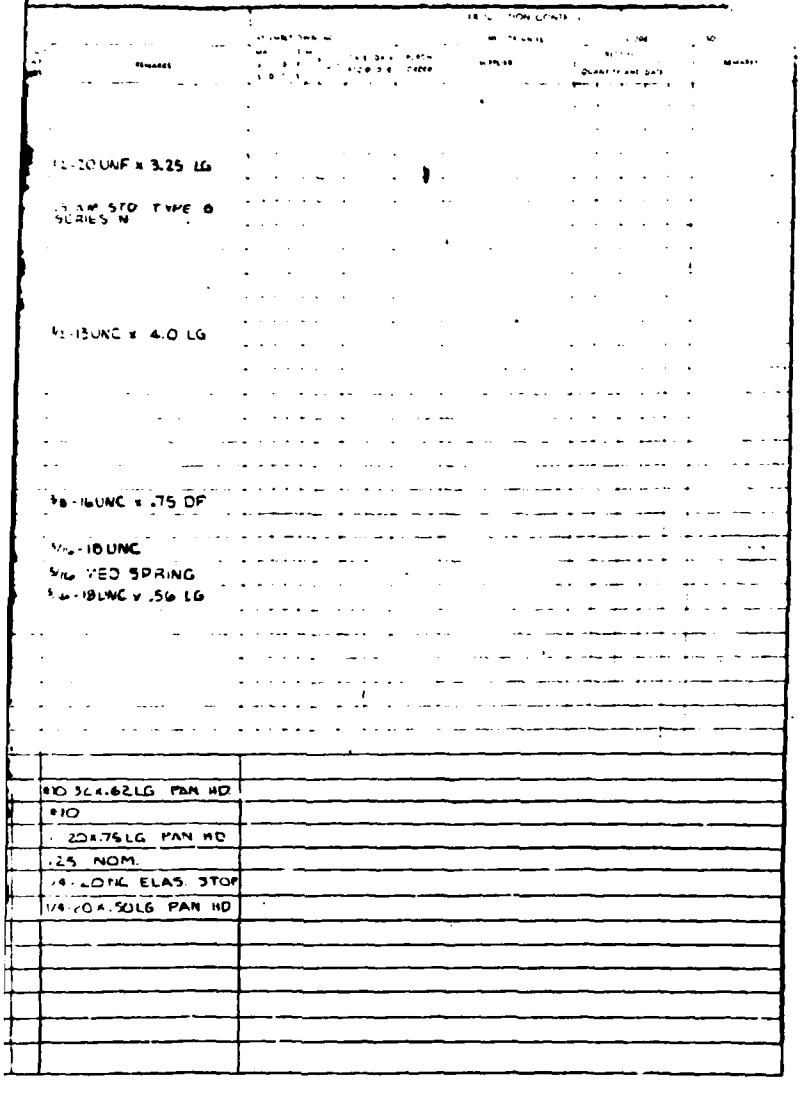
N NO CERTIFICATION REQUIRED

D316127D

Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 6 of 8)

LIST OF MATERIALS

[illegible]	NAME OF PART	[illegible]	[illegible]	NAME	MATERIAL	MATERIAL SPEC	REMARKS
172	END PLATE	4	B310434	WGC	STEEL	SEE DWG	
173	LOAD CELL	2	A307921	WGC	VAR	SEE DWG	
174	STUD	2	A306525	WGC	STEEL	STD DWG	
175	HEX HD CAP SCREW	2		COMML	STEEL	COMML	1/2-20 UNF x 3.25 LG
176	SPACER	2	A306526	WGC	STEEL	COMML	
177	FLAT WASHER	24		COMML	STEEL	COMML	.5 AM STD TYPE B SERIES N
178	ROD END COUPLER	4	LC-1-03	UN-ACT	STEEL	COMML	
179	FLEX PLATE	4	B310411	WGC	ST STL	SEE DWG	
180	MOUNTING BLOCK	4	B310412	WGC	STEEL	SEE DWG	
181	MOUNTING BLOCK	4	B310412	WGC	STEEL	SEE DWG	
182	HEX HD CAP SCREW	20		COMML	STEEL	GRD 5	1/2-13UNC x 4.0 LG
183	REDUCER ASSY	1	D316292	WGC		SEE DWG	
184	END FRAME	1	D313277	WGC	STEEL	SEE DWG	
185	END FRAME	1	D313276	WGC	STEEL	SEE DWG	
186	FRICTION PAD	.04	C312998	WGC		SEE DWG	
187	TIMING BELT	1	210L050	DODGE			
188	SIGNAL GENERATOR	1	D316338	WGC		SEE DWG	
189	HEX HD CAP SCREW	228		COMML	STEEL	COMML	5/8-16UNC x .75 DF
190	TIMING BELT GUARD	1	D316404	WGC	STEEL	SEE DWG	
191	THREADED INSERT	4	3585-SCN0-47	HELI-COIL			5/16-18 UNC
192	LOCK WASHER	4		COMML	STEEL	COMML	5/16 MED SPRING
193	HEX HD CAP SCREW	4		COMML	STEEL	COMML	5/16-18UNC x .56 LG
194	8x6x4 ENCLOSURE	1	A8064CHNFSS	HOFFMAN	ST STL		
195	PANEL	1	A-8P6	HOFFMAN	STEEL		
196	TERMINAL BOARD	1	6TB24	KULKA			
197	STUFFING TUBE	1	M19622/1005	DORN DANCO			
198	STUFFING TUBE	4	M19622/1001	DORN-DANCO			
199	PACKING ASSY	1	M19622/16-0016	DORN-DANCO			
200	PACKING ASSY	4	M19622/16-0005	DORN-DANCO			
201	MACHINE SCREW	2	116164	WGC	STEEL		#10 32x.62LG PAN HD
202	FLAT WASHER	2	153745	WGC	STEEL		#10
203	MACHINE SCREW	4	116541	WGC	STEEL		. 20x.75LG PAN HD
204	FLAT WASHER	9	153746	WGC	STEEL		.25 NOM.
205	HEX LOCKNUT	4	128100	WGC			/4-20NC ELAS STOP
206	MACHINE SCREW	9	116539	WGC	STEEL		1/4-20x.50LG PAN HD
207	MOUNTING CLIP	9	MECH-3-25	PANDUIT			
208	CABLE TIE	9	PRT6EH	PANDUIT			
209	CORROSION INHIB	1	A-HCI-1	HOFFMAN			
210	CABLE, 7 COND	A/R	MSCA-7	ANIXTER			
211	MACH. WIRING DIAG	0	C317802	WGC			
212	STR. CONN 1/2 FEMALE THD	4	CGK193	CROUSE-HINDS			



CERTIFICATION LEGEND

C CHEMICAL

P PHYSICAL

H HARDNESS

C C CERTIFICATION OF COMMERCIAL TO BE USED FOR COMMERCIAL PRODUCTS SUCH AS BRAKE, HUB BUSHINGS ETC.)

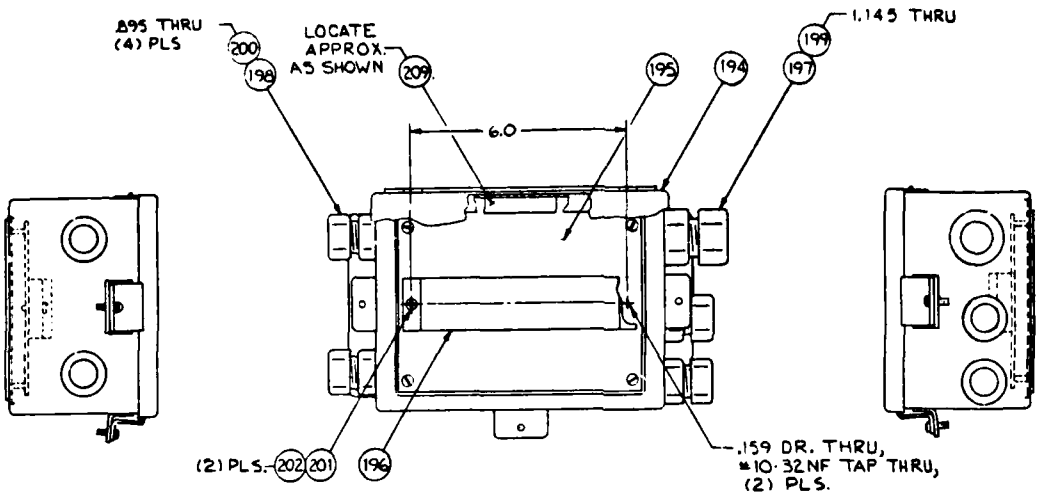
N D NONDESTRUCTIVE TEST CONSISTING OF

MT MAGNETIC PARTICLE INSPECTION
WT WEIGHT - FOR O.D. INSPECTION
RT RADIOGRAPHIC INSPECTION
PT PENETRANT TEST
UT ULTRASONIC TEST

N NO CERTIFICATION REQUIRED

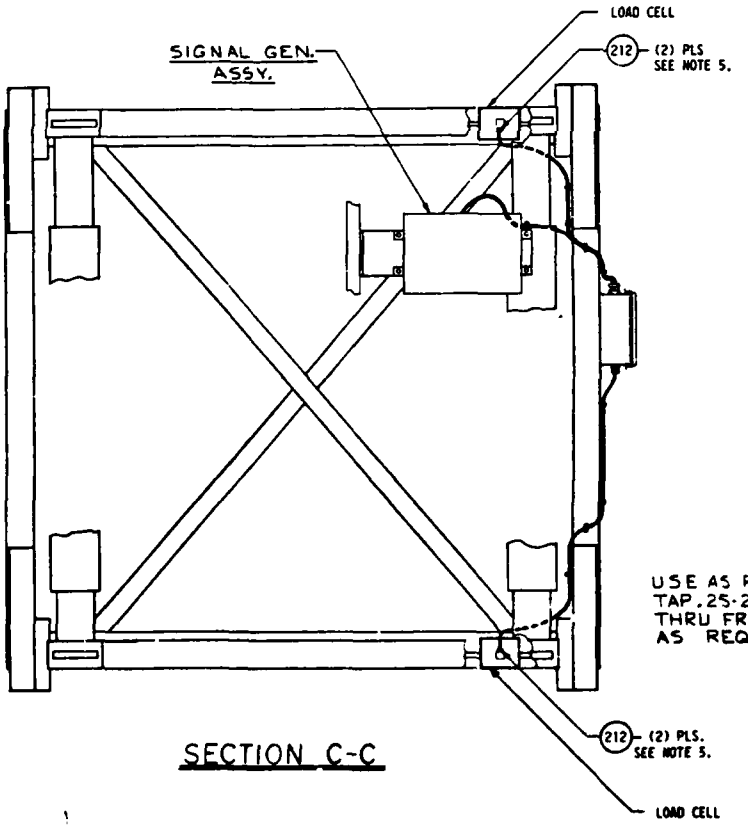
D316127D

Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 7 of 8)

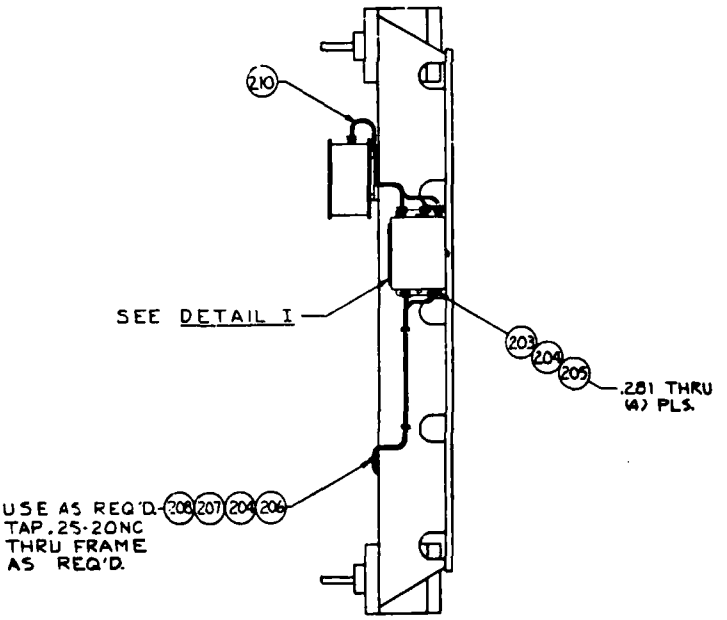


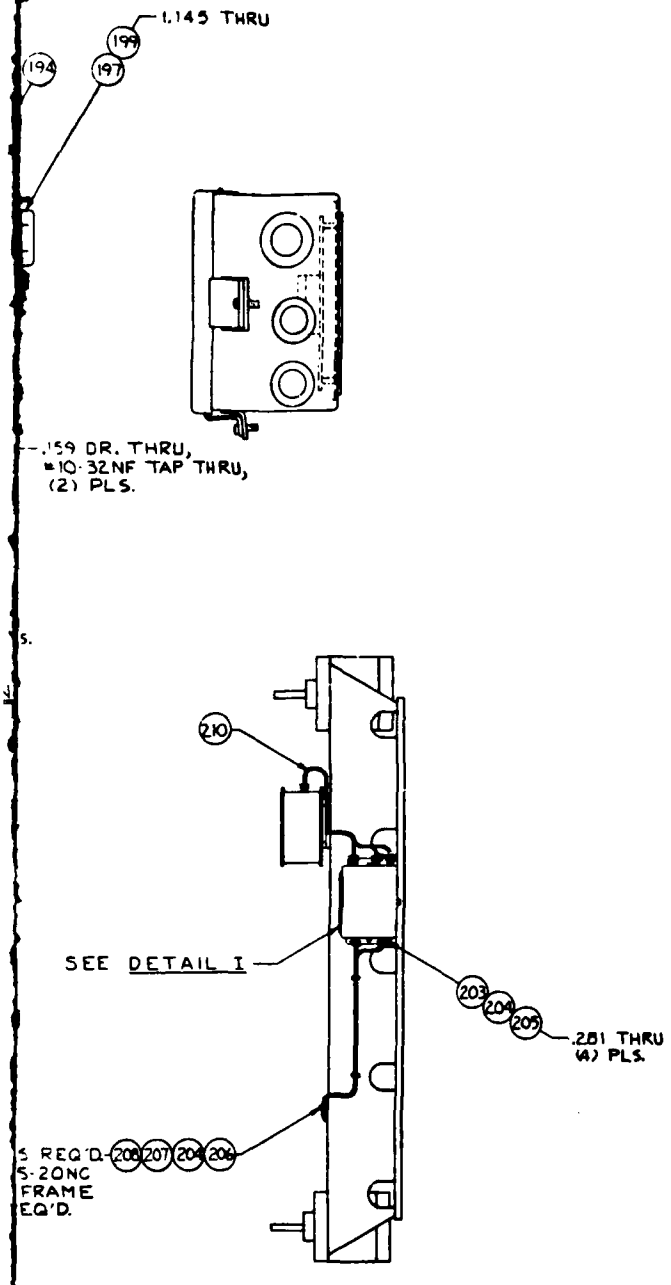
DETAIL I

ROTATED 90° CW



SECTION C-C



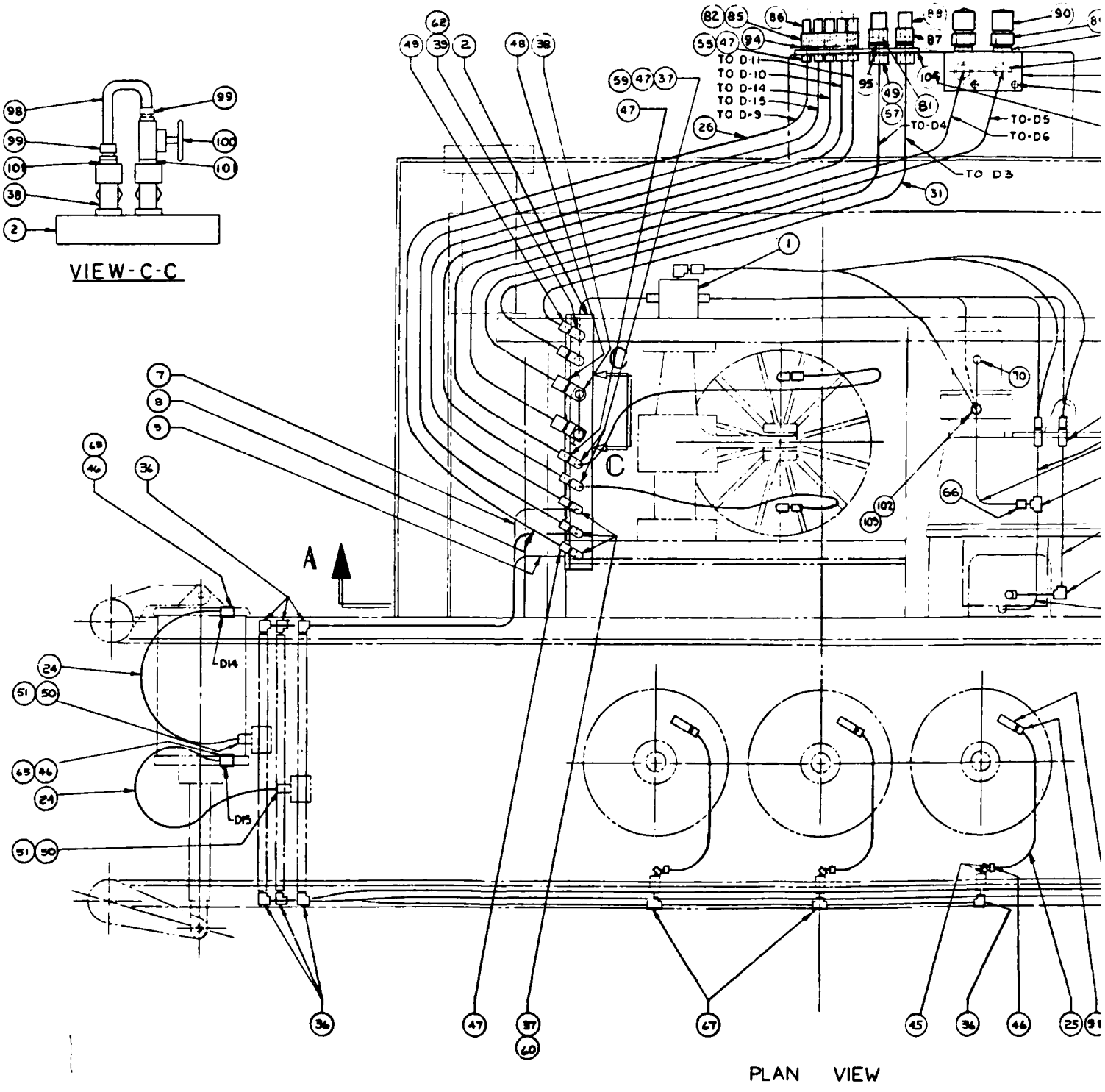


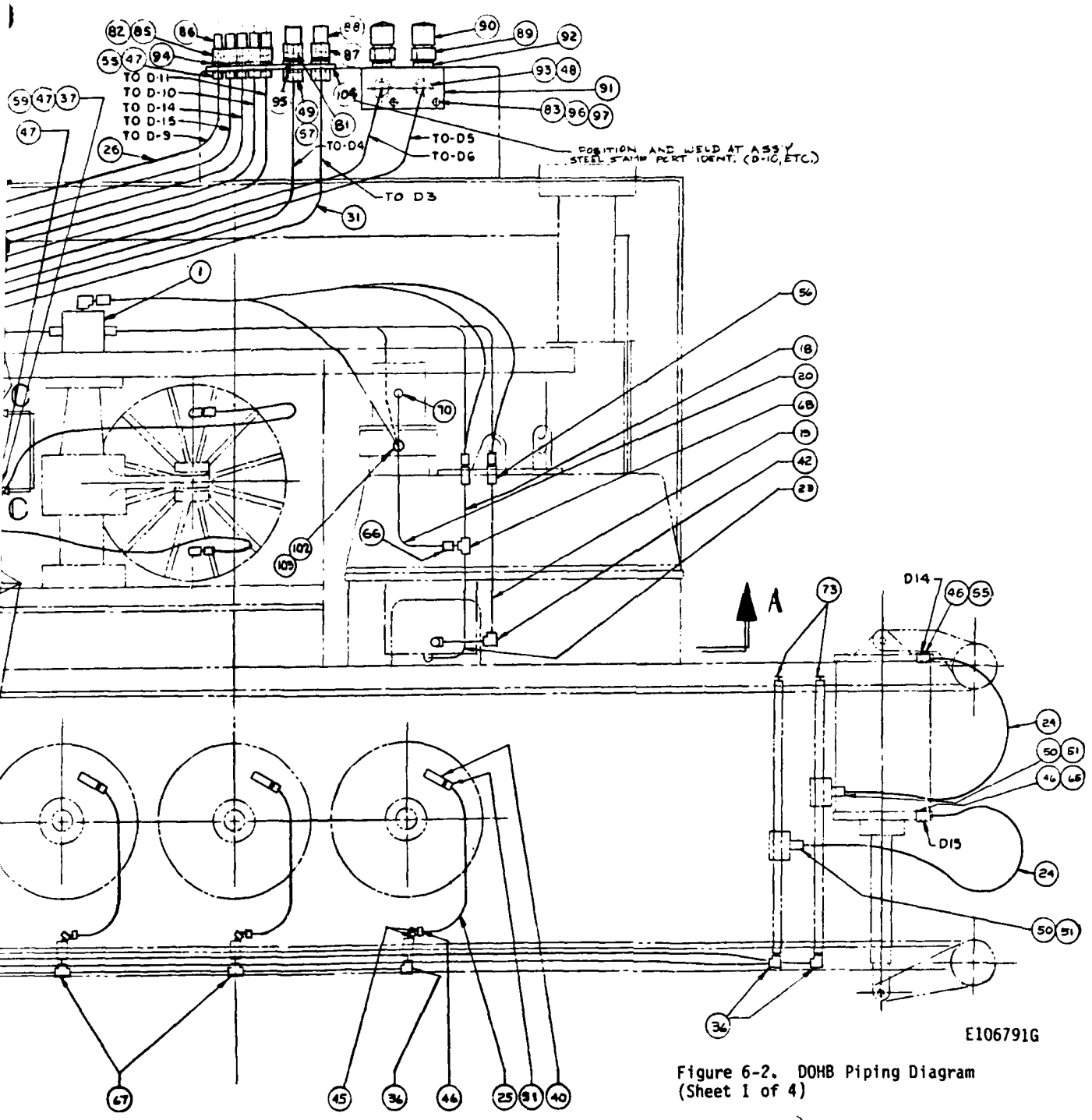
NOTES:

1. WIRE PER WGC DWG NO. C312802 (F/N 211).
2. APPLY "LOCTITE" 242 TO THREADS AT ASSY.
3. SEE WGC DWG NO. D316125, SH5 FOR J-BOX 3 DETAIL SHOWING ASSEMBLY OF QUICK DISCONNECT ELECTRICAL FITTINGS ON D.O.-H.B. J-BOX.
4. SEE WGC DWG NO. A307881 FOR J-BOX 3 QUICK DISCONNECT FITTING WIRING.
5. ADD STRAIN RELIEF FITTINGS, F/N 212, AFTER WRAPPING MALE THREADS WITH TEFLON TAPE. IF POSSIBLE, INSTALL LOAD CELLS SO THAT THEIR CABLES EXIT THE LOAD CELLS IN A HORIZONTAL DIRECTION TOWARDS THE INTERIOR OF THE MACHINE AS SHOWN.

D316127D

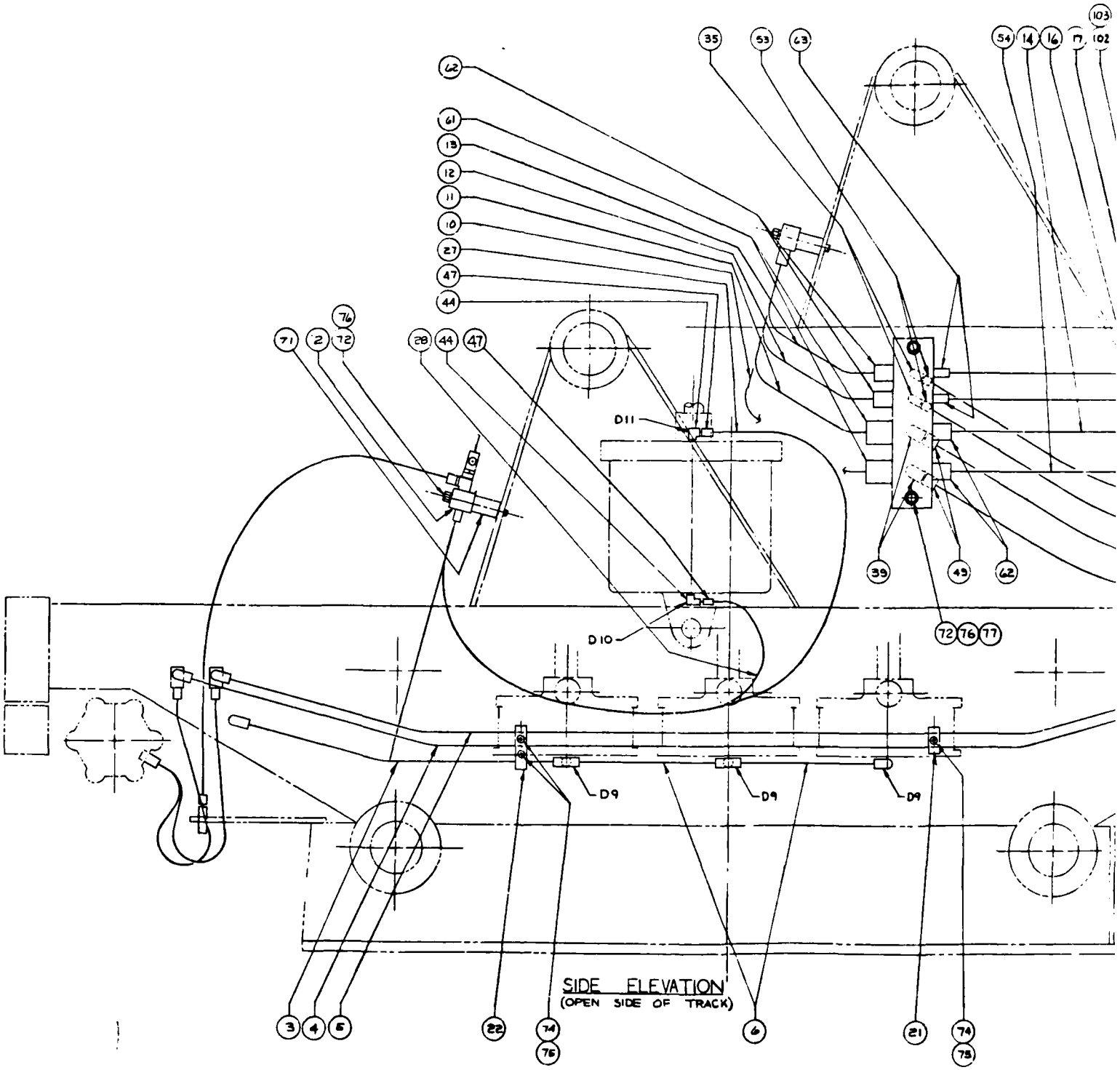
Figure 6-1. Draw Off-Holdback Machine Assembly (Sheet 8 of 8)


VIEW-C-C
TO D-11
TO D-10
TO D-14
TO D-15
TO D-9
TO-D4
TO-D5
TO-D6
TO D3
D14
D15
A
C
C
PLAN VIEW

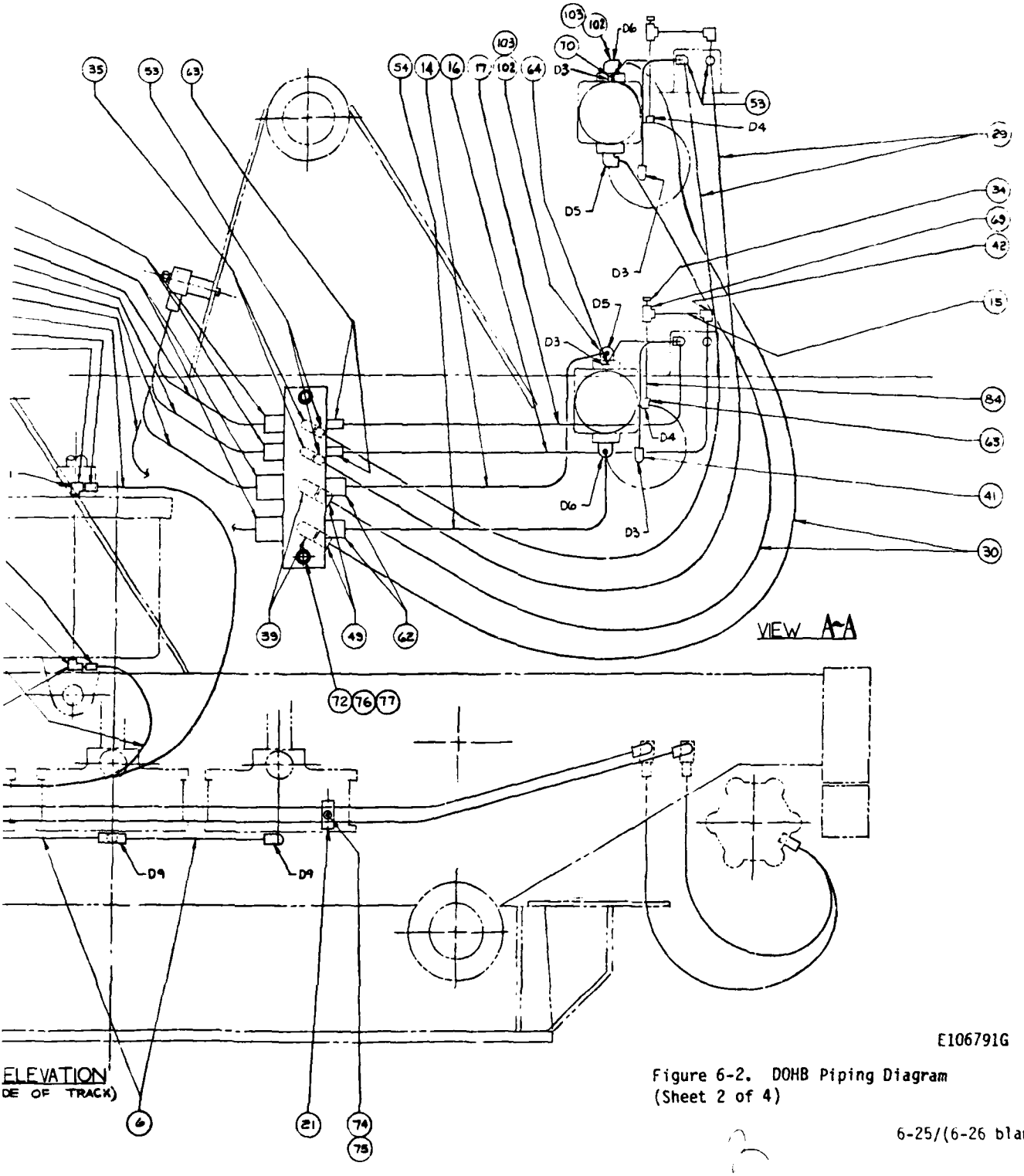


E106791G

Figure 6-2. DOHB Piping Diagram
(Sheet 1 of 4)



SIDE ELEVATION
(OPEN SIDE OF TRACK)



E106791G

Figure 6-2. DOHB Piping Diagram
(Sheet 2 of 4)

LIST OF MATERIALS FOR ONE UNIT

PART NO.	NAME OF PART	NO. REQ'D	MANUFACTURER'S PART OR DWG. NO.	MANUFACTURER NAME	MATERIAL	MATERIAL SPEC	REMARKS
1	MANIFOLD	1	C-111,551	WGC	STL	ASTM-A36	
2	MANIFOLD	1	C-111,555	WGC	STL	ASTM-A36	
3	TUBING	1		COMML	STL	ASTM A269 TYPE 304	3/8 OD x .065 WALL x 26 3/4 LG
4	TUBING	1		COMML	STL		3/8 OD x .065 WALL x 86 LG
5	TUBING	1		COMML	STL		3/8 OD x .065 WALL x 81 LG
6	TUBING	2		COMML	STL		3/8 OD x .065 WALL x 11 LG
7	TUBING	1		COMML	STL		3/8 OD x .065 WALL x 39 LG
8	TUBING	1		COMML	STL		3/8 OD x .065 WALL x 37 LG
9	TUBING	1		COMML	STL		3/8 OD x .065 WALL x 35 LG
10	TUBING	1		COMML	STL		1" OD x .120 WALL x 32½LG
11	TUBING	1		COMML	STL		1" OD x .120 WALL x 26½LG
12	TUBING	1		COMML	STL		3/4 OD x [illegible] WALL x 24½LG
13	TUBING	1		COMML	STL		3/4 OD x [illegible] WALL x 20 LG
14	TUBING	1		COMML	STL		3/4 OD x [illegible] WALL x 31 LG
15	TUBING	2		COMML	STL		5/8 OD x [illegible] WALL x 5 LG
16	TUBING	1		COMML	STL		5/8 OD x [illegible] WALL x 39½LG
17	TUBING	1		COMML	STL		5/8 OD x [illegible] WALL x 37½LG
18	TUBING	2		COMML	STL		5/8 OD x [illegible] WALL x 2 LG
19	TUBING	2		COMML	STL		5/8 OD x [illegible] WALL x 12 LG
20	TUBING	2		COMML	STL	ASTM A269 TYPE 304	5/8 OD x .065 WALL x 13½LG
21	TUBE CLAMP	1	C-111,533	WGC	STL	ASTM-A36	
22	TUBE CLAMP	1	C-111,534	WGC	STL	ASTM-A36	
23	TUBING	2		COMML	STL	ASTM A269 TYPE 304	5/8 OD x [illegible] WALL x 17 6
24	HOSE	4	301-4	PARKER	VAR	COMML	1/4 ID x 24 LG
25	HOSE	3	301-4	PARKER	VAR	COMML	1/4 ID x 14 LG
26	HOSE	5	301-6	PARKER	VAR	COMML	3/8 ID x 79 LG
27	HOSE	1	301-6	PARKER	VAR	COMML	3/8 ID x 57 LG
28	HOSE	1	301-6	PARKER	VAR	COMML	3/8 ID x 46 LG
29	HOSE	2	301-8	PARKER	VAR	COMML	1/2 ID x 63"LG
30	HOSE	2	301-12	PARKER	VAR	COMML	3/4 ID x 51"LG
31	HOSE	2	301-12	PARKER	VAR	COMML	3/4 ID x 79"LG
32	HOSE	2	341-16	PARKER	VAR	COMML	1" ID x 84"LG
33							
34	CAP	2	10 FNU-S	PARKER	STL	COMML	5/8 TUBE
35	STR THD ELBOW	2	10-C50U-S	PARKER	STL	COMML	5/8 TUBE
36	MALE ELBOW	9	6-CBU-S	PARKER	STL	COMML	3/8 TUBE TO 1/4 PIPE
37	STR. THD. ELBOW	5	6-C50U-S	PARKER	STL	COMML	3/8 TUBE
38	STR THD TEE	2	16-R5BU-S	PARKER	STL	COMML	1" TUBE
39	STR THD ELBOW	5	12-C50U-S	PARKER	STL	COMML	3/4 TUBE
40	MALE ELBOW	3	4-CDU-S	PARKER	STL	COMML	1/4 TUBE TO 1/8 PIPE
41	MALE ELBOW	2	10-6CBU-S	PARKER	STL	COMML	5/8 TUBE TO 3/8 PIPE
42	UNION ELBOW	2	10-EBU-S	PARKER	STL	COMML	5/8 TUBE
43	STR THD ELBOW	3	12-C50U-S	PARKER	STL	COMML	3/4 TUBE
44	MALE ELBOW	2	6-2CDU-S	PARKER	STL	COMML	3/8 TUBE TO 1/8 PIPE
45	STREET ELBOW 45°	6	1/4-CD45-S	PARKER	STL	COMML	1/4 NPT
46	MALE PIPE THD CONN.	7	20130-4-4	PARKER	STL	COMML	1/4 HOSE TO 1/4 PIPE
47	SWIVEL NUT CONNECTOR	10	21230-6-6	PARKER	STL	COMML	3/8 TUBE TO 3/8 HOSE
48	SWIVEL NUT CONNECTOR	2	21230-16-16	PARKER	STL	COMML	1" TUBE TO 1" HOSE
49	SWIVEL NUT CONNECTOR	6	21230-12-12	PARKER	STL	COMML	3/4 TUBE TO 3/4 HOSE
50	MALE CONNECTOR	4	4-4F0U-S	PARKER	STL	COMML	1/4 TUBE TO 1/4 PIPE
51	SWIVEL NUT CONNECTOR	7	21230-4-4	PARKER	STL	COMML	1/4 TUBE TO 1/4 HOSE
52							
53	FLARELESS SWIVEL	4	21230-10-8	PARKER	STL	COMML	5/8 TUBE TO 1/2 HOSE
54	TUBING	1		COMML	STL	ASTM A269 TYPE 304	3/4 OD x [illegible] WALL x 34LG
55	BULKHEAD UNION	5	6 WBU-S	PARKER	STL	COMML	3/8 TUBE DELETE (1) NUT (1) FERRULE
56	BULKHEAD UNION	4	10 WBU-S	PARKER	STL	COMML	5/8 TUBE DELETE (1) NUT (1) FERRULE
57	BULKHEAD UNION	2	12 WBU-S	PARKER	STL	COMML	3/4 TUBE DELETE (1) NUT (1) FERRULE
58							
59	STR THD CONNEC[illegible]	2	6 [illegible]U-S	PARKER	STL	COMML	[illegible]

NOTES:

1. For interconnecting piping by shipyard see W.E.C. Dwg. E-106,849
2. For Hydraulic Schematic see W.E.C. Dwg. E-106,682
3. For [illegible] Machine assy. see W.E.C. Dwg. E-106,739

E106791G

Figure 6-2. DOHB Piping Diagram
(Sheet 3 of 4)

LIST OF MATERIALS

PART NO.	NAME OF PART	NO. REQ'D	SERVICE PART OR DWG NO. (MANUFACTURER)	NAME (MANUFACTURER)	MATERIAL	MATERIAL SPEC.	ALTERNATE SPEC.	UNIT WT. LB.	REMARKS
78									
79									
80									
81	ADAPTER	2	2244-12-12	AEROQUIP	[illegible]	COMML			3/4 FLT MALE/1 1/16 STHD FEM
82	ADAPTER	5	6404-6-6	AIRWAY	STL	COMML	[illegible]		3/8 NPT MALE/9/16 ST THD FEM
83	LOCK WASHER	2		COM'L	STL	COM'L			3/8 MED.
84	TUBING	2		COMML	STL	ASTM A 269 TYPE 304			1/8 OD x .035 WALL x 4 LG
85	QUICK DISCONNECT NIPPLE	5	SYHN 16-6F	[illegible]	S.STL	COM'L			
86	DUST CAP	5	PDC-6	[illegible]		COM'L			
87	QUICK DISCONNECT NIPPLE	2	SYHN 12-12F	[illegible]	S.STL	COM'L			
88	DUST CAP	2	PDC-12	[illegible]	PLASTIC	COM'L			
89	QUICK DISCONNECT NIPPLE	2	7IN16-20-2F	[illegible]	S.STL	COM'L			
90	DUST CAP	2	7INC-16	[illegible]	RUBBER	COM'L			
91	MANIFOLD	1	C313670	[illegible]	STL	ASTM A36			
92	UNION	2	20FSOFSO-S	PARKER	STL	COM'L			
93	STR. THD CONNECTOR	2	16F5BU-S	PARKER	STL	COM'L			
94	"O" RING	5	3-6	PARKER	BUNA N	COM'L			.464 ID. X .078 W.
95	"O" RING	2	3-12	PARKER	BUNA N	COM'L			.924 ID. X .116 W.
96	HEX. HD. CAP SCR.	2		COM'L	STL	COM'L			3/8-16 NC X 4.50 LG.
97	HEX NUT	2		COM'L	STL	COM'L			3/8-16 NC.
98	TUBING	1		COMML	STL				1/2 OD x .065 WALL x 24 LG
99	ST THD CONNECTOR	2	8-F5BU-S	PARKER	STL	COMML			
100	VALVE	1	10-0-1-8-T	[illegible]	STL	COMML			
101	TUBE END REDUCER	2	16-8 TRBU-S	PARKER	[illegible]	COMML			
102	MALE CONNECTOR	4	12-16FBTX-S	PARKER	STL	COMML			
103	SWIVEL NUT ELBOW	4	12 C6BX-S	PARKER	STL	COMML			
104	BRACKET	1	C313742	[illegible]	STL	ASTM A 36			

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Figure 6-2. DOHB Piping Diagram
(Sheet 4 of 4)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC
					PART OR DWG NO.	NAME		
1	D4	PLATE .38x5.00x21.5	1				HRS	ASTM A36
2	A5	PLATE .38x1.0x5.0	1				HRS	ASTM A36
3	C2	LOWER FRAME	1		E-106,805			
4	C6	TUBE	5		B-111,830		STL	AISI-M1015
5	D5	T-FITTING	5		B-111,829		STL	ASTM A7
6	C5	TUBE	5		B-111,831		STL	AISI-M1015
7	B4	ANGLE 2x1.5x.19x5016	1				STL	ASTM A36

Figure 6-3. Lower Frame Mod
Refurbishment - DOHB Machine

	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC
			PART OR DWG NO.	NAME		
21.5	1				HRS	ASTM A36
.0	1				HRS	ASTM A36
	1		E-106,805			
	5		B-111,830		STL	AISI-M1015
	5		B-111,829		STL	ASTM A7
	5		B-111,831		STL	AISI-M1015
5016	1				STL	ASTM A36

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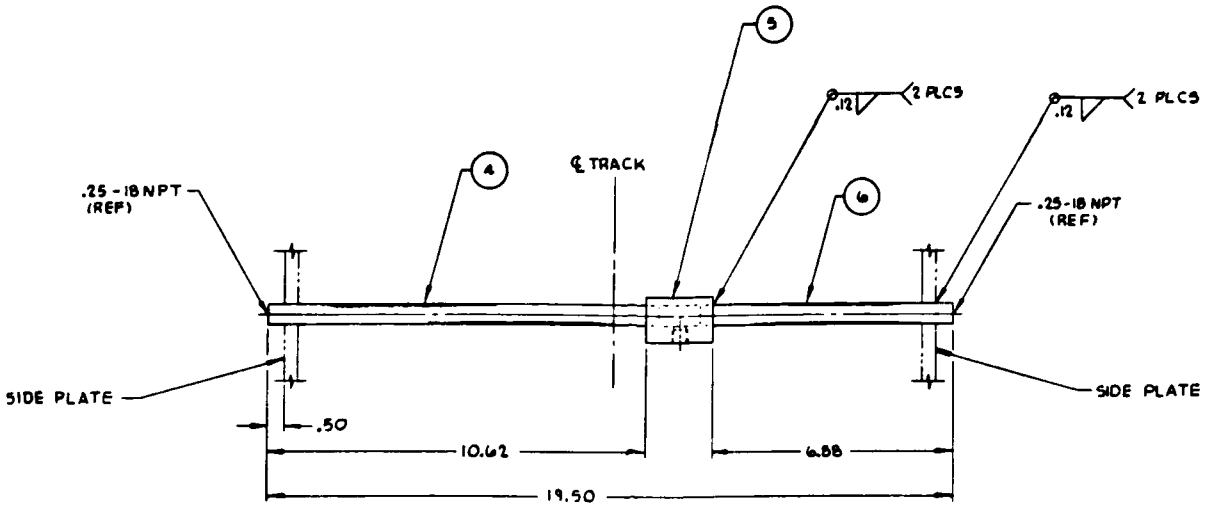
Figure 6-3. Lower Frame Modification and Refurbishment - DOHB Machine (Sheet 1 of 3)



DETAIL 13
(AIR PIPE)
SCALE: 1/2
NOTE: POSITION F/N'S 4,5 & 6 AS SHOWN ON PLAN VIEW (SHT 1).

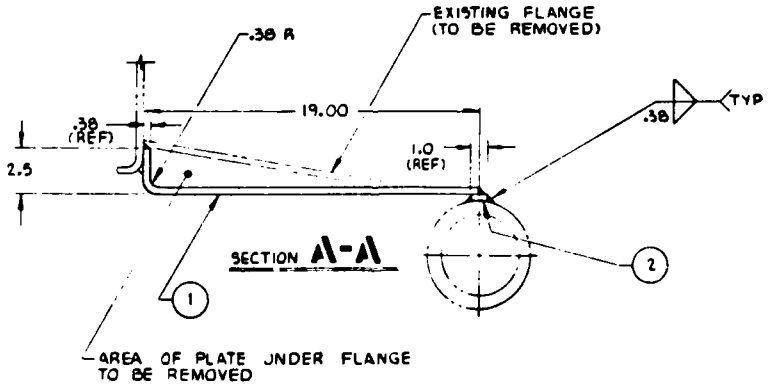
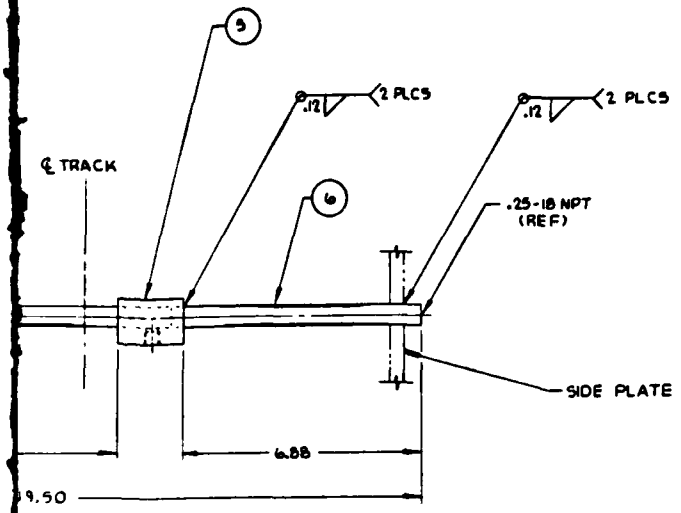
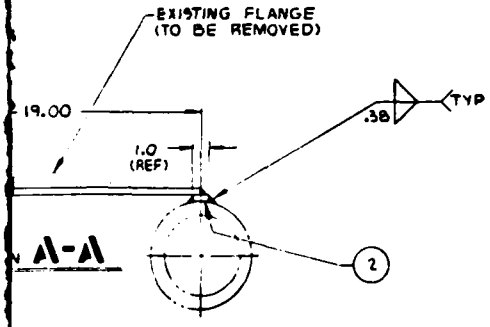


Figure 6-3. L
Refurbishment -



TAIL 13
PIPE)
LE: 1/2
E: POSITION P/N'S 4,5 & 6 AS SHOWN
ON PLAN VIEW (SHT 1).



DER FLANGE

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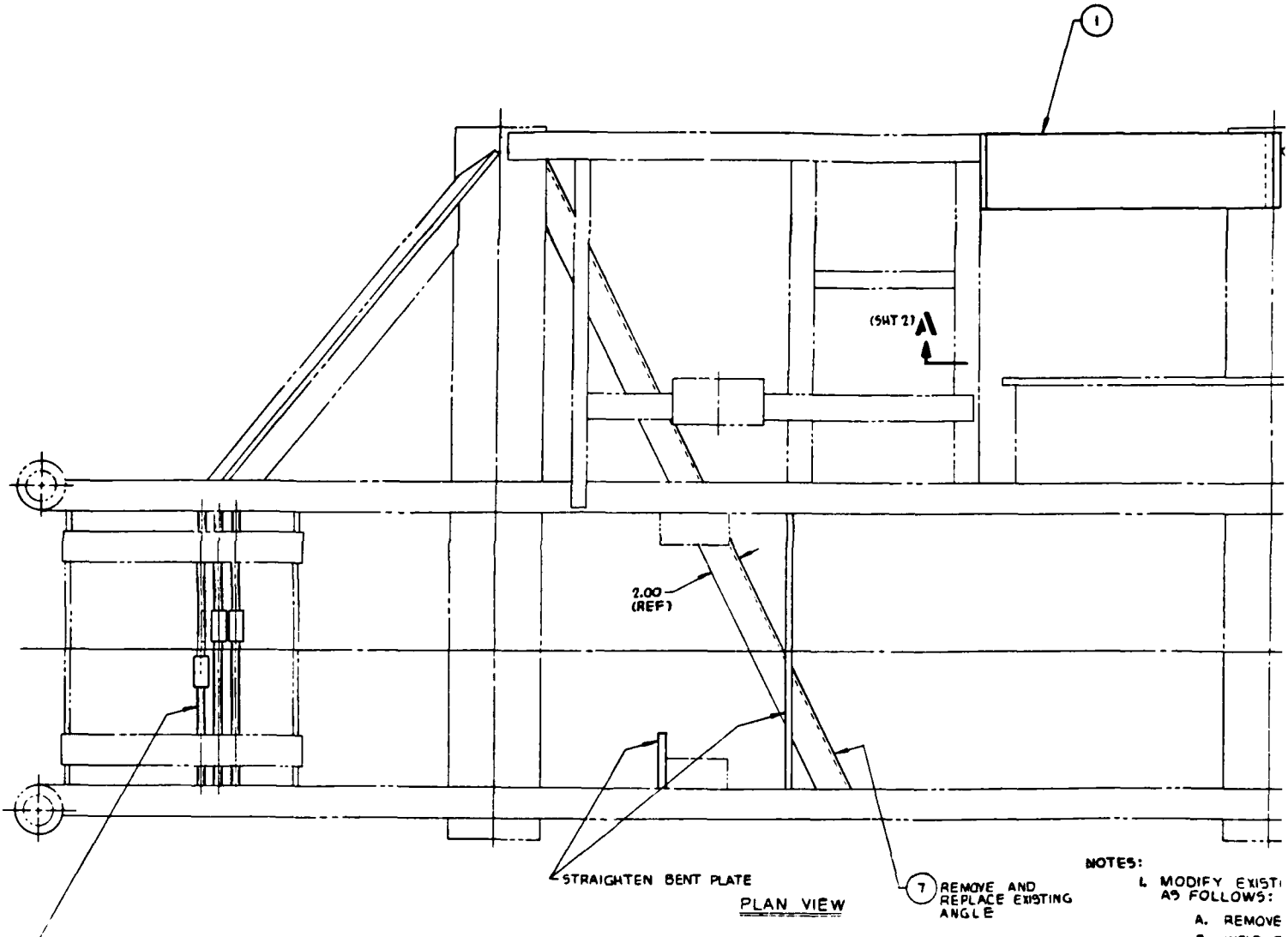
Figure 6-3. Lower Frame Modification and Refurbishment - DOHB Machine (Sheet 2 of 3)



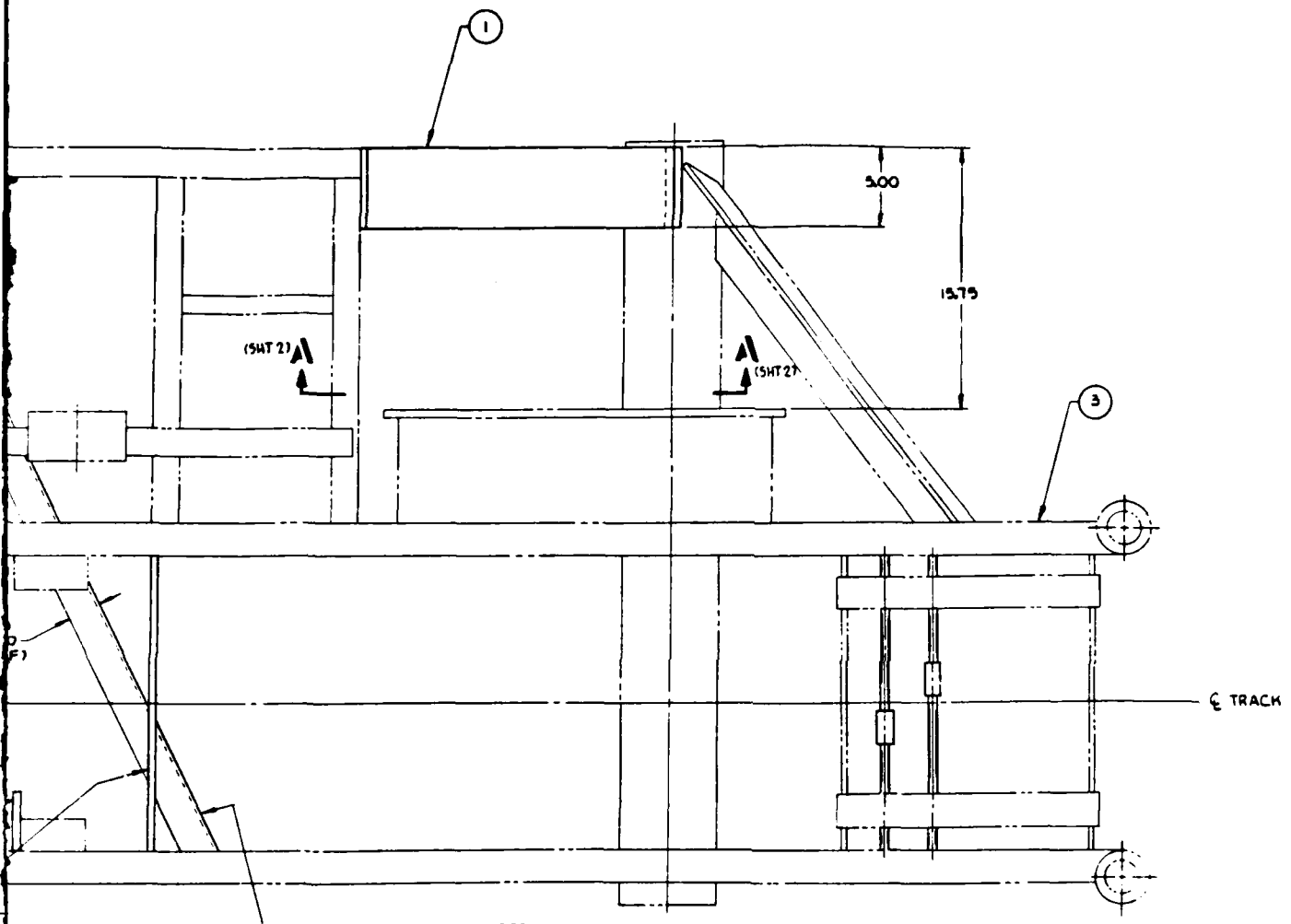
PLAN VIEW

NOTES:

1. MODIFY EXIST
AS FOLLOWS:
   A. REMOVE
   B. WELD F
   C. FIT F/N
OF PLA
WELD
2. WELD PER W.G.
3. ALL WELDS TO

NOTES (CONT)

4. REWORK FRAME AS FOLLOWS:
   A. INSPECT FRAME FOR DAMAGE NOT CORRECTED BY THIS DRAWING AND REPORT TO ENGINEERING.
   B. REWORK FRAME AS SHOWN.
   C. AFTER REWORK CLEAN MACHINED BORES AND CHECK FOR BORE ALIGNMENT. (REF DWG E-106, 805).
   D. PROTECT MACHINED BORES AND TAPPED HOLES, THEN SANDBLAST AND PAINT.



BENT PLATE

PLAN VIEW

NOTES:

1. MODIFY EXISTING LOWER FRAME (E-106,805 STBD) AS FOLLOWS:
   - A. REMOVE EXISTING FLANGE (SEE SECTION A-A).
   - B. WELD F/N 2 AS SHOWN.
   - C. FIT F/N 1 AS SHOWN BY REMOVING AREA OF PLATE UNDER FLANGE AS SHOWN AND WELD F/N 1 AS SHOWN.
2. WELD PER W.G.C. PROCEDURE NO. 752.
3. ALL WELDS TO BE CONTINUOUS.

OTES (CONT)

4. REWORK FRAME AS FOLLOWS:
   - A. INSPECT FRAME FOR DAMAGE NOT CORRECTED BY THIS DRAWING AND REPORT TO ENGINEERING.
   - B. REWORK FRAME AS SHOWN.
   - C. AFTER REWORK CLEAN MACHINED BORES AND CHECK FOR BORE ALIGNMENT. (REF DWG E-106,803).
   - D. PROTECT MACHINED BORES AND TAPPED HOLES, THEN SANDBLAST AND PAINT.

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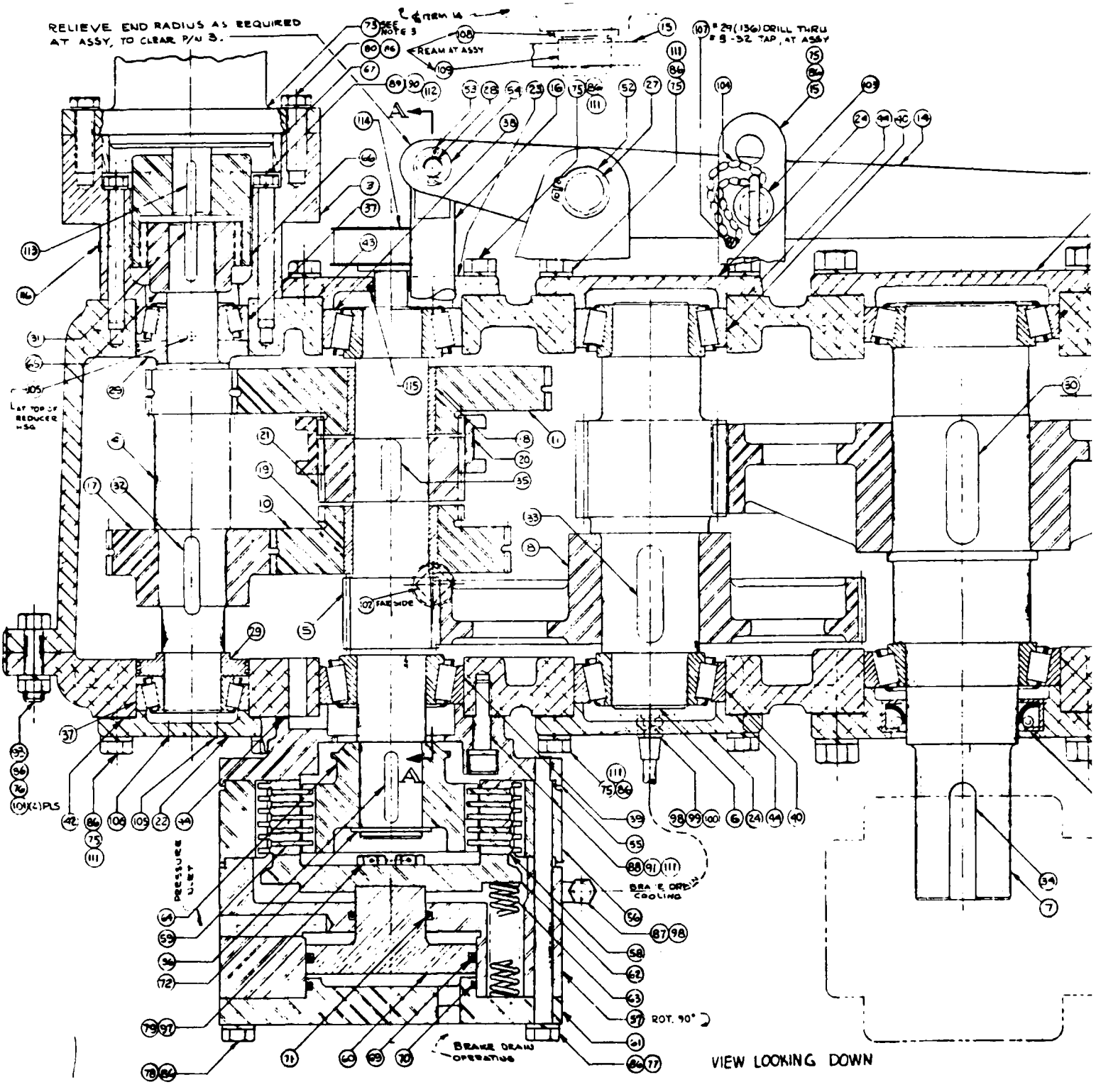
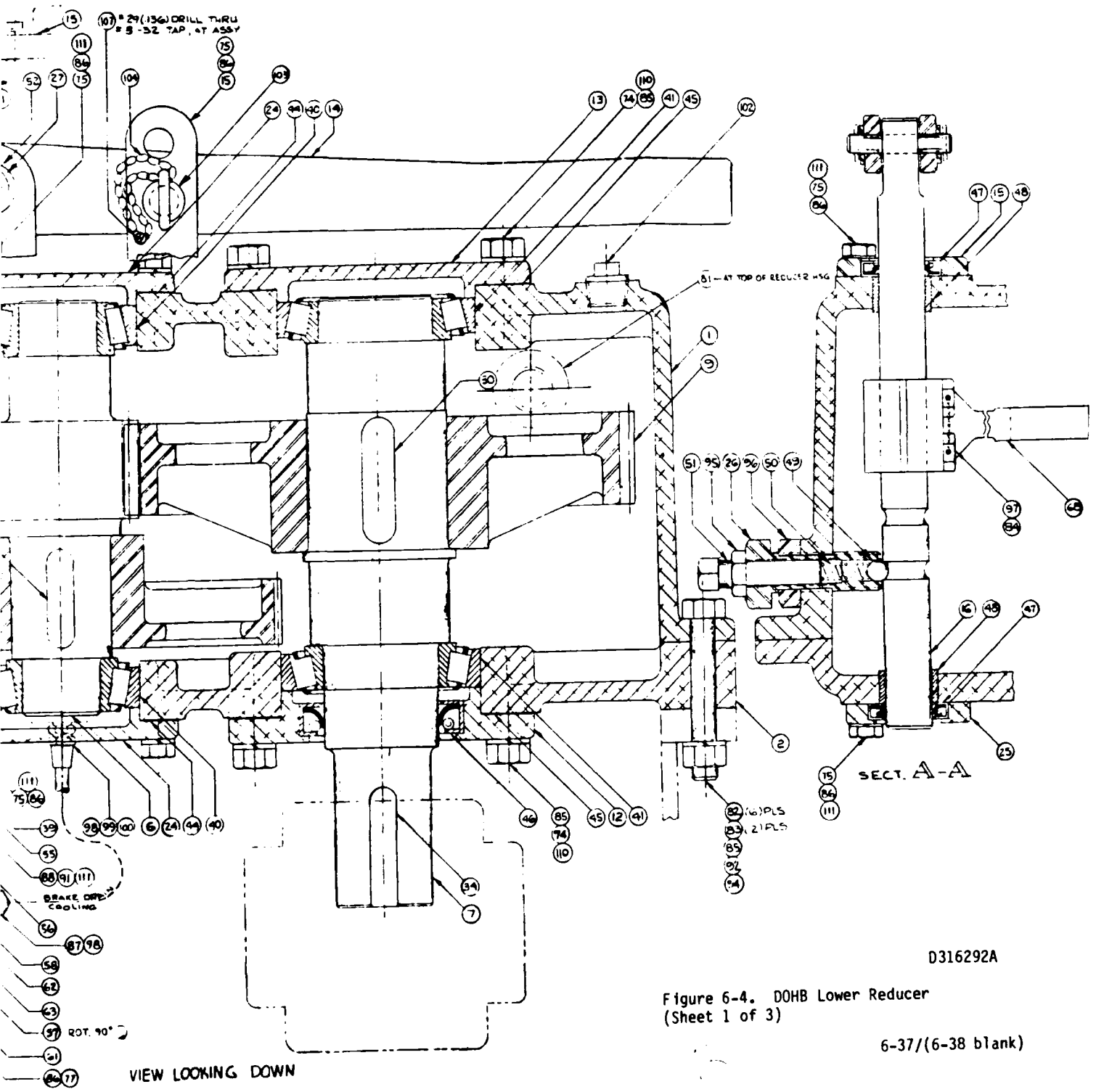
Figure 6-3. Lower Frame Modification and Refurbishment - DOHB Machine (Sheet 3 of 3)


RELIEVE END RADIUS AS REQUIRED AT ASSY. TO CLEAR P/N 3.
SEE NOTE 3
ITEM 14
REAM AT ASSY
#29 (.136) DRILL THRU
#9-32 TAP, AT ASSY
FAR SIDE
AT TOP OF REDUCER HSG.
PRESSURE JET
BRAKE DRAW OPERATING
BRAKE DRAW COOLING
ROT. 90°
VIEW LOOKING DOWN



D316292A

Figure 6-4. DOHB Lower Reducer
(Sheet 1 of 3)

LIST OF MATERIALS FOR ONE REDUCER ASSY.

PART NO	NAME OF PART	NO REQ'D	MANUFACTURER SERVICE PART OR DWG NO	MANUFACTURER NAME	MATERIAL	MATERIAL SPEC	REQUIRED CERTS	ALTERNATE SPEC (FOR BUYT REFERENCE)	UNIT WT LBS	REMARKS	ASSEMBLY DWG NO / MAT'L CODE NO	QTY	DATE MOD	DATE DUE	PURCH ORDER
1	REDUCER HOUSING (ADJ)	1	C313007	WGC	CAST AL	AL 356-T6			25						
2	REDUCER BASE	1	E-106,806	WGC	CAST AL	AL 356-T6			22						
3	ADAPTER HOUSING	1	C312974	WGC	STL	AISI C1018C.F.			10						
4	H. S. SHAFT	1	D-106,452	WGC	STL	AISI 4140			4.1						
5	INT. PINION SHAFT (MOD)	1	C313000	WGC	STL	AISI 4140			4.9						
6	SPUR PINION	1	D-200,525	WGC	STL	AISI 8620			6.8						
7	OUTPUT SHAFT	1	D-200,524	WGC	STL	AISI 4140			14.5						
8	HELICAL GEAR	1	D-200,522	WGC	CAST,STL	QQ-S-681b			12.1	CL 4C2					
9	SPUR GEAR	1	D-200,521	WGC	CAST,STL	SAE 8620			14.0	CARBURIZE					
10	GEAR	1	D-200,520	WGC	STL	AISI 4140			4.4						
11	GEAR	1	D-106,454	WGC	STL	AISI 4140			7.2						
12	RETAINER	1	D-200,518	WGC	CAST AL	356-T6			1.5						
13	RETAINER	1	D-200,517	WGC	CAST AL	356-T6			1.0						
14	LEVER	1	D-200,515	WGC	CAST STL	QQ-S-681b			4.0	CL 1					
15	BRACKET	1	D-106,449	WGC	CAST STL	QQ-S-681b			4.6	CL 1					
16	SHIFT ROD	1	C-200,642	WGC	ST.STL	QQ-S-763			1.5	CL 304 COND. A					
17	GEAR	1	C-200,687	WGC	STL	AISI 4140			4.2						
18	BUSHING	1	C-200,686	WGC	BRONZE	SAE 660			.5						
19	BUSHING	1	C-200,685	WGC	BRONZE	SAE 660			.5						
20	CLUTCH COLLAR	1	C-200,684	WGC	STL	AISI 4140			1.4						
21	CLUTCH SPLINE	1	C-200,683	WGC	STL	AISI 4140			1.8						
22	RETAINER	1	C-111,617	WGC	CAST AL	356-T6			.2						
23	RETAINER	1	C313001	WGC	CAST AL	356-T6			.6						
24	RETAINER	2	C-200,680	WGC	CAST AL	356-T6			.7						
25	RETAINER	1	C-200,679	WGC	CAST AL	356-T6									
26	CAPSCREW	1	B-200,461	WGC	STL	COMM									
27	PIN	1	B-200,450	WGC	ST.STL	QQ-S-763				CL 304 COND A					
28	PIN	1	B-200,459	WGC	ST.STL	QQ-S-763				CL 304 COND A					
29	GREASE RING	2	B-200,458	WGC	STL	ASTM-A7									
30	KEY	1	B-200,457	WGC	STL	AISI C1018									
31	KEY	1	B-200,456	WGC	STL	AISI C1018									
32	KEY	1	B-200,455	WGC	STL	AISI C1018									
33	KEY	1	B-200,454	WGC	STL	AISI C1018									
34	KEY	1	B-200,453	WGC	STL	AISI C1018									
35	KEY	1	B-200,452	WGC	STL	AISI C1018									
36	KEY	1	B-200,451	WGC	STL	AISI C1018									
37	BEARING	2	15579-15520	TIMKEN	STL	COMM									
38	BEARING	1	2558-2523	TIMKEN	STL	COMM									
39	BEARING	1	2793-27354	TIMKEN	STL	COMM									
40	BEARING	2	2788-2720	TIMKEN	STL	COMM									
41	BEARING	2	387A-382	TIMKEN	STL	COMM									
42	SHIM	1 SET	K-209	TIMKEN	BRASS	COMM									
43	SHIM	1 SET	K-211	TIMKEN	BRASS	COMM									
44	SHIM	3 SETS	K-212	TIMKEN	BRASS	COMM									
45	SHIM	2 SETS	K-216	TIMKEN	BRASS	COMM									
46	SEAL	1	63X7382H1	GARLOCK	VAR	COMM									
47	SEAL	2	94 x 0215	GARLOCK	VAR	COMM									
48	BUSHING	2	AA-1108	KINGWELL	OILITE	COMM									
49	DETENT BALL	1		COMM	STL	COMM				3/8 DIA HARDENED					
50	DETENT SPRING (COMM/MOD)	1	#5	CHAGIN	STL	COMM				11/32 OD x 1½ LG					
51	SQ HD SET SCREW	1		COMM	STL	COMM				½-13NC x 2 LG					
52	RETAINER RING	2	5100-87	WALDES	STL	COMM									
53	COTTER PIN	2		COMM	BRASS	COMM				3/32 DIA x ½ LG					
54	WASHER PLAIN	2		COMM	BRASS	COMM				3/8 ID MED					
55	ADAPTER	1	D-200,529	WGC	CAST STL	QQ-S-681b			9.0	CL 1					
56	BRAKE GEAR HOUSING	1	D-200,531	WGC	CAST STL	QQ-S-681b			5.1	CL 1					
57	SPRING HOUSING	1	D-200,530	WGC	CAST STL	QQ-S-681b			10.0	CL 1					
58	FRICTION PLATE	6	C-200,692	WGC	VAR	COMM			.2						
59	SEPARATER PLATE	5	C-200,691	WGC	STL	QQ-S-633			.3	FS-1070					

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Figure 6-4. DOHB Lower Reducer
(Sheet 2 of 3)

LIST OF MATERIALS FOR ONE REDUCER ASSY.

PART NO.	NAME OF PART	NO REQ'D	MANUFACTURER: SERVICE PART OR DWG NO	MANUFACTURER: NAME	MATERIAL	MATERIAL SPEC	REQUIRED CERTS	ALTERNATE SPEC (FOR GOV'T REFERENCE)	UNIT WT LBS	REMARKS	ASSEMBLY DWG NO / MAT'L CODE	QTY	DATE REQ'D	DATE DUE	PURCH ORDER
78	HEX HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1½ LG					
79	HEX HD CAPSCREW	3		COMML	STL	COMML				5/16-18UNC x 7/8 LG (DRILLED HEAD)					
80	HEX HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1.38 LG					
81	BREATHER	1	MODEL 200T17	AIR MAZE	VARIOUS	COMML			25	3/8 NPT					
82	HEX HD CAPSCREW	6		COMML	STL	COMML				½-13UNC x 2½ LG					
83	HEX HD CAPSCREW	2	B-112-279	WGC	STL	AISI C1018									
84	HEX HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1½ LG (DRILLED HEAD)					
85	LOCKWASHER	1-1		COMML	STL	COMML				½ ID MED					
86	LOCKWASHER	5C		COMML	STL	COMML				3/8 ID MED					
87	90° ELBOW	1	49-F	IMPERIAL	BRASS	COMML				5/16" TUBE x 1/8 NPT					
88	HI-COLLAR LOCKWASHER	4		COMML	STL	COMML				3/8 ID					
89	HI-COLLAR LOCKWASHER	8		COMML	STL	COMML				5/16 ID					
90	SOCKET HD CAPSCREW	8		COMML	STL	COMML				5/16-18UNC x 2½ LG					
91	SOCKET HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1½ LG					
92	HEX NUT	2		COMML	STL	COMML				⅝-11 UNC					
93	HEX NUT	8		COMML	STL	COMML				3/8-16UNC					
94	LOCK WASHER	2								5/8 ID MED.					
95	JAM NUT	1		COMML	STL	COMML				½-13 UNC					
96	JAM NUT	1		COMML	STL	COMML				⅜-10UNC					
97	LOCKWIRE	AS REQ'D		COMML	STL	COMML				18 GA					
98	UNION NUT	2	61F	IMPERIAL	BRASS	COMML				5/16 TUBE					
99	HALF UNION	1	48F	IMPERIAL	BRASS	COMML				5/16 TUBE 1/8 NPT					
100	TUBING	1		COMML	COPPER	COMML				5/16 OD x 12" LG					
101	DOWEL PIN	2		COMML	STL	COMML				3/8 x 1" LG					
102	PIPE PLUG	3		COMML	ALUM	COMML				⅛ NPT SQ. HEAD					
103	SHOULDER EYEBOLT	1	#25	WILLIAMS	STL	COMML				BLANK SHANK 1½ LG RELIEVE ADDITIONAL 1/8" LG. SHOULDER					
104	CHAIN, SINGLE JACK	1		COMML	BRASS	COMML				#12 x 12" LG					
105	GREASE FITTING	2	1921-B	ALEMITE	MONEL	COMML				⅛ P.T.F					
106	RELIEF FITTING	1	47200	ALEMITE	STL	COMML				⅛ P.T.F					
107	SCREW RD. HD.	1		COMML	STL	COMML				#8-32					
108	FLANGE BUSHING	2	FF-1001-2	KINGWELL	OILITE	COMML				7/8 x 1 x 5/8					
109	PLAIN BUSHING	7	AA-1008-9	KINGWELL	OILITE	COMML				7/8 x 1 x ½					
110	HELICOIL INSERT (STD)	8	1185-8CN-0750	HELI-COIL CORP	ST. STL	COMML				1/2-13NC					
111	HELICOIL INSERT (STD)	32	1185-6CN-0375	↓	↓	↓				3/8-16NC					
112	HELICOIL INSERT (STD)	8	1185-5CN-0469	↓	↓	↓				5/16-18NC					
113	KEY	1	BK-BC-1		C1018	COMML				1/4 x 1 1/4					
114	PULLEY	1	A307981	WGC		COMML									
115	SEAL	1	71X7024	GARLOCK	COMM										
116	PIPE PLUG, SOC HD	1		COMML	STEEL	COMML				.25-18 NPT					

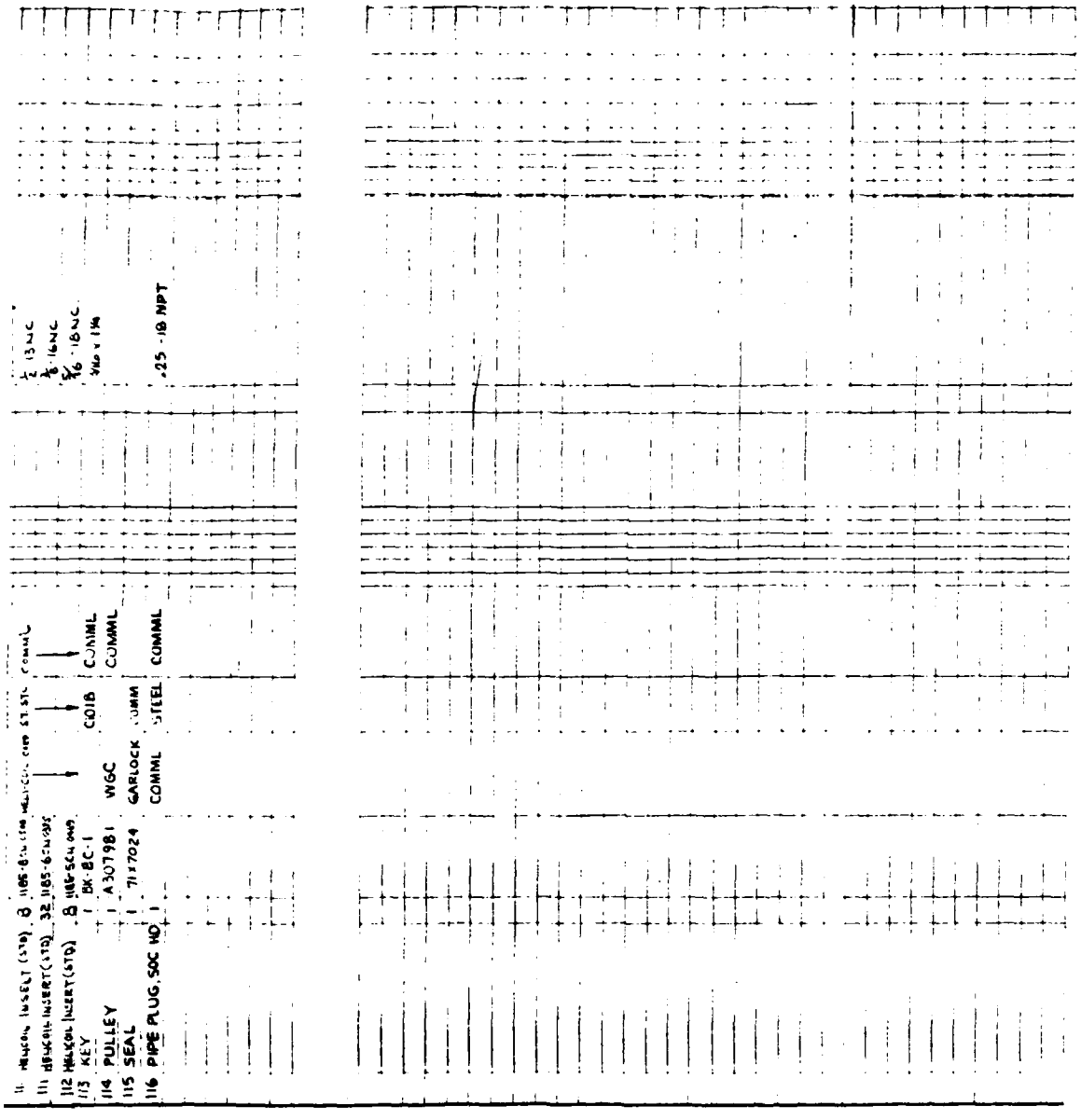

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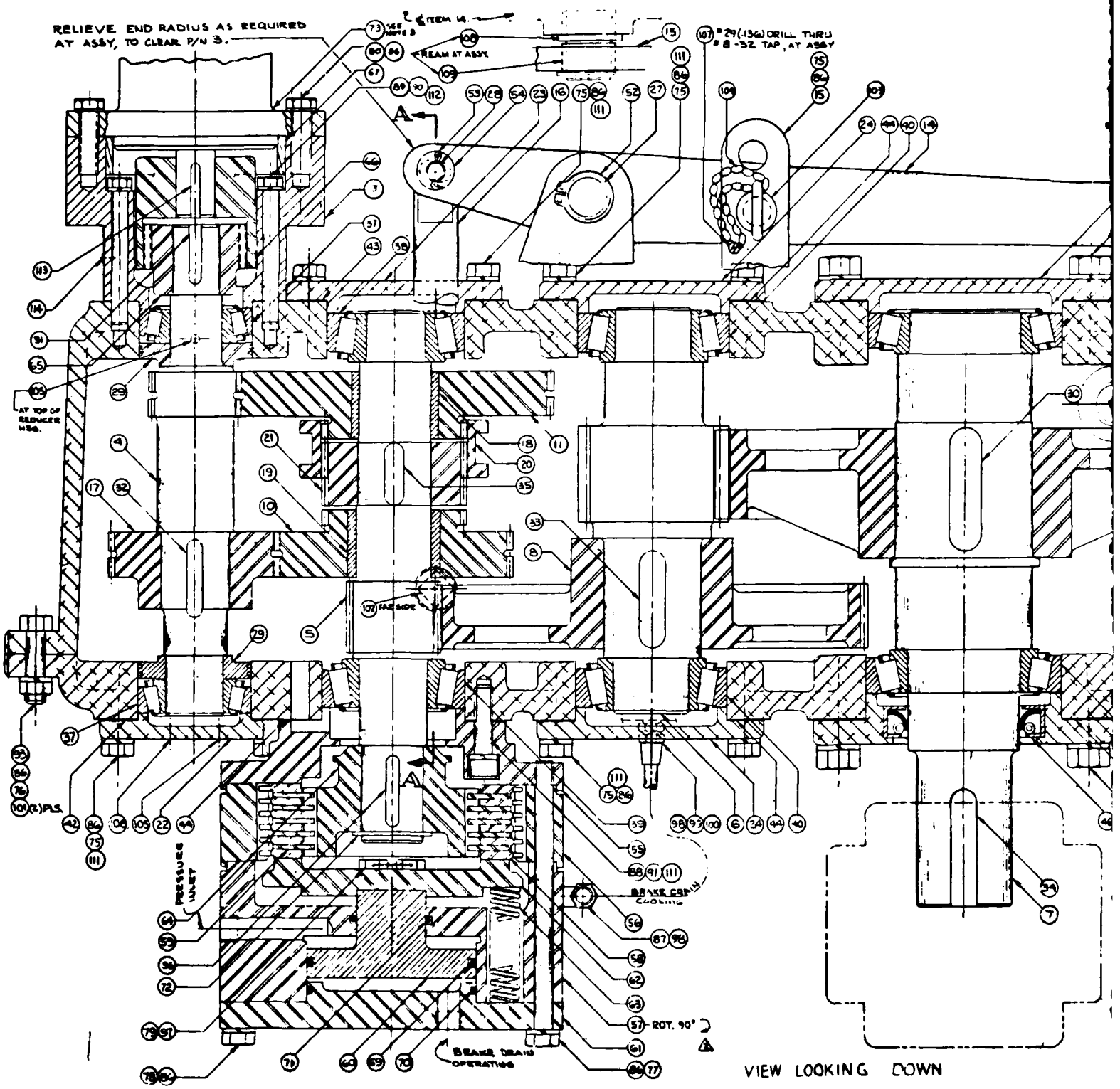
Figure 6-4. DOHB Lower Reducer
(Sheet 3 of 3)


RELIEVE END RADIUS AS REQUIRED AT ASSY, TO CLEAR P/N 3.
ITEM 14.
REAM AT ASSY.
#29 (.136) DRILL THRU
#8-32 TAP, AT ASSY
AT TOP OF REDUCER HSG.
PRESSURE INLET
BRAKE DRAIN OPERATING
BRAKE CRPN COOLING
ROT. 90°
VIEW LOOKING DOWN

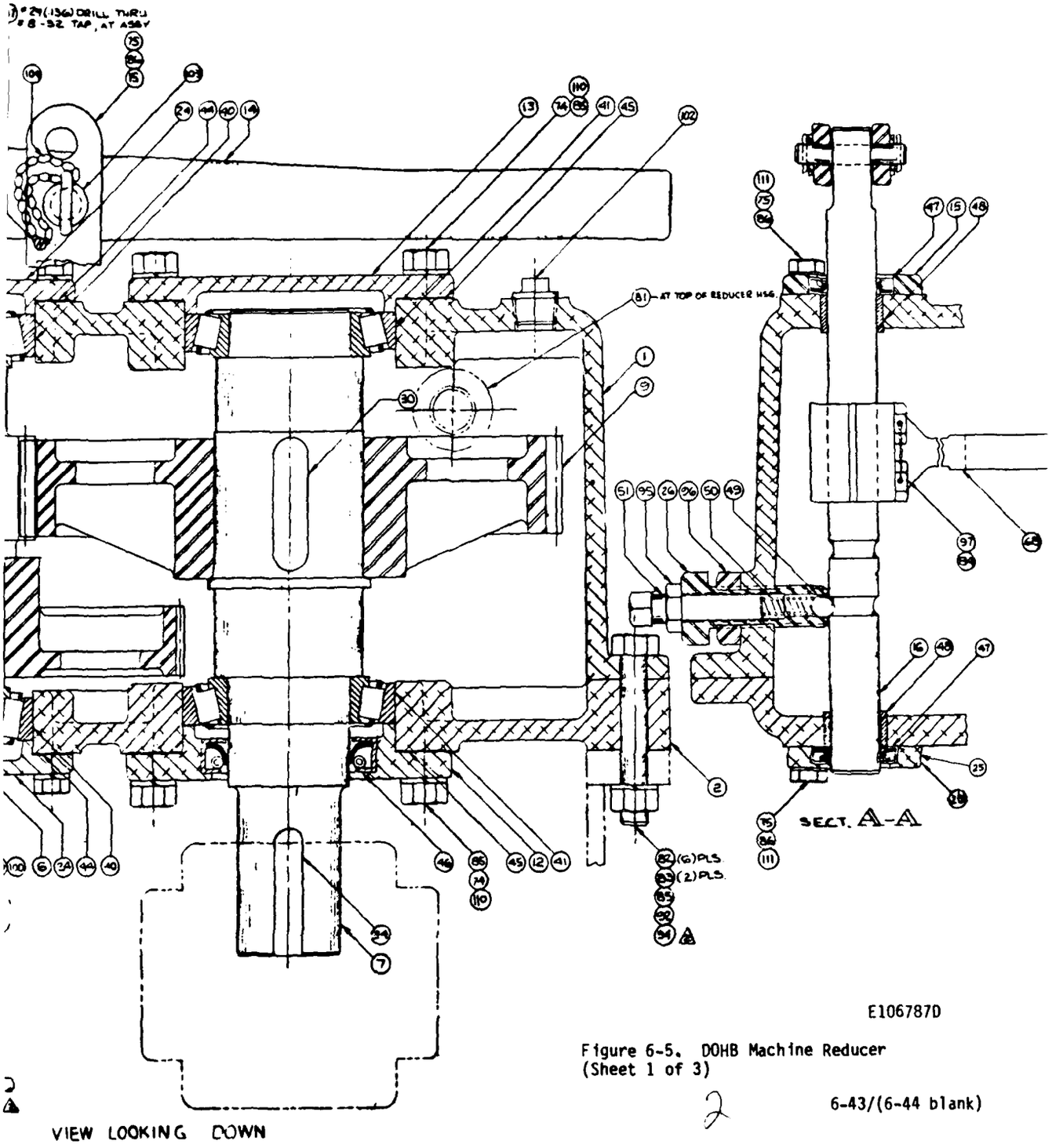


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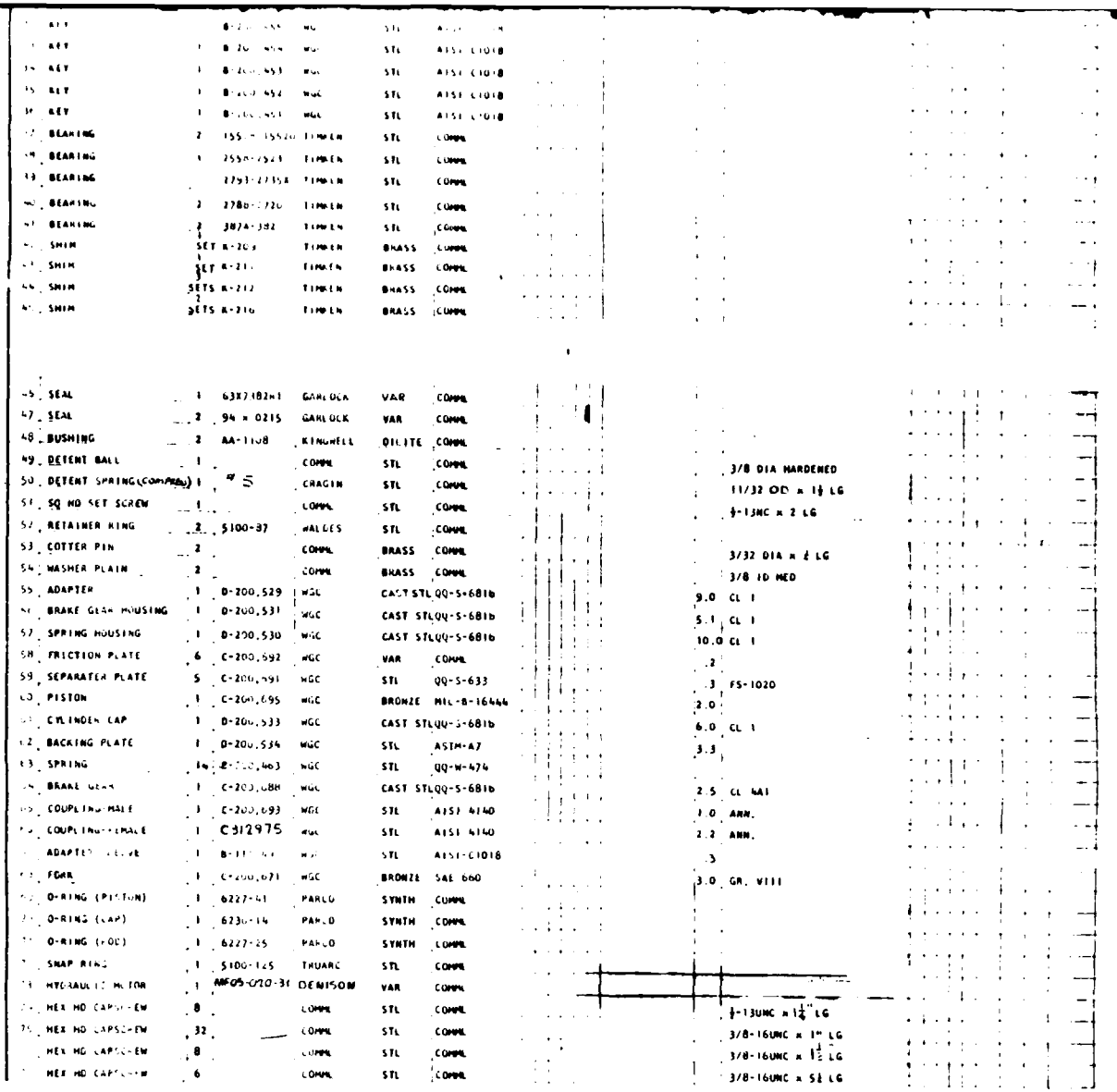
Figure 6-5. DOHB Machine Reducer
(Sheet 1 of 3)

LIST OF MATERIALS FOR ONE [illegible] ASSY.

PART NO.	NAME OF PART	NO. REQ'D	MANUFACTURER PART OR DWG NO.	MANUFACTURER NAME	MATERIAL	MATERIAL SPEC	UNIT WT LBS	REMARKS
1	REDUCER HOUSING	1	E-106,809	WGC	CAST AL	AL 356-T6	25	
2	REDUCER BASE	1	E-106,808	WGC	CAST AL	AL 356-T6	22	
3	ADAPTER HOUSING	1	C3l2974	WGC	STL	AISI C1018C.F.	10	
4	H. S. SHAFT	1	D-106,452	WGC	STL	AISI 4140	4.1	
5	IBT. PINION SHAFT	1	D-200,526	WGC	STL	AISI 4140	4.7	
6	SPUR PINION	1	D-200,525	WGC	STL	AISI 8620	6.8	
7	OUTPUT SHAFT	1	D-200,524	WGC	STL	AISI 4140	14.5	
8	HELICAL GEAR	1	D-200,522	WGC	CAST, STL	QQ-S-681b	12.1	CL 4C2
9	SPUR GEAR	1	D-200,521	WGC	CAST, STL	SAE 8620	14.0	CARBURIZE
10	GEAR	1	D-200,520	WGC	STL	AISI 4140	4.4	
11	GEAR	1	D-106,454	WGC	STL	AISI 4140	7.2	
12	RETAINER	1	D-200,518	WGC	CAST AL	356-T6	1.5	
13	RETAINER	1	D-200,517	WGC	CAST AL	356-T6	1.0	
14	LEVER	1	D 200,515	WGC	CAST STL	QQ-S-681b	4.0	CL 1
15	BRACKET	1	D-106,449	WGC	CAST STL	QQ-S-681b	4.6	CL 1
16	SHIFT ROD	1	C-200,642	WGC	ST. STL	QQ-S-763	1.5	CL 304 COND. A
17	GEAR	1	C-200,687	WGC	STL	AISI 4140	4.2	
18	BUSHING	1	C-200,686	WGC	BRONZE	SAE 660	.5	
19	BUSHING	1	C-200,685	WGC	BRONZE	SAE 660	.5	
20	CLUTCH COLLAR	1	C-200,684	WGC	STL	AISI 4140	1.4	
21	CLUTCH SPLINE	1	C-200,683	WGC	STL	AISI 4140	1.8	
22	RETAINER	1	C-111,617	WGC	CAST AL	356-T6	.2	
23	RETAINER	1	B-111,477	WGC	CAST AL	356-T6	.6	
24	RETAINER	2	C-200,680	WGC	CAST AL	356-T6	.7	
25	RETAINER	1	C-200,679	WGC	CAST AL	356-T6		
26	CAPSCREW	1	B-200,461	WGC	STL	COMM		
27	PIN	1	B-200,460	WGC	ST. STL	QQ-S-763		CL 304 COND A
28	PIN	1	B-200,459	WGC	ST. STL	QQ-S-763		CL 304 COND A
29	GREASE RING	2	B-200,458	WGC	STL	ASTM-A7		
30	KEY	1	B-200,457	WGC	STL	AISI C1018		
31	KEY	1	B-200,456	WGC	STL	AISI C1018		
32	KEY	1	B-200,455	WGC	STL	AISI C1018		
33	KEY	1	B-200,454	WGC	STL	AISI C1018		
34	KEY	1	B-200,453	WGC	STL	AISI C1018		
35	KEY	1	B-200,452	WGC	STL	AISI C1018		
36	KEY	1	B-200,451	WGC	STL	AISI C1018		
37	BEARING	2	15578-15520	TIMKEN	STL	COMM		
38	BEARING	1	2550-2523	TIMKEN	STL	COMM		
39	BEARING		2793-2735X	TIMKEN	STL	COMM		
40	BEARING	1	2788-2720	TIMKEN	STL	COMM		
41	BEARING	2	387A-382	TIMKEN	STL	COMM		
42	SHIM	1 SET	K-203	TIMKEN	BRASS	COMM		
43	SHIM	1 SET	K-211	TIMKEN	BRASS	COMM		
44	SHIM	2 SETS	K-212	TIMKEN	BRASS	COMM		
45	SHIM	2 SETS	K-216	TIMKEN	BRASS	COMM		
46	SEAL	1	63X7182H1	GARLOCK	VAR	COMM		
47	SEAL	2	94 x 0215	GARLOCK	VAR	COMM		
48	BUSHING	2	AA-1108	KINGWELL	OILITE	COMM		
49	DETENT BALL	1		COMM	STL	COMM		3/8 DIA HARDENED
50	DETENT SPRING(COMPRESS)	1	#5	CRAGIN	STL	COMM		11/32 OD x 1½ LG
51	SQ HD SET SCREW	1		COMM	STL	COMM		½-13NC x 2 LG
52	RETAINER RING	2	5100-87	WALDES	STL	COMM		
53	COTTER PIN	2		COMM	BRASS	COMM		3/32 DIA x ¾ LG
54	WASHER PLAIN	2		COMM	BRASS	COMM		3/8 ID MED
55	ADAPTER	1	D-200,529	WGC	CAST STL	QQ-S-681b	9.0	CL 1
56	BRAKE GEAR HOUSING	1	D-200,531	WGC	CAST STL	QQ-S-681b	5.1	CL 1
57	SPRING HOUSING	1	D-200,530	WGC	CAST STL	QQ-S-681b	10.0	CL 1
58	FRICTION PLATE	6	C-200,692	WGC	VAR	COMM	2	
59	SEPARATOR PLATE	5	C-200,691	WGC	STL	QQ-S-633	3	FS-1020
60	PISTON	1	C-200,695	WGC	BRONZE	MIL B-16444	2.0	



[illegible]	KEY		[illegible]	MGC	STL	[illegible]
[illegible]	KEY	1	B-200-654	MGC	STL	AISI C1018
34	KEY	1	B-200-653	MGC	STL	AISI C1018
35	KEY	1	B-200-652	MGC	STL	AISI C1018
36	KEY	1	B-200-651	MGC	STL	AISI C1018
37	BEARING	2	155[illegible]-15520	TIMKEN	STL	COMML
38	BEARING	1	7553-7524	TIMKEN	STL	COMML
39	BEARING		27593-27358	TIMKEN	STL	COMML
40	BEARING	2	2780-2720	TIMKEN	STL	COMML
41	BEARING	2	387A-382	TIMKEN	STL	COMML
42	SHIM	SET	A-209	TIMKEN	BRASS	COMML
43	SHIM	SET	A-211	TIMKEN	BRASS	COMML
44	SHIM	SETS	A-212	TIMKEN	BRASS	COMML
45	SHIM	SETS	A-216	TIMKEN	BRASS	COMML
46	SEAL	1	63X7182H1	GARLOCK	VAR	COMML
47	SEAL	2	94 x 0215	GARLOCK	VAR	COMML
48	BUSHING	2	AA-1108	KINGWELL	OILITE	COMML
49	DETENT BALL	1		COMML	STL	COMML
50	DETENT SPRING (COMPRN)	1	# 5	CRAGIN	STL	COMML
51	SQ HD SET SCREW	1		COMML	STL	COMML
52	RETAINER RING	2	5100-87	WALDES	STL	COMML
53	COTTER PIN	2		COMML	BRASS	COMML
54	WASHER PLAIN	2		COMML	BRASS	COMML
55	ADAPTER	1	D-200,529	MGC	CAST STL	QQ-S-681b
56	BRAKE GEAR HOUSING	1	D-200,531	MGC	CAST STL	QQ-S-681b
57	SPRING HOUSING	1	D-200,530	MGC	CAST STL	QQ-S-681b
58	FRICTION PLATE	6	C-200,692	MGC	VAR	COMML
59	SEPARATER PLATE	5	C-200,691	MGC	STL	QQ-S-633
60	PISTON	1	C-200,695	MGC	BRONZE	MIL-B-16444
61	CYLINDER CAP	1	D-200,533	MGC	CAST STL	QQ-S-681b
62	BACKING PLATE	1	D-200,534	MGC	STL	ASTM-A7
63	SPRING	16	B-200,463	MGC	STL	QQ-W-474
64	BRAKE GEAR	1	C-200,688	MGC	CAST STL	QQ-S-681b
65	COUPLING-MALE	1	C-200,693	MGC	STL	AISI 4140
66	COUPLING-FEMALE	1	C312975	MGC	STL	AISI 4140
[illegible]	ADAPTER SLEEVE	1	B-[illegible]	MGC	STL	AISI-C1018
68	GEAR	1	C-200,671	MGC	BRONZE	SAE 660
69	O-RING (PISTON)	1	6227-41	PARCO	SYNTH	COMML
70	O-RING (CAP)	1	6230-14	PARCO	SYNTH	COMML
71	O-RING (POT)	1	6227-25	PARCO	SYNTH	COMML
72	SNAP RING	1	5100-125	TRUARC	STL	COMML
73	HYDRAULIC MOTOR	1	MF05-020-3[illegible]	DENISON	VAR	COMML
74	HEX HD CAPSCREW	8		COMML	STL	COMML
75	HEX HD CAPSCREW	32		COMML	STL	COMML
[illegible]	HEX HD CAPSCREW	8		COMML	STL	COMML
[illegible]	HEX HD CAPSCREW	6		COMML	STL	COMML

	3/8 DIA HARDENED
	11/32 OD x 1¼ LG
	⅜-13NC x 2 LG
	3/32 DIA x ⅝ LG
	3/8 ID MED
9.0	CL 1
5.1	CL 1
10.0	CL 1
.2	
.3	FS-1020
2.0	
6.0	CL 1
3.3	
2.5	CL 4A1
1.0	ANN.
2.2	ANN.
.3	
3.0	GR. VIII
	⅜-13UNC x 1¾" LG
	3/8-16UNC x 1" LG
	3/8-16UNC x 1½ LG
	3/8-16UNC x 5⅛ LG

NOTES:

1. ALL HARDWARE TO BE CADMIUM PLATED .0003 THICK.
2. ALL STEEL TO ALUMINUM JOINTS TO BE COATED WITH MINNESOTA MINING & MFG. CO. COMPOUND EC-612 OR EQUAL.
3. ORIENT (73) HYDRAULIC MOTOR) SUCH THAT THE DENISON LABEL IS ON THE LEFT AND THE PUMP ROTATION LABEL IS ON THE RIGHT AS VIEWED FROM THE SHAFT END.

Figure 6-5. DOHB Machine Reducer
(Sheet 2 of 3)

E1067870

LIST OF MATERIALS FOR ONE REDUCER ASSY.

PART NO	NAME OF PART	NO REQD	MANUFACTURER SERVICE PART OR DWG NO	MANUFACTURER NAME	MATERIAL	MATERIAL SPEC	REQUIRED CERTS (C, P, H, C/C, H/D, H)	ALTERNATE SPEC (FOR GOV'T REFERENCE)	UNIT WT LBS	REMARKS	ASSEMBLY DWG NO / MATL CODE NO / QTY	DATE MOD	DATE DUE	PURCH ORDER
78	HEX HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1½ LG				
79	HEX HD CAPSCREW	1		COMML	STL	COMML				5/16-18UNC x 7/8 LG (DRILLED HEAD)				
80	HEX HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1.38 LG				
81	BREATHER	1	MODEL 200717	AIR MAZE	VARIOUS	COMML			.25	3/8 NPT				
82	HEX HD CAPSCREW	6		COMML	STL	COMML				½-13UNC x 2½ LG				
83	HEX HD CAPSCREW	2	B-112-279	WGC	STL	AISI C1018								
84	HEX HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1½ LG (DRILLED HEAD)				
85	LOCKWASHER	14		COMML	STL	COMML				½ ID MED				
86	LOCKWASHER	50		COMML	STL	COMML				3/8 ID MED	[illegible]			
87	90° ELBOW	1	49-F	IMPERIAL	BRASS	COMML				5/16" TUBE x 1/8 NPT				
88	HI-COLLAR LOCKWASHER	4		COMML	STL	COMML				3/8 ID				
89	HI-COLLAR LOCKWASHER	8		COMML	STL	COMML				5/16 ID				
90	SOCKET HD CAPSCREW	8		COMML	STL	COMML				5/16-18UNC x 2½ LG				
91	SOCKET HD CAPSCREW	4		COMML	STL	COMML				3/8-16UNC x 1½ LG				
92	HEX NUT	4		COMML	STL	COMML				5/8-11 UNC				
93	HEX NUT	8		COMML	STL	COMML				3/8-16UNC				
94	LOCK WASHER	4								5/8 ID MED.				
95	JAM NUT	1		COMML	STL	COMML				½-13 UNC				
96	JAM NUT	1		COMML	STL	COMML				¾-10UNC				
97	LOCKWIRE	AS REQ'D		COMML	STL	COMML				18 GA				
98	UNION NUT	2	61F	IMPERIAL	BRASS	COMML				5/16 TUBE				
99	HALF UNION	1	68F	IMPERIAL	BRASS	COMML				5/16 TUBE 1/8 NPT				
100	TUBING	1		COMML	COPPER	COMML				5/16 OD x 12" LG				
101	DOWEL PIN	2		COMML	STL	COMML				3/8 x 1" LG				
102	PIPE PLUG	2		COMML	ALUM	COMML				½ NPT SQ. HEAD				
103	SHOULDER EYEBOLT	1	#25	WILLIAMS	STL	COMML				BLANK SHANK 1½ LG RELIEVE ADDITIONAL 1/8" LG.				
104	CHAIN, SINGLE JACK	1		COMML	BRASS	COMML				#12 x 12" LG				
105	GREASE FITTING	2	1921-B	ALEMITE	MONEL	COMML				1/8 P.T.F				
106	RELIEF FITTING	1	47200	ALEMITE	STL	COMML				1/8 P.T.F				
107	SCREW RD. HD.	1		COMML	STL	COMML				#8-32				
108	FLANGE BUSHING	2	FF-1001-2	KINGWELL	OILITE	COMML				7/8 x 1 x 5/8				
109	PLAIN BUSHING	2	AA-1008-9	KINGWELL	OILITE	COMML				7/8 x 1 x ½				
110	HELICOIL INSERT (STD)	8	1185-8CN 0500	HELI-COIL CORP	ST. STL	COMML				½-13NC				
111	HELICOIL INSERT (STD)	32	1185-6CN 0375	↓	↓	↓				3/8-16NC				
112	HELICOIL INSERT (STD)	8	1185-5CN 0469	↓	↓	↓				5/16-18NC				
113	KEY	1	BK-BC-1		C1018	COMML				3/16 x 1 1/4				
114	PIPE PLUG SOC HD	1		COMML	STEEL	COMML				.25-18 NPT				

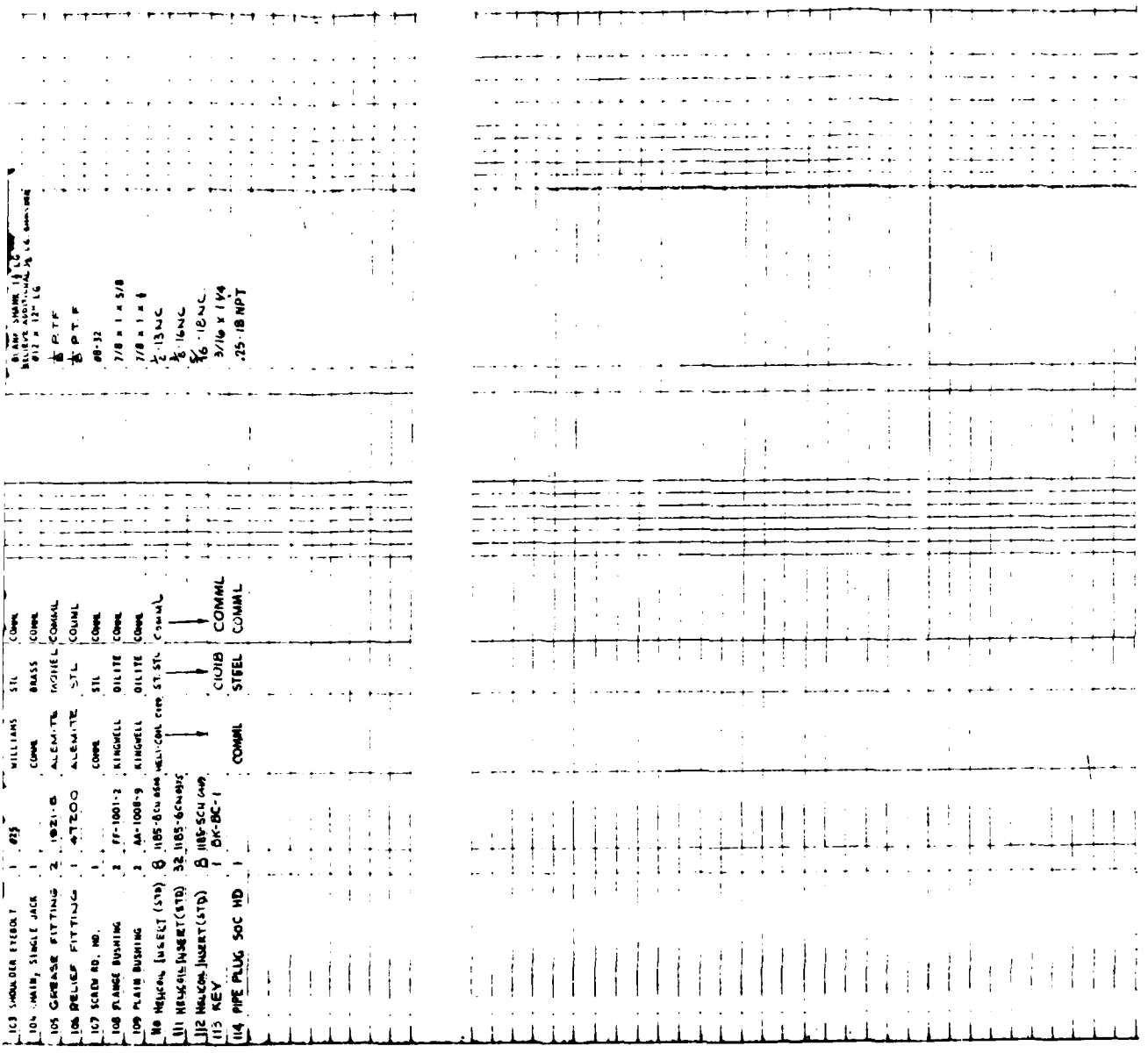


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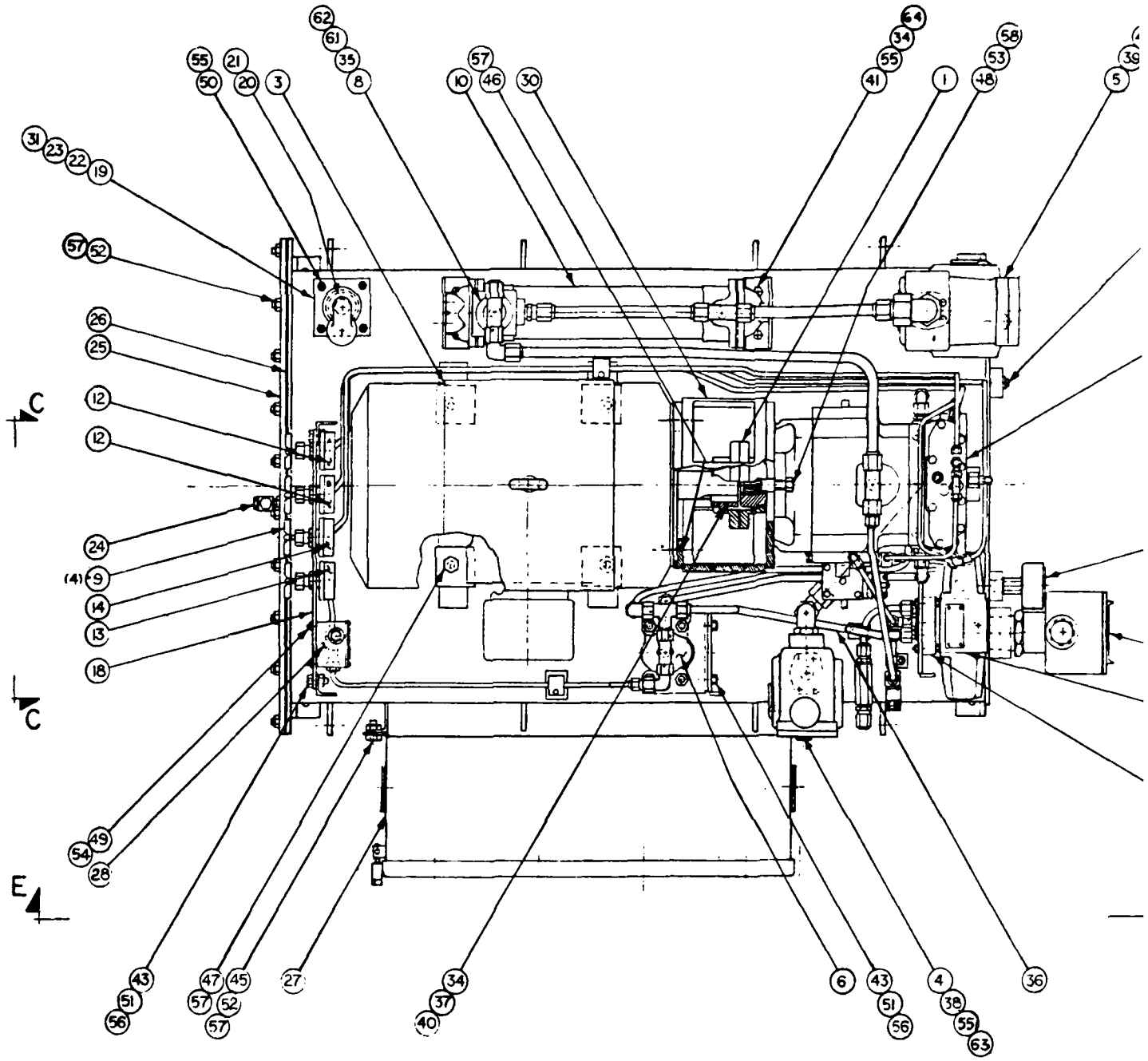
Figure 6-5. DOHB Machine Reducer
(Sheet 3 of 3)

Figure 6-6 and 6-7. Not Used


62
61
35
8
55
50
21
20
3
57
10
46
30
64
34
55
41
1
58
53
48
5
31
23
22
19
57
52
26
25
12
12
24
(4)
9
14
13
18
C
C
E
49
54
28
43
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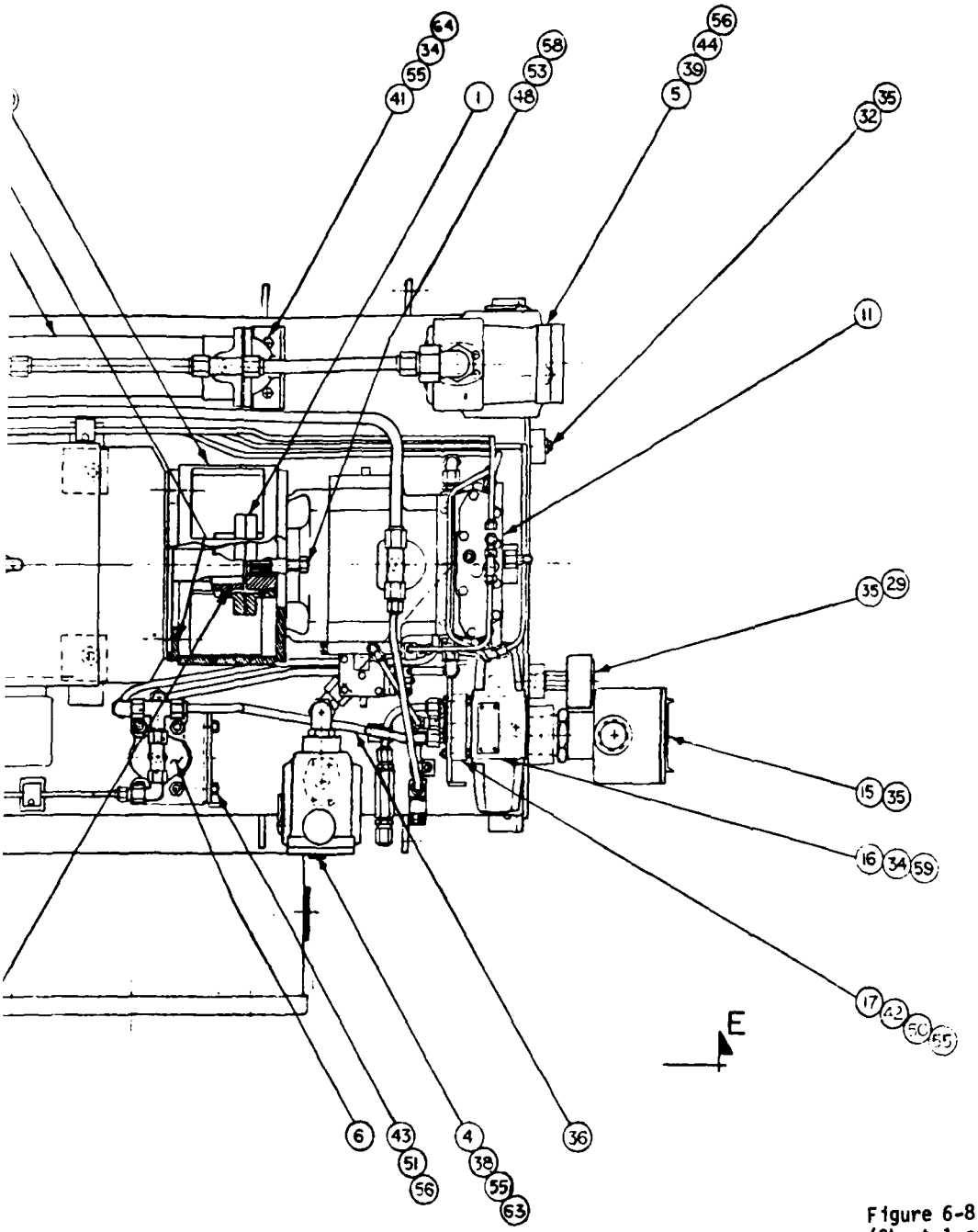


NOTES:

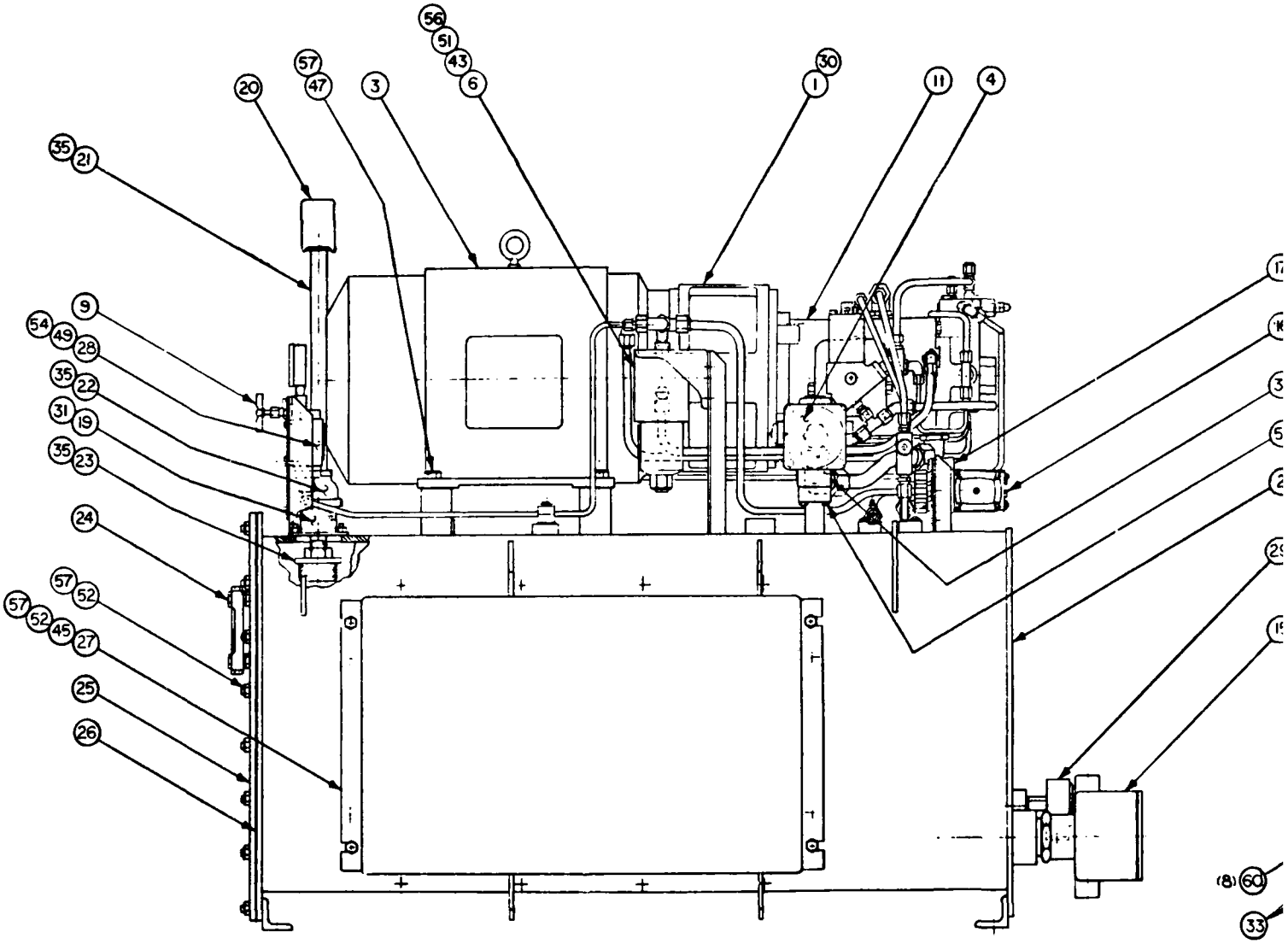
1. SEE DWG. D316464 FOR PIPING ASSEMBLY.
2. REF. D316505 FOR VENDOR DWG OF DENISON PUMP, F/N 11.
3. WEIGHT OF POWER UNIT:
   RESERVOIR DRY — 1500 LBS
   RESERVOIR FULL — 2340 LBS

REV. STATUS

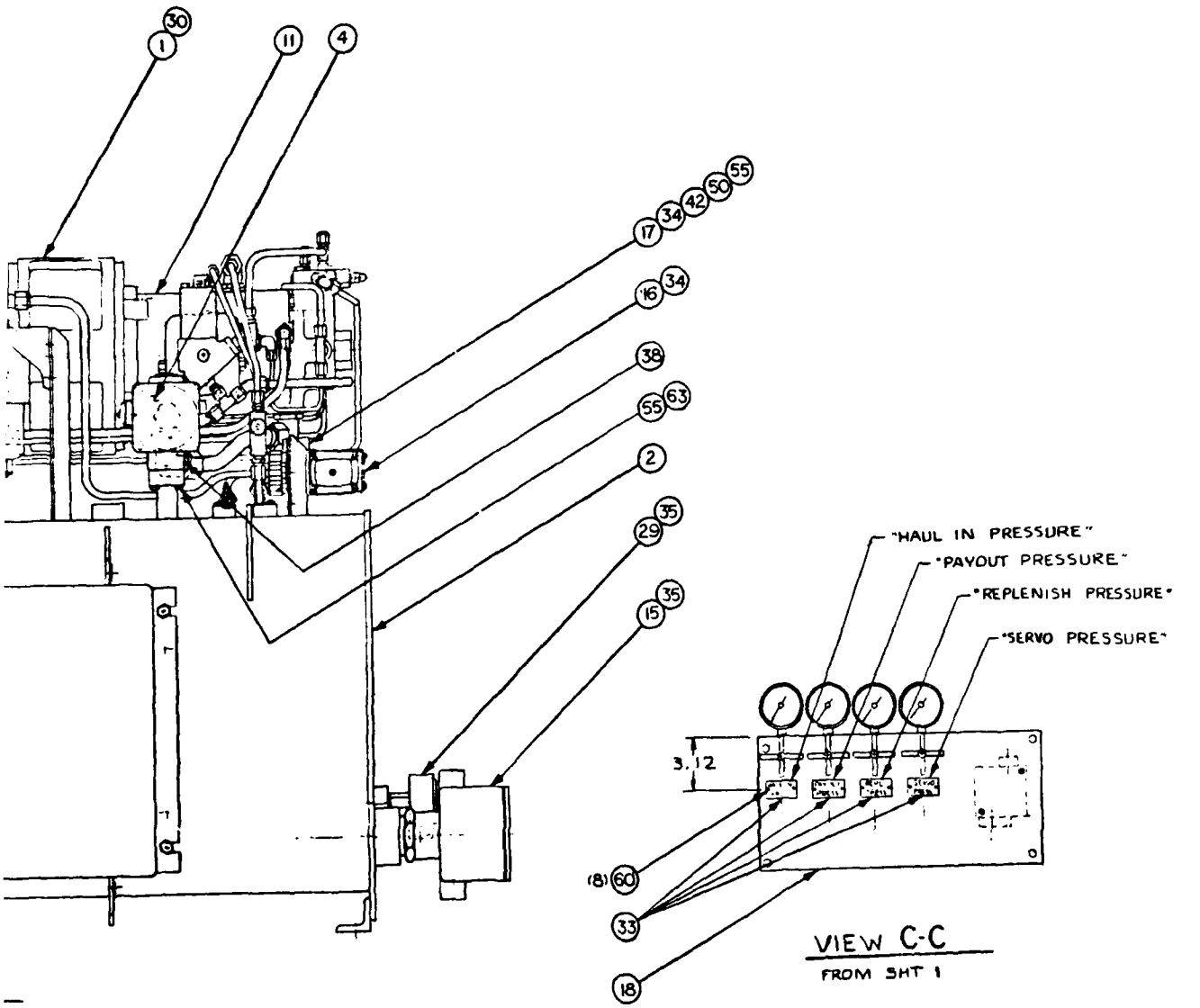
SHT	1	2	3	-
REV	B	A	B	-

D3161288

Figure 6-8. DOHB Power Unit Assembly (Sheet 1 of 8)

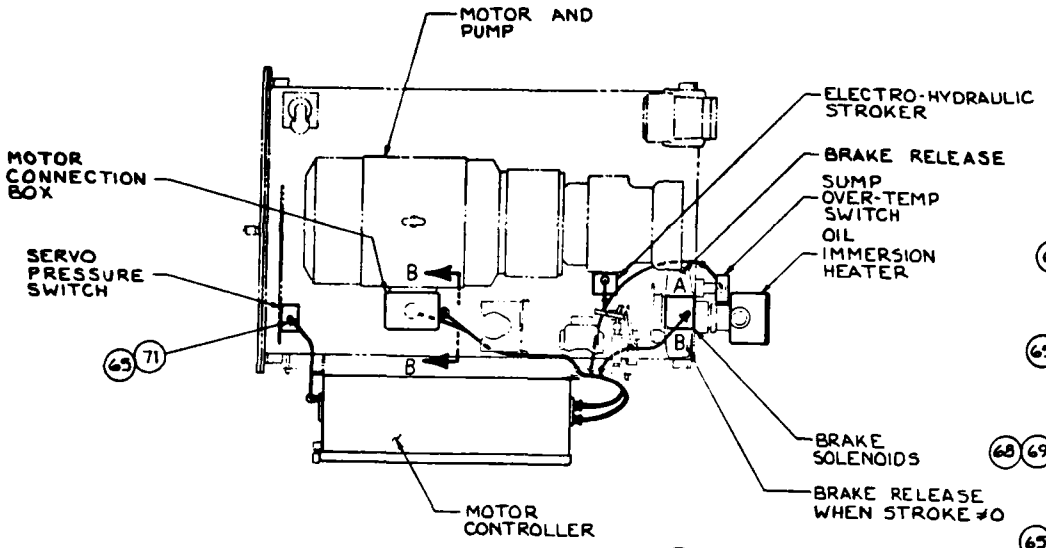


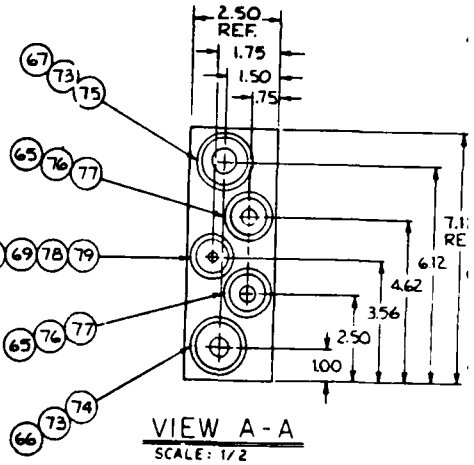
VIEW E-E
FROM SHT 1



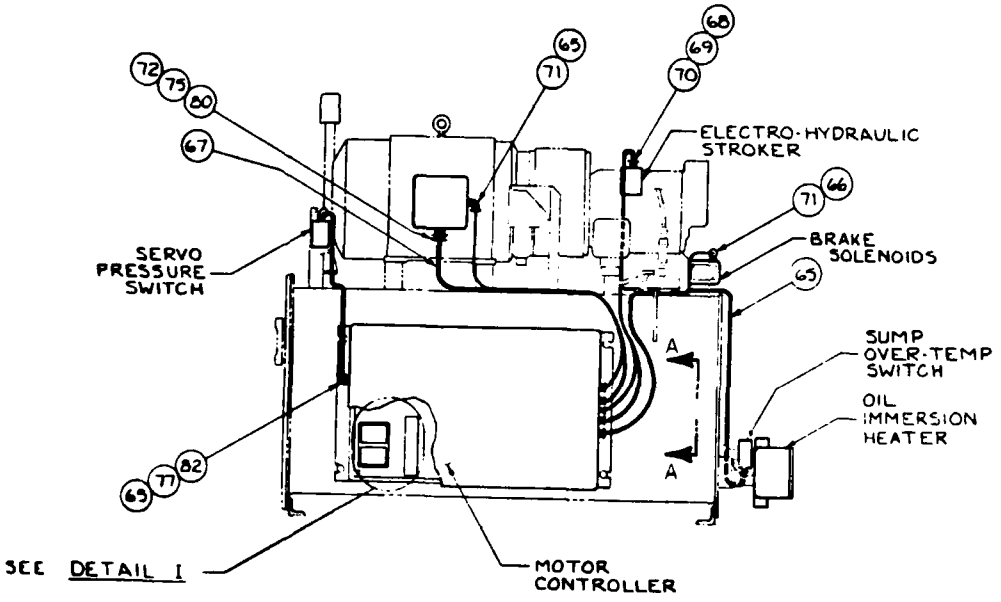
D316128 B

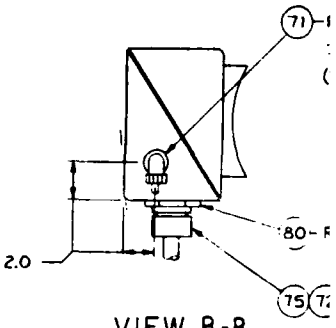
Figure 6-8. DOHB Power Unit Assembly
(Sheet 2 of 8)





VIEW A-A
SCALE: 1/2





VIEW B-B
SCALE: NONE
ROTATED 90° CW

ELECTRO-HYDRAULIC
STROKER

BRAKE RELEASE

SUMP
OVER-TEMP
SWITCH
OIL
IMMERSION
HEATER

BRAKE
SOLENOIDS

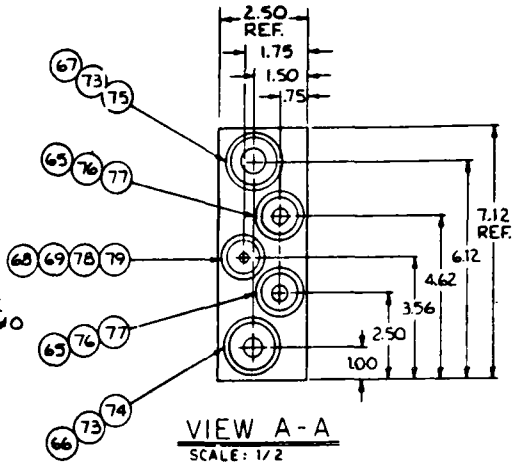
BRAKE RELEASE
WHEN STROKE ≠0

RAULIC

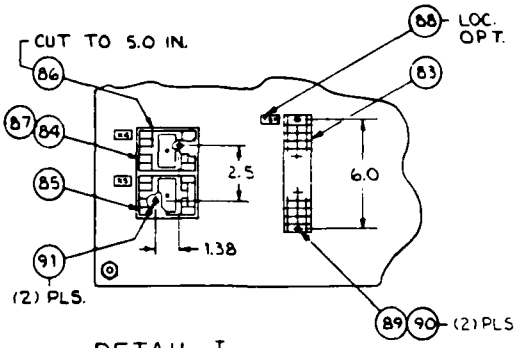
KE
LENOIDS

SUMP
- OVER-TEMP
SWITCH

OIL
- IMMERSION
HEATER

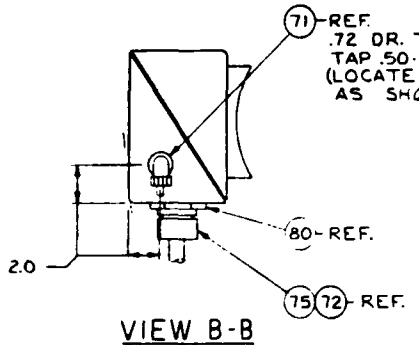


VIEW A-A
SCALE: 1/2



DETAIL I
LOCATE AT ASSY.

.159 DR. THRU, TAP #10-32NF THRU (4) PLS.



VIEW B-B
SCALE: NONE
ROTATED 90° CW

NOTES:

1. WIRE PER WGC DWG NO. D316129 (F/N 81).
2. USE CABLE CLAMPS (F/N'S 92 THRU 95) AS REQ'D. DRILL & TAP #10-32 NF AS REQ'D FOR FASTENERS (F/N'S 89 90 91 & 96).
3. SEE WGC DWG NO. D316125, SH3, FOR TANK HEATER DETAIL AND SH4 FOR J-BOX 2 DETAIL SHOWING ASSY OF QUICK DISCONNECT ELECTRICAL FITTINGS ON OIL IMMERSION HEATER AND MOTOR CONTROLLER.
4. SEE WGC DWG NO. A307881 FOR TANK HEATER AND J-BOX 2 QUICK DISCONNECT FITTING WIRING.

D316128B

Figure 6-8. DOHB Power Unit Assembly (Sheet 3 of 8)

REVISIONS				REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED	LTR	DESCRIPTION	DATE	APPROVED
A	SH 1: REVISED REV. STATUS. SHEET WAS 1 OF 4. SH 2: SHEET WAS 2 OF 4. SH 3: F/N 29 P/N WAS 17800-0. SHEET WAS 3 OF 4. SH 4: ADDED F/N'S 65-81. SHEET WAS 4 OF 4. SH 5: ADDED SHEET. ADDED F/N'S 82 THRU 96	1-14-81	JDM				

Figure 6-8.
(Sheet 4 of

		REVISIONS			
DATE	APPROVED	LTR	DESCRIPTION	DATE	APPROVED
4-91	Tom				

D316128B

Figure 6-8. DOHB Power Unit Assembly
(Sheet 4 of 8)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE
					PART OR DWG NO.	NAME			C	P	H	C/L	M/D	N		
1		COUPLING	1		B311221	WGC	VAR	COML								
2		TANK REWORK	1		D316390	WGC	VAR	SEE DWG								
3		ELECT. MOTOR	1		A307886	WGC	VAR	COML								
4		SUCTION FILTER	1		A307919	WGC	VAR	COML								
5		RETURN FILTER	1		A307918	WGC	VAR	COML								
6		REPLENISH FILTER	1		A307917	WGC	VAR	COML								
7																
8		THERMOSTAT VALVE	1		3/4 CM-BRZ HSG-110°F	AMOT CONTROLS	VAR	COML								
9		NEEDLE VALVE	4		N 3432	MARSH	VAR	COML								
10		HEAT EXCHANGER	1		F-302-HY-4P-CNT-B	YOUNG	VAR	COML								
11	/	HYDRAULIC PUMP	1		A307924	WGC	VAR	COML								
12		PRESSURE GAGE	2		J717B	MARSH	VAR	COML								
13		PRESSURE GAGE	1		J757Z	MARSH	VAR	COML								
14		PRESSURE GAGE	1		J7558	MARSH	VAR	COML								
15		IMMERSION HEATER	1		295528-ARMTD-2255E2T1	CHROMALOX	VAR	COML								
16		SOLENOID VALVE	1		DG4S4-018C-50	VICKERS	VAR	COML								
17		SUB-PLATE	1		DGSM-01X-10	VICKERS	STL	COML								
18		GAUGE PANEL	1		C313018	WGC	STL SHT	A569 HR.								
19		FILLER	1		B1112499	WGC	STL	SEE DWG								
20		BREATHER ASSY	1		D100636	WGC	VAR	SEE DWG								
21		.75 NPT, SCH 40 PIPE x 16.5	1		101805	WGC	STL	A-53								
22		PIPE REDUCER 2 x .75	1			WGC	M. I.	COML								
23		SUCTION SCREEN	1		F-6-60	FLOW-EZY	VAR	COML								
24		LIQUID LEVEL GAGE	1		G605-4-B-1	LUBE DEVICES	VAR	COML								
25		COVER REWORK	1		C313019	WGC	STL	SEE DWG								
26		GASKET	1		D106866	WGC										
27		MOTOR CONTROLLER	1		A307882	WGC	VAR	SEE DWG								

ACTURER NAME	MATL	MATL SPEC	REQ'D CERTS C	P	M	C/C	N/D	N	ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
WGC	VAR	COML								18	SPEC. CONTROL
WGC	VAR	SEE DWG								750	ASSY
WGC	VAR	COML								330	SPEC. CONTROL (30 HP)
WGC	VAR	COML								17	SOURCE CONTROL
WGC	VAR	COML								29	SOURCE CONTROL
WGC	VAR	COML								30	SOURCE CONTROL
AMOT CONTROLS	VAR	COML								5	
MARSH	VAR	COML									
YOUNG	VAR	COML								25	
WGC	VAR	COML									SOURCE CONTROL
MARSH	VAR	COML									0-3000 PSI
MARSH	VAR	COML									0-1000 PSI
MARSH	VAR	COML									0-300 PSI
CHROMALOX	VAR	COML								8	OBTAIN FROM SPARES
VICKERS	VAR	COML								11	
VICKERS	STL	COML								5	
WGC	STL SHT	A569 HR.								5	
WGC	STL	SEE DWG									
WGC	VAR	SEE DWG									DISCARD .75 x 2.0 NIPPLE
WGC	STL	A-53									BLACK
WGC	M.I.	COML									FEM x M 150 LB
FLOW-EZY	VAR	COML									.75 NPT.
LUBE DEVICES	VAR	COML									
WGC	STL	SEE DWG								89	
WGC											ARMSTRONG DC 167 (REF)
WGC	VAR	SEE DWG								120	

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Figure 6-8. DOHB Power Unit Assembly
(Sheet 5 of 8)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							AL SPE RI
					PART OR DWG NO.	NAME			C	P	H	C/C	N/D	N		
28		PRESSURE SWITCH	1		E1H-H500	BARKSDALE	VAR	COML								
29		THERMO SWITCH TEMP. CONTROL	1		21153-32C	FENWAL	VAR	COML								
30		PUMP ADAPTER	1		D316428	WGC	STL	SEE DWG								
31		GASKET	1		B111300	WGC		SEE DWG								
32		PLUG SQ HD SOLID	1		111782	WGC	C.I.	ASTM A-126A								
33		NAMEPLATES	1		A307989	WGC	SST	TYPE 304								
34		ADHESIVE-LOCTITE 242	A/R		900017	WGC	ADHESIVE	COML								
35		PIPE SEALANT, LOCTITE PS/T	A/R		900018	WGC	SEALANT	COML								
36		PWR UNIT HYD. PIPING	1		D316464	WGC	VAR	SEE DWG								
37		KEY, AK-13F-1	1		B8614	WGC	STL	AISI 1018								
38		O-RING	2		M345-24	ANCHOR	BUNA-N	COML								
39		O-RING	2		M345-27	ANCHOR	BUNA-N	COML								
40		SET SCREW, SOC HD, FLT PT	1		105181	WGC	STL	COML								
41		CAPSCREW, HEX HD, GR 5	4		103803	WGC	STL	COML								
42		CAPSCREW, HEX HD, GR 5	4		103808	WGC	STL	COML								
43		CAPSCREW, HEX HD, GR 5	8		103825	WGC	STL	COML								
44		CAPSCREW, HEX HD, GR 5	8		103826	WGC	STL	COML								
45		CAPSCREW, HEX HD, GR 5	4		107980	WGC	STL	COML								
46		CAPSCREW, HEX HD GR 5	4		103844	WGC	STL	COML								
47		CAPSCREW HEX HD GR 5	4		103847	WGC	STL	COML								
48		CAPSCREW, HEX HD, GR 5	2		103887	WGC	STL	COML								
49		NUT, HEX, MACH.	2		108902	WGC	STL	COML								
50		NUT, HEX, STD	8		105257	WGC	STL	COML								
51		NUT, HEX, STD	8		105258	WGC	STL	COML								
52		NUT, HEX, STD	36		105259	WGC	STL	COML								
53		NUT, HEX, STD	2		105261	WGC	STL	COML								
54		LOCKWASHER REG	2		109249	WGC	STL	COML								

MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS	MATL CLASS
	NAME			C	P	H	C/C	N/D	N					
00	BIRNDALE	VAR	COML											
C	FENWAL	VAR	COML										AT WGC, SET SW @ 170°F.	
Z8	WGC	STL	SEE DWG									47		
)	WGC		SEE DWG											
	WGC	C.I.	ASTM A-126A										125 LB	
89	WGC	SST	TYPE 304										DWG HAS (4) DIFF. NAMEPLATES ALL ARE USED	
	WGC	ADHESIVE	COML											
	WGC	SEALANT	COML											
4	WGC	VAR	SEE DWG											
	WGC	STL	AISI 1018											
4	ANCHOR	BUNA-N	COML										OR EQUAL	
7	ANCHOR	BUNA-N	COML										OR EQUAL	
	WGC	STL	COML										.25-20 x .38 LG, PLTD.	
	WGC	STL	COML										.38-16 x .75 LG, PLTD	
	WGC	STL	COML										.38-16 x 1.75 LG, PLTD	
	WGC	STL	COML										.44-14 x 1.25 LG, PLTD	
	WGC	STL	COML										.44-14 x 1.50 LG, PLTD	
	WGC	STL	COML										.50-13 x 1.0 LG, PLTD	
	WGC	STL	COML										.50-13 x 1.25 LG, PLTD	
	WGC	STL	COML										.50-13 x 2.0 LG PLTD	
	WGC	STL	COML										.62-11 x 2.25 LG PLTD	
	WGC	STL	COML										#8-32 PLTD.	
	WGC	STL	COML										.38-16 PLTD	
	WGC	STL	COML										.44-16 PLTD	
	WGC	STL	COML										.50-13 PLTD	
	WGC	STL	COML										.62-11 PLTD	
7	WGC	STL	COML										#8 NOM PLTD	

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Figure 6-8. DOHB Power Unit Assembly
(Sheet 6 of 8)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNA SPEC FOR C REFEREN
					PART OR DWG NO.	NAME			C	P	M	C/C	M/D	M		
55		LOCKWASHER, REG	20		105381	WGC	STL	COML								
56		LOCKWASHER, REG	16		105382	WGC	STL	COML								
57		LOCK WASHER REG	44		105383	WGC	STL	COML								
58		LOCKWASHER, REG	2		105385	WGC	STL	COML								
59		BOLT KIT	1		BKD601-633	VICKERS	STL	COML								
60		DRIVE SCREW, TYPE "U"	8		136590	WGC	STL	COML								
61		NIPPLE	1		111623	WGC	STL	COML								
62		PIPE THD REDUCER	1		134620	WGC	STL	COML								
63		CAPSCREW, HEX HD GR 5	8		103807	WGC	STL	COML								
64		FLAT WASHER	4		133747	WGC	STL	COML								
65		CABLE (2-COND)	1		DSGA-4	ANIXTER	VAR	MIL-C-915E/29								
66		CABLE (4-COND)	1		FSGA-4	ANIXTER	VAR	MIL-C-915E/3								
67		CABLE (3-COND)	1		TSGA-14	ANIXTER	VAR	MIL-C-915E/30								
68		CABLE (2-COND)	1		2SJ-18	ANIXTER	VAR	MIL-C-915E/60								
69		ARMOR BRAID (1/4")	1		2142	ALPHA	VAR	COML								
70		CONNECTOR	1		MS3106F-10SL-4S	CANNON OR EQUIV.	VAR	MIL-C-5015								
71		CORD CONNECTOR	3		2682	THOMAS & BETTS	VAR	COML								
72		STUFFING TUBE (#4 NPT)	1		M19622/3-004	DORN OR EQ	NYLON	MIL-S-19622								
73		STUFFING TUBE (#4 STR)	2		M19622/1-005	DORN OR EQ	NYLON	MIL-S-19622								
74		PACKING ASSY (#4A)	1		M19622/19-0001	DORN OR EQ	VAR	MIL-S-19622								
75		PACKING ASSY (#4E)	2		M19622/19-0005	DORN OR EQ	VAR	MIL-S-19622								
76		STUFFING TUBE (#2 STR)	2		M19622/1-002	DORN OR EQ	NYLON	MIL-S-19622								
77		PACKING ASSY (#2D)	3		M19622/17-04	DORN OR EQ	VAR	MIL-S-19622								
78		STUFFING TUBE (#1 STR)	1		M19622/1-001	DORN OR EQ	NYLON	MIL-S-19622								
79		PACKING ASSY (#1B)	1		M19622/16-0004	DORN OR EQ	VAR	MIL-S-19622								
80		THREADED REDUCER (1-1/2" X 1")	1		609	THOMAS & BETTS	STL	COML								
81		WIRING DIAGRAM - P.U.	1		D316129	WGC										

MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
ART OR WG NO.	NAME			C	P	H	C/E	M/D	H				
381	WGC	STL	COML										.38 NOM. PLTD
382	WGC	STL	COML										.44 NOM. PLTD
383	WGC	STL	COML										.50 NOM. PLTD
385	WGC	STL	COML										.62 NOM. PLTD
01-633	VICKERS	STL	COML										USE W/ F/N 16 & 17
590	WGC	STL	COML										#10 x .38 LG PLTD
623	WGC	STL	COML										3/4 FF-S (PARKER)
620	WGC	STL	COML										1 x 3/4 FTR-S (PARKER)
807	WGC	STL	COML										.38-16 x 1.50 LG PLTD.
747	WGC	STL	COML										.38 NOM.
-4	ANIXTER	VAR	MIL-C-915E/29									•	25.0 FT. LG.
-4	ANIXTER	VAR	MIL-C-915E/3										6.0 FT. LG.
-14	ANIXTER	VAR	MIL-C-915E/30										6.0 FT. LG.
18	ANIXTER	VAR	MIL-C-915E/60										6.0 FT. LG.
	ALPHA	VAR	COML										6.0 FT. LG.
06F-10SL-	CANNON OR EQUIV.	VAR	MIL-C-5015										
	THOMAS & BETTS	VAR	COML										
22/3-004	DORN OR EQ	NYLON	MIL-S-19622										
22/1-005	DORN OR EQ	NYLON	MIL-S-19622										
22/19-0001	DORN OR EQ	VAR	MIL-S-19622										
22/19-0005	DORN OR EQ	VAR	MIL-S-19622										
22/1-002	DORN OR EQ	NYLON	MIL-S-19622										
22/17-04	DORN OR EQ	VAR	MIL-S-19622										
22/1-001	DORN OR EQ	NYLON	MIL-S-19622										
22/16-0004	DORN OR EQ	VAR	MIL-S-19622										
	THOMAS & BETTS	STL	COML										
129	WGC												

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Figure 6-8. DOHB Power Unit Assembly
(Sheet 7 of 8)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR SOURCE REFERENCE
					PART OR DWG NO.	NAME			C	P	M	C/C	M/D	M		
82		STUFFING TUBE (#2)	1		M1962212-002	DORN OR EQ.	NYLON	MIL-S-19622								
83		TERM. BLOCK	1		6TB24	KULKA	VAR.	COML.								
84		RELAY	1		D26MR804A	CUTLER-HAMMER	VAR.	COML.								
85		RELAY	1		D26MR20C	CUTLER-HAMMER	VAR.	COML.								
86		MTG. CHANNEL	1		D26MC4	CUTLER-HAMMER	VAR.	COML.								
87		MOV	2		V130LA10A	GE	VAR.	COML.								
88		LABELS	1		A308138	WGC	VAR.	COML.								
89		MACH.SCREW	7		116164	WGC	STL	COML.								
90		FLAT WASHER	27		108975	WGC	STL	COML.								
91		MACH. SCREW	22		116132	WGC	STL	COML.								
92		CLAMP, CUSH.	4		112100	WGC	VAR	COML.								
93		CLAMP, CUSH.	8		114101	WGC	VAR	COML.								
94		CLAMP, CUSH.	4		114102	WGC	VAR	COML.								
95		CLAMP, CUSH.	4		114103	WGC	VAR.	COML.								
96		NUT, HEX, ELAS STOP	5		130961	WGC	STL	COML.								

MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
CAGE NO.	NAME			C	P	M	C/C	M/D	N				
2-002	DORMAN OR EQ.	NYLON	MIL-S-19622										90 DEG.
	KULKA	VAR.	COML.										
04A	CUTLER-HAMMER	VAR.	COML.										
0C	CUTLER-HAMMER	VAR.	COML.										
	CUTLER-HAMMER	VAR.	COML.										CUT TO LEN.
10A	GE	VAR.	COML.										
8	WGC	VAR.	COML.										
	WGC	STL	COML.										#10-32 X .62 LG, CR. REC. PAN HD. PLTD.
	WGC	STL	COML.										#10 NOM.
	WGC	STL	COML.										#10-32 X .38 LG. CR. REC. PAN HD. PLTD
	WGC	VAR	COML.										TA1716S4
	WGC	VAR	COML.										TA1716S6
	WGC	VAR	COML.										TA1716S8
	WGC	VAR.	COML.										TA1716S10
	WGC	STL	COML.										#10-32, PLTD

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Figure 6-8. DOHB Power Unit Assembly
(Sheet 8 of 8)

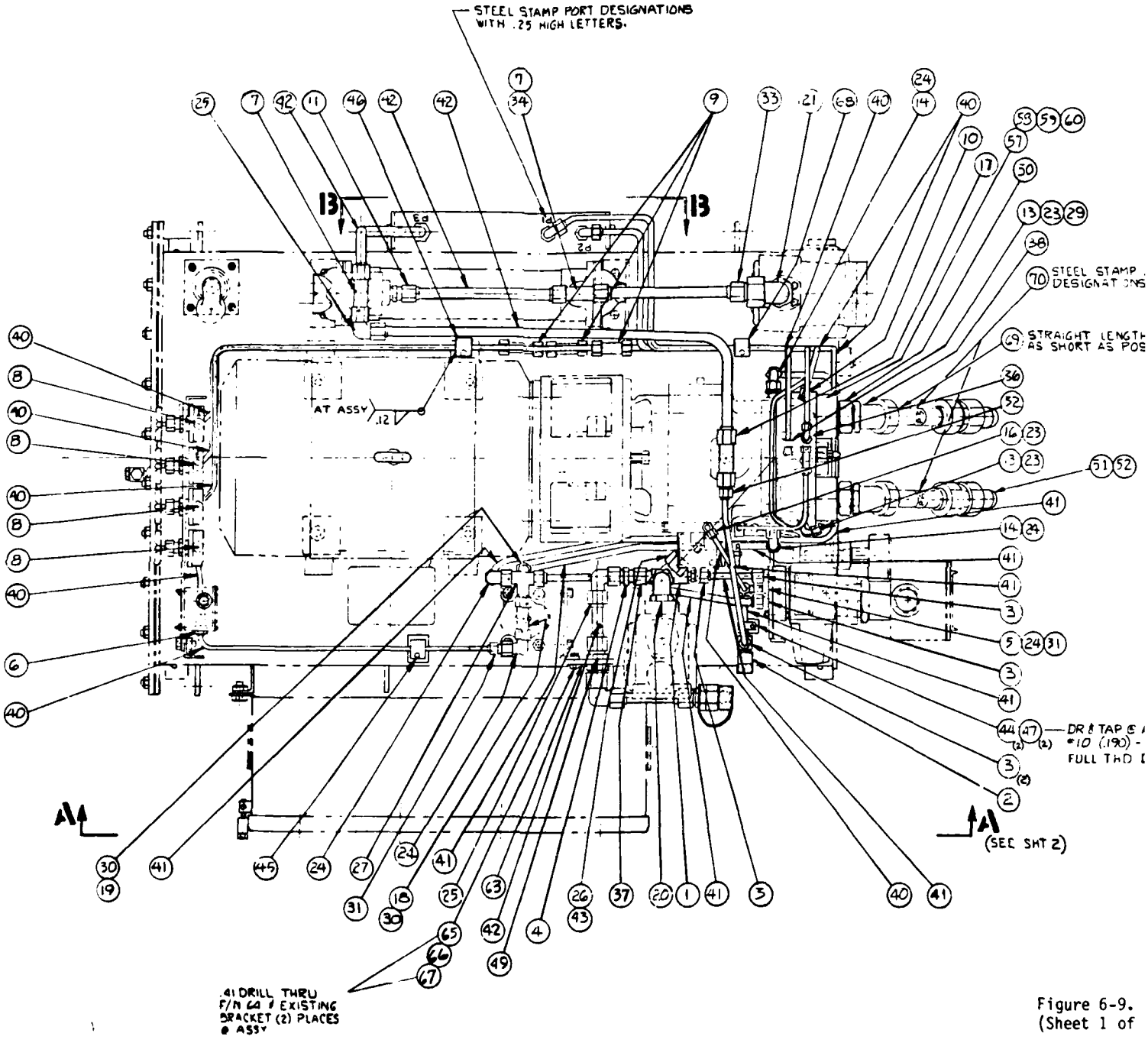

Figure 6-9.
(Sheet 1 of

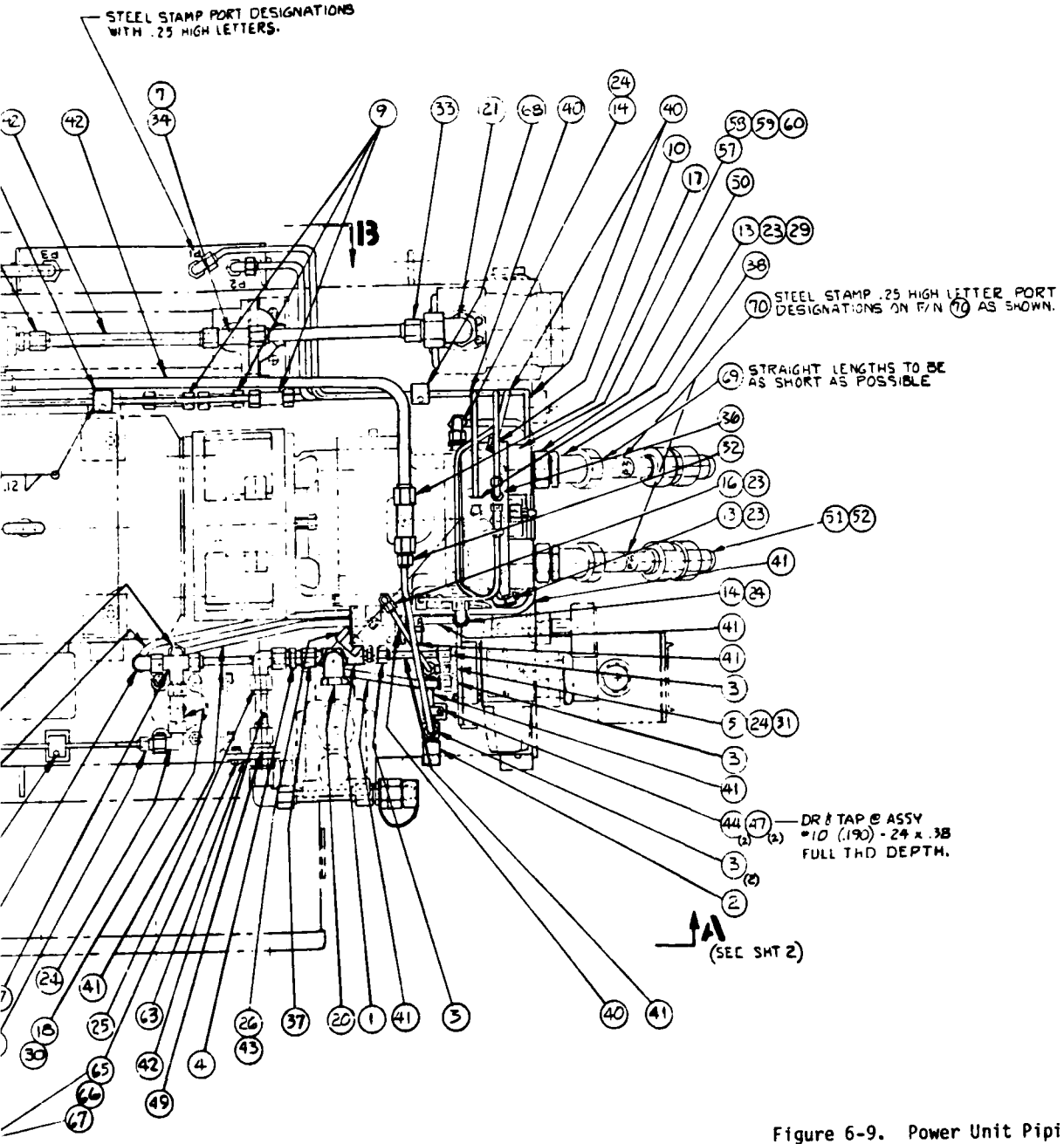

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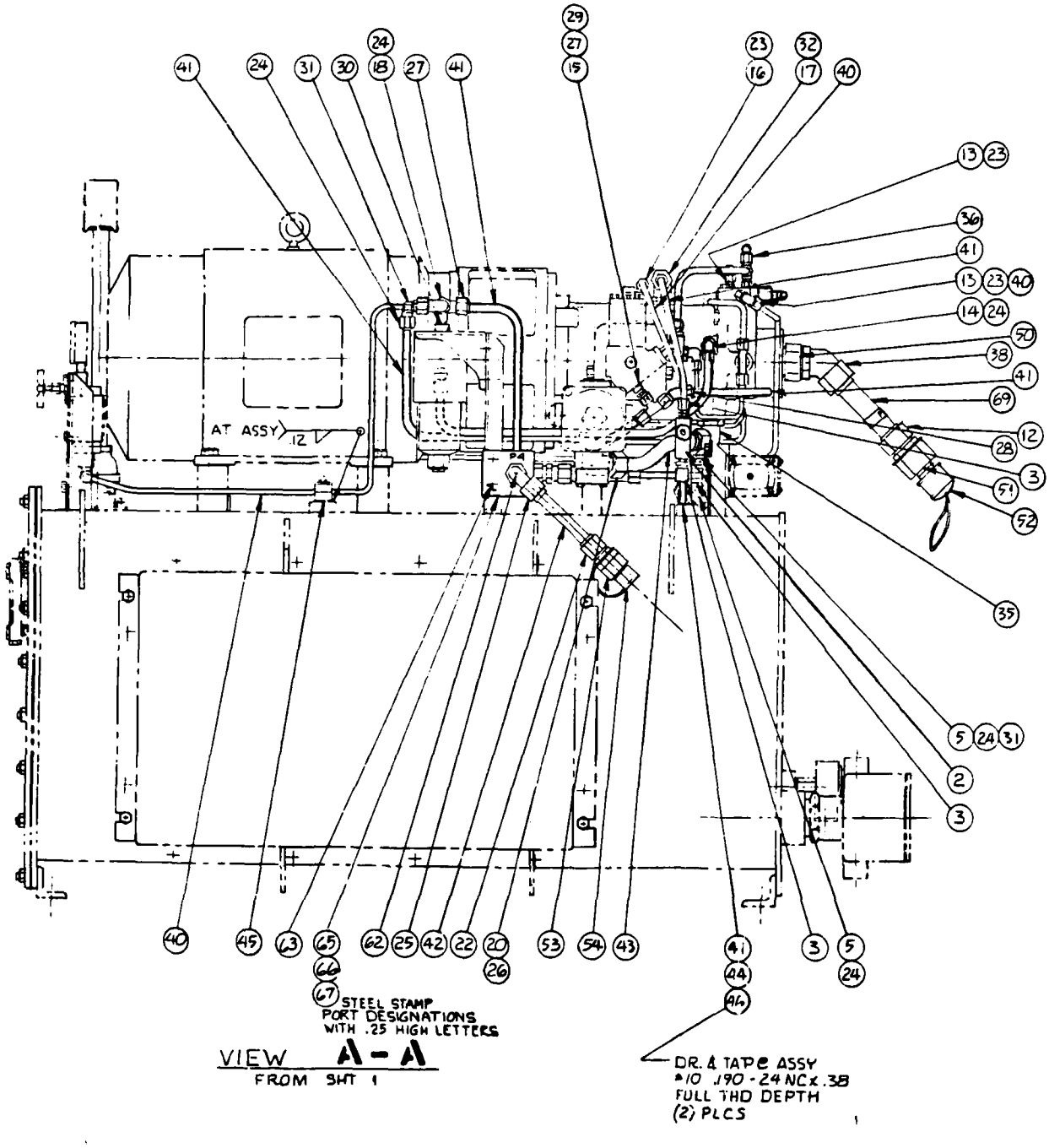
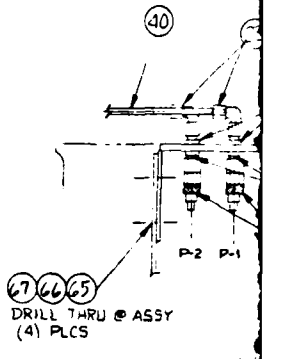
Figure 6-9. Power Unit Piping Diagram
(Sheet 1 of 5)





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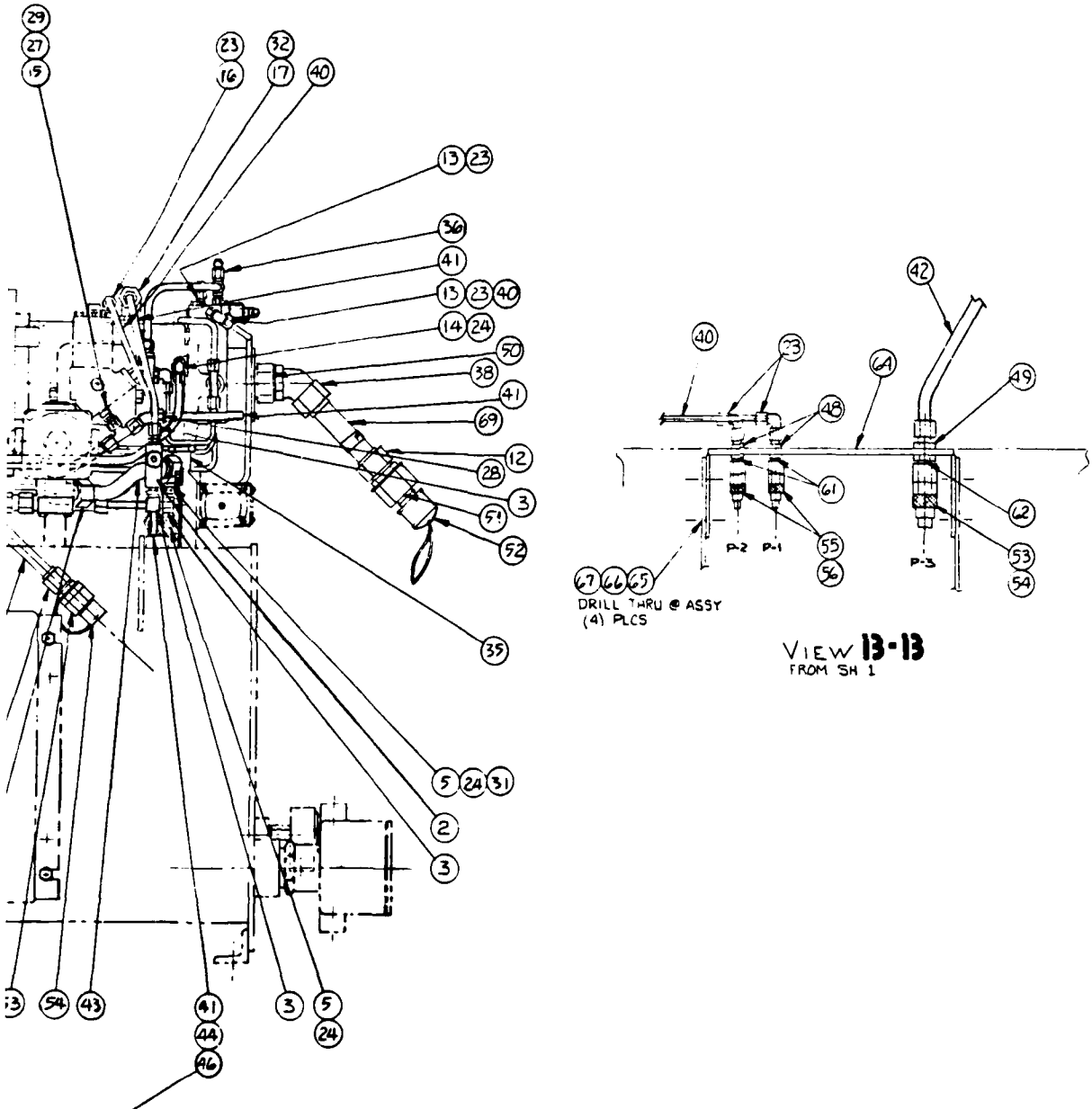

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Figure 6-9. Power Unit Piping Diagram
(Sheet 2 of 5)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
					PART OR DRG NO.	NAME			C	P	H	C/E	N/D	N				
1		FLOW CONTROL VALVE	1		F-375-BBC	REGO M&M	BRASS	COML										
2		FLOW CONTROL VALVE	1		F-600-S	PARKER	STL	COML										3000 PSI
3		CONNECTOR, MALE	5		111323	WGC	STL	COML										8-FBTX-S
4		CONNECTOR, MALE	1		111328	WGC	STL	COML										12-8 FBTX-S
5		CONNECTOR, MALE BODY	2		134450	WGC	STL	COML										8 FTX-S
6		"T", MALE BRANCH	1		111301	WGC	STL	COML										8 SBTX-S
7		"T" MALE BRANCH	2		111304	WGC	STL	COML										12 SBTX-S
8		CONNECTOR, FEMALE	4		111152	WGC	STL	COML										6 GBTX-S
9		UNION	3		111179	WGC	STL	COML										6 HBTX-S
10		CONNECTOR, ST. THD	1		110685	WGC	STL	COML										6 F5BX-S
11		CONNECTOR, MALE	1		111327	WGC	STL	COML										12 FBTX-S
12		CONNECTOR, ST. THD.	2		110705	WGC	STL	COML										20 F5BX-S
13		CONNECTOR, ST. THD BODY ONLY W/ O-RING	2		134652	WGC	STL	COML										6 F50X-S
14		CONNECTOR, ST. THD. BODY ONLY W/O-RING	2		134664	WGC	STL	COML										8 F50X-S
15		CONNECTOR ST. THD. BODY ONLY W/ O-RING	1		134896	WGC	STL	COML										8-6 F50X-S
16		LG. CONNECTOR ST. THD BODY ONLY W/ O-RING	1		138604	WGC	STL	COML										6 FF50X-S
17		BR. "T", ST. THD	2		110637	WGC	STL	COML										12 35BX-S
18		BR. "T", ST. THD BODY ONLY W/ O-RING	1		134625	WGC	STL	COML										8 55OX-S
19		ELBOW, ST THD	1		110645	WGC	STL	COML										8 C5BX-S
20		ELBOW, ST. THD BODY ONLY W/ O-RING	1		134292	WGC	STL	COML										16 C50X-S
21		ELBOW, ST. THD. BODY ONLY W/ O-RING	1		134293	WGC	STL	COML										20 C50X-S
22		CONNECTOR, ST. THD	1		110695	WGC	STL	COML										12 F5BX-S
23		ELBOW, SWIVEL NUT	5		110659	WGC	STL	COML										6 C6BX-S
24		ELBOW, SWIVEL NUT	6		110660	WGC	STL	COML										8 C6BX-S
25		ELBOW, SWIVEL NUT	3		110662	WGC	STL	COML										12 C6BX-S
26		ELBOW, SWIVEL NUT	1		110664	WGC	STL	COML										16 C6BX-S
27		BR. T, SWIVEL NUT	2		110624	WGC	STL	COML										8 36BX-S

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NAME	MATL	MATL SPEC	REQ'D CERTS C	P	H	C/E	M/D	H	ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS	MATL CLASS A	B	C	D
) M&M	BRASS	COML													
:KER	STL	COML									3000 PSI MAX. OP. PRESS.				
GC	STL	COML									8 FBTX-S PARKER				
'GC	STL	COML									12 8 FBTX-S PARKER				
GC	STL	COML									8 FTX-S PARKER				
'GC	STL	COML									8 SBTX-S PARKER				
IGC	STL	COML									12 SBTX-S PARKER				
'GC	STL	COML									6 GBTX-S PARKER				
IGC	STL	COML									6 HBTX-S PARKER				
'GC	STL	COML									6 F5BX-S PARKER				
'GC	STL	COML									12 FBTX-S PARKER				
IGC	STL	COML									20 F5BX-S PARKER				
IGC	STL	COML									6 F50X-S PARKER				
VGC	STL	COML									8 F50X-S PARKER				
VGC	STL	COML									8-6 F50X-S PARKER				
VGC	STL	COML									6 FF50X-S PARKER				
VGC	STL	COML									12 S5BX-S PARKER				
WGC	STL	COML									8 S50X-S PARKER				
WGC	STL	COML									8 C5BX-S PARKER				
VGC	STL	COML									16 C50X-S PARKER				
WGC	STL	COML									20 C50X-S PARKER				
WGC	STL	COML									12 F5BX-S PARKER				
WGC	STL	COML									6 C6BX-S PARKER				
WGC	STL	COML									8 C6BX-S PARKER				
WGC	STL	COML									12 C6BX-S PARKER				
WGC	STL	COML									16 C6BX-S PARKER				
WGC	STL	COML									8 S6BX-S PARKER				

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Figure 6-9. Power Unit Piping Diagram (Sheet 3 of 5)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER PART OR DWG NO.	MANUFACTURER NAME	MATL	MATL SPEC	REQ'D CERTS C	P	H	C/C	N/D	N	ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
28		45° ELBOW, ST. THD	1		110672	WGC	STL	COML									8 V6BX-S
29		REDUCER - EXPANDER	2		127627	WGC	STL	COML									4-6 F50G5-S
30		REDUCER-EXPANDER	2		127634	WGC	STL	COML									12-8 F50G5-S
31		REDUCER, TUBE END	1		110990	WGC	STL	COML									8-6 TRBTX-S
32		REDUCER, TUBE END	1		110996	WGC	STL	COML									12-8 TRBTX-S
33		REDUCER, TUBE END	1		111003	WGC	STL	COML									20-12 TRBTX-S
34		REDUCER BUSHING - NPT	1		134620	WGC	STL	COML									1X 3/4 PTR-S
35		ELBOW, ST. THD	1		110651	WGC	STL	COML									16 C5BX-S
36		RUN "T", SWIV. NUT	1		110611	WGC	STL	COML									6 RGBX-S
37		REDUCING CONNECTOR	1		111637	WGC	STL	COML									1/2 x 3/8 FG-S
38		45° ELBOW, ST. THD.	2		110606	WGC	STL	COML									20 V5BX-S
39																	
40		STL TUBE, C.D.	300 IN. (25 FT)		102290	WGC	ST STL	TYPE 304 ASTM A-269									.38 OD x .049
41		STL TUBE, C.D.	168 IN. (14 FT)		102293	WGC	ST STL	TYPE 304 ASTM A-269									.50 OD x .06
42		STL TUBE, C.D.	60 IN. (5 FT)		102296	WGC	ST STL	TYPE 304 ASTM A-269									.75 OD x .09
43		STL TUBE C.D.	16 IN.		136939	WGC	ST STL	TYPE 304 ASTM A-269									1.0 O.D. x 0
44		TUBE CLAMP, CUSHIONED	2		114102	WGC	STL	COML									.5 TUBE, NEOP
45		CLAMP 3/8 TUBE	1		A305446	WGC	VAR	COML									STAUFF, SP-109
46		CLAMP, (1) STACK, 3/8 TUBE	1		A308004	WGC	VAR	COML									STAUFF, 1x SP-109 2x 109
47		SCREW HEX. HD. MACH.	2		108988	WGC	STL	COML									#10-24 x .3
48		BULKHEAD UNION	2		111247	WGC	STL	COML									6 WBTX-S
49		BULKHEAD UNION	2		111250	WGC	STL	COML									12 WBTX-S
50		REDUCER/ EXPANDER	2		111662	WGC	STL	COML									24-20 F50G5-
51		QUICK DISCONNECT NIPPLE END	2		71-1N16-20-EF	SNAP-TITE	STL	COML									
52		DUST CAP	2		71NCC-16	SNAP-TITE	RUBBER	COML									
53		QUICK DISCONNECT NIPPLE END	2		SVHN12-12EF	SNAP-TITE	STL	COML									
54		DUST CAP	2		PDC-12	SNAP-TITE	PLASTIC	COML									

Figure
(Sheet

ME	MATL	MATL SPEC	REQ'D CERTS C	P	H	C/C	M/O	N		ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS	MATL CLASS D	D	D	D
C	STL	COML										8 V6BX-S PARKER				
C	STL	COML										4-6 F50G5-S PARKER				
C	STL	COML										12-8 F50G5-S PARKER				
C	STL	COML										8-6 TRBTX-S PARKER				
C	STL	COML										12-8 TRBTX-S PARKER				
C	STL	COML										20-12 TRBTX-S PARKER				
C	STL	COML										1X 3/4 PTR-S PARKER				
C	STL	COML										16 C5BX-S PARKER				
C	STL	COML										6 RGBX-S PARKER				
C	STL	COML										1/2 x 3/8 FG-S PARKER				
C	STL	COML										20 V5BX-S PARKER				
	ST STL	TYPE 304 ASTM A-269										.38 OD X .049 W.				
	ST STL	TYPE 304 ASTM A-269										.50 OD X .065 W.				
	ST STL	TYPE 304 ASTM A-269										.75 OD x .095 W.				
	ST STL	TYPE 304 ASTM A-269										1.0 O.D. x 083 W.				
	STL	COML										.5 TUBE, NEOPRENE CUSH.				
	VAR	COML										STAUFF, SP-1095-PP-DP-AS				
C	VAR	COML										STAUFF, 1x SP-1095-PP-DP-AS 2x 1095-PP-AF-S1				
C	STL	COML										#10-24 x .38 LG PLTD				
C	STL	COML										6 WBTX-S PARKER				
C	STL	COML										12 WBTX-S PARKER				
C	STL	COML										24-20 F50G5-S PARKER				
TITE	STL	COML														
TITE	RUBBER	COML														
TITE	STL	COML														
TITE	PLASTIC	COML														

D316464B

Figure 6-9. Power Unit Piping Diagram
(Sheet 4 of 5)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER PART OR DWG NO.	MANUFACTURER NAME	MATL	MATL SPEC	REQ'D CERTS C	P	H	C_E	N_D	N		ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	
55		QUICK DISCONNECT NIPPLE END	2		SYHN-6-6EF	SNAP-TITE	STL	COML										
56		DUST CAP	2		PDC-6	SNAP-TITE	PLASTIC	COML										
57		FLANGE	2		TSAET-12-60	MAIN MFD PRODUCTS	STL	COML										
58		SOC HD CAP SCREW	8		109813	WGC	STL	COML										5/8 -
59		LOCK WASHER-HI COLLAR	8		105398	WGC	STL	COML										5/8
60		O RING	2		2-225	PARKER												
61		"O" RING	2		3-6	PARKER												.078
62		"O" RING	2		3-12	PARKER												.116
63		BRACKET	1		B312509	WGC	STL											
64		BRACKET	1		C313722	WGC	STL											
65		CAP SCREW, HEX HD	6		103809	WGC	STL	COML										3/8 - 1
66		HEX NUT	6		105258	WGC	STL	COML										3/8 - 1
67		LOCK WASHER	6		105381	WGC	STL	COML										3/8
68		CLAMP(S) STACK, 3/8 TUBE	1		A308518	WGC	VAR	COML										STAUF
69		TUBE	2		102302	WGC	SSTL	COML										1 1/4 0
70		MARKER	2		T-1009-SST	METAL MARKER MFG. CO	STL	COML										

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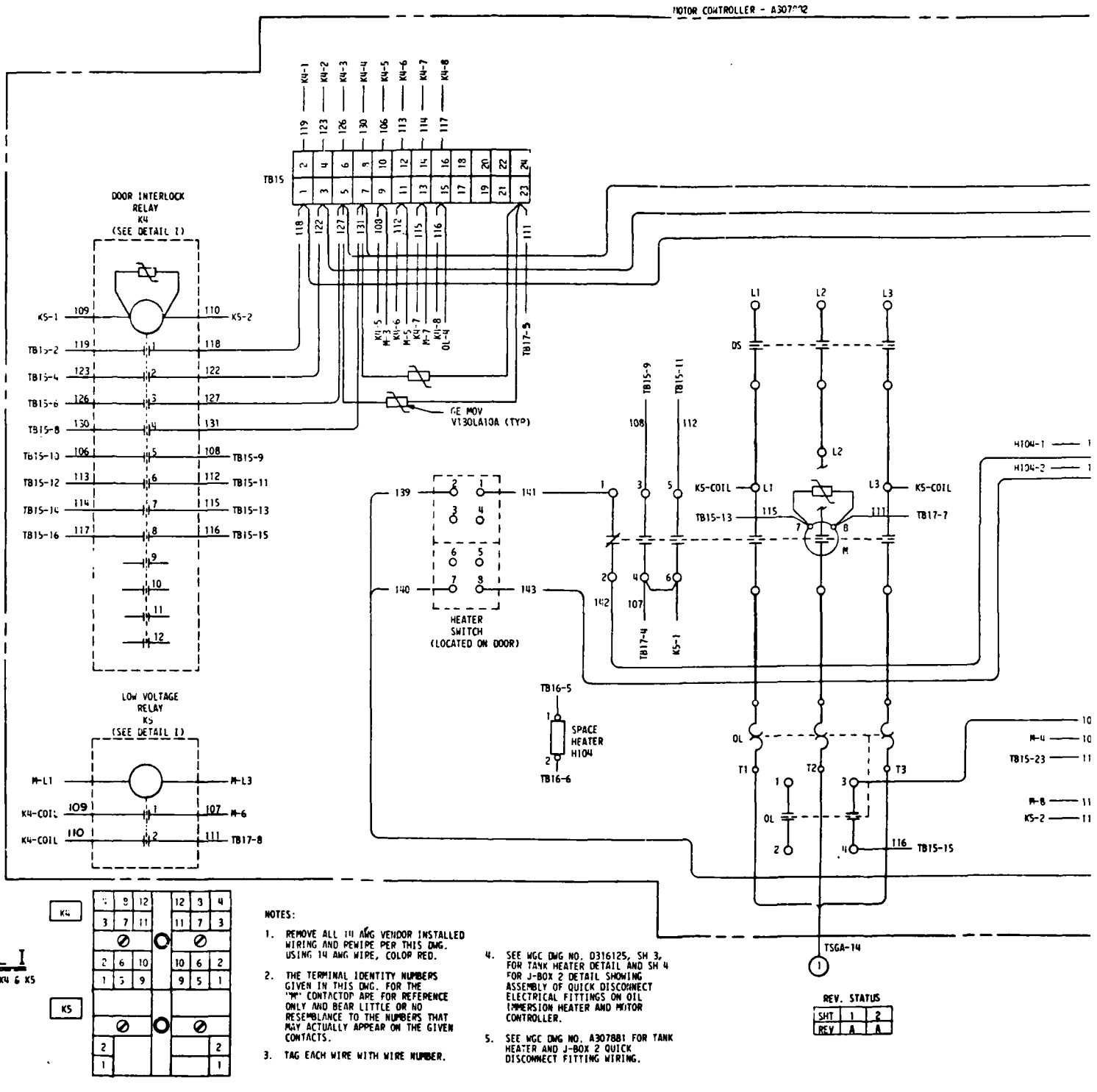
MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS	MATL CLASS			
OR NO.	NAME			C	P	H	C/C	N/D	N								
6EF	SNAP-TITE	STL	COML														
	SNAP-TITE	PLASTIC	COML														
-12-60	MAIN MFD PRODUCTS	STL	COML														
313	WGC	STL	COML										5/8-11NC x 2				
98	WGC	STL	COML										5/8				
5	PARKER																
	PARKER												.078 W x .468 I.D.				
	PARKER												.116 W x .971 I.D.				
509	WGC	STL															
22	WGC	STL															
03	WGC	STL	COML										3/8-16NC x 1				
58	WGC	STL	COML										3/8-16NC				
81	WGC	STL	COML										3/8				
518	WGC	VAR	COML										STAUFF, 1 x SP-1077 [illegible] 4 x 1077 [illegible]				
302	WGC	SSTL	COML										1 1/4 OD X .120 W. [illegible] LG				
9.SST	METAL MARKER MFG.CO	STL	COML														

D316464B

Figure 6-9. [illegible] Unit Piping Diagram
(Sheet 5 of 5)



DETAIL I

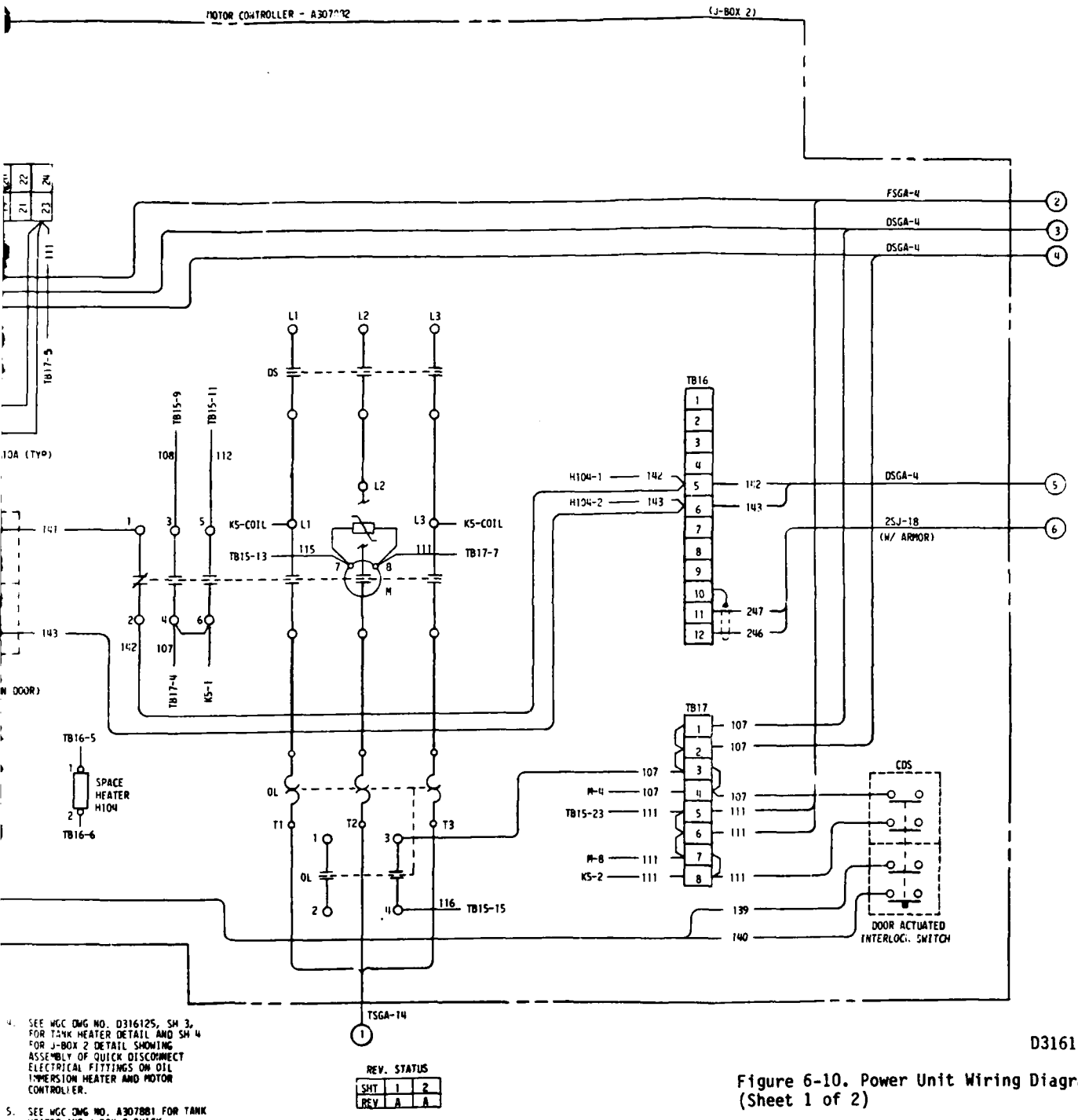
LAYOUT FOR K4 & K5

NOTES:

1. REMOVE ALL 14 AWG VENDOR INSTALLED WIRING AND REWIRE PER THIS DWG. USING 14 AWG WIRE, COLOR RED.
2. THE TERMINAL IDENTITY NUMBERS GIVEN IN THIS DWG. FOR THE "M" CONTACTOR ARE FOR REFERENCE ONLY AND BEAR LITTLE OR NO RESEMBLANCE TO THE NUMBERS THAT MAY ACTUALLY APPEAR ON THE GIVEN CONTACTS.
3. TAG EACH WIRE WITH WIRE NUMBER.
4. SEE WGC DWG NO. D316125, SH 3, FOR TANK HEATER DETAIL AND SH 4 FOR J-BOX 2 DETAIL SHOWING ASSEMBLY OF QUICK DISCONNECT ELECTRICAL FITTINGS ON OIL IMMERSION HEATER AND MOTOR CONTROLLER.
5. SEE WGC DWG NO. A307881 FOR TANK HEATER AND J-BOX 2 QUICK DISCONNECT FITTING WIRING.

REV. STATUS

SHT	1	2
REV	A	A

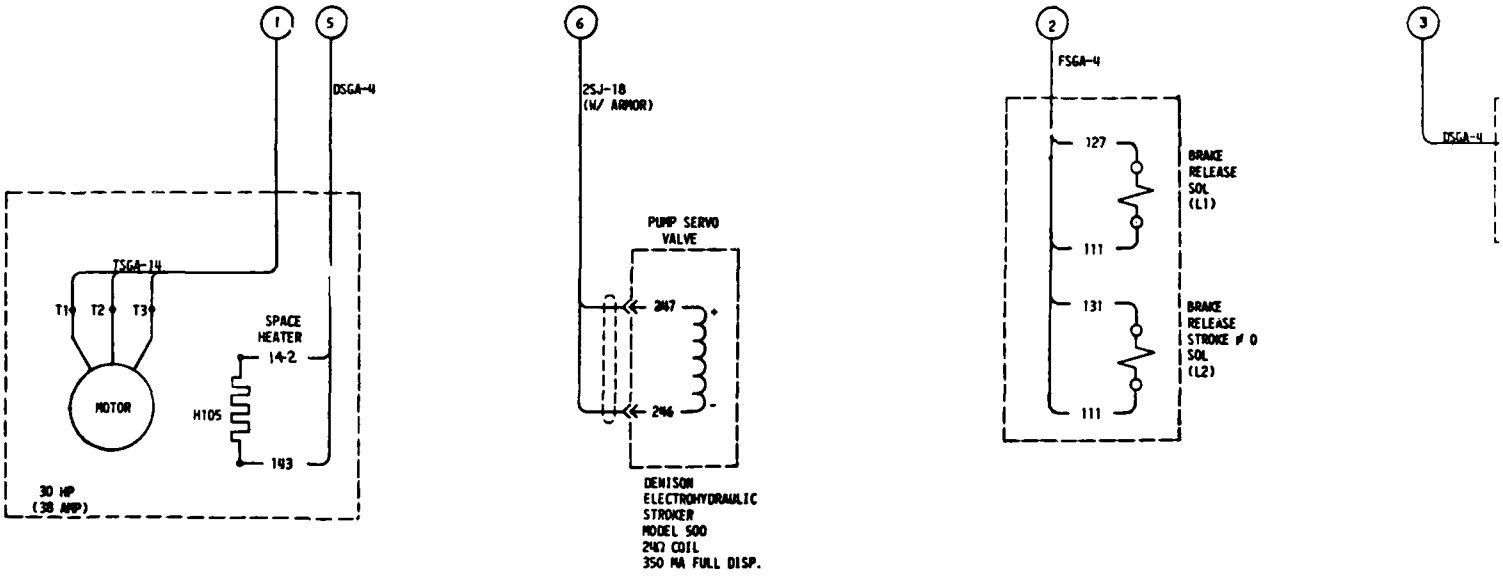


4. SEE WGC DWG NO. D316125, SH 3, FOR TANK HEATER DETAIL AND SH 4 FOR J-BOX 2 DETAIL SHOWING ASSEMBLY OF QUICK DISCONNECT ELECTRICAL FITTINGS ON OIL IMMERSION HEATER AND MOTOR CONTROLLER.

5. SEE WGC DWG NO. A307881 FOR TANK HEATER AND J-BOX 2 QUICK DISCONNECT FITTING WIRING.

D316129A

Figure 6-10. Power Unit Wiring Diagram (Sheet 1 of 2)


SERVO PRESSURE SWITCH
107
118
SET TO CLOSE AT 300 PSI
DSGA-4
(S111)
4
TANK HEATER
120 VAC 2.5 KVA HEATER SUPPLY
(W3)
T44
T45
1
5
DSGA-4
TSGA-14
T1
T2
T3
SPACE HEATER
14-2
MOTOR
H105
143
30 HP (38 AMP)
6
2SJ-18 (W/ ARMOR)
PUMP SERVO VALVE
247
246
DENISON ELECTROHYDRAULIC STROKER MODEL 500 247 COIL 350 MA FULL DISP.
2
FSGA-4
127
111
BRAKE RELEASE SOL (L1)
131
111
BRAKE RELEASE STROKE # 0 SOL (L2)
3
DSGA-4

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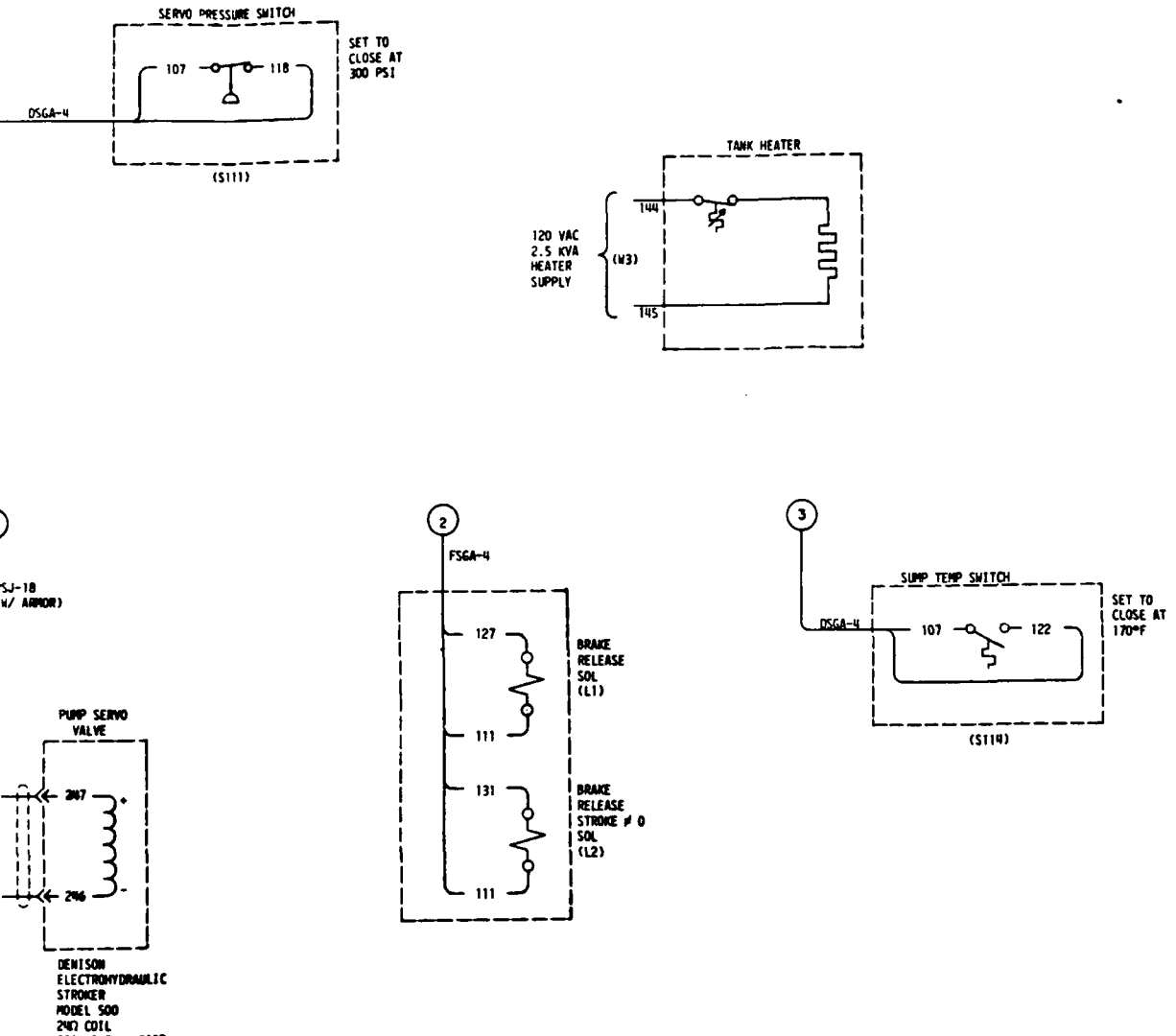
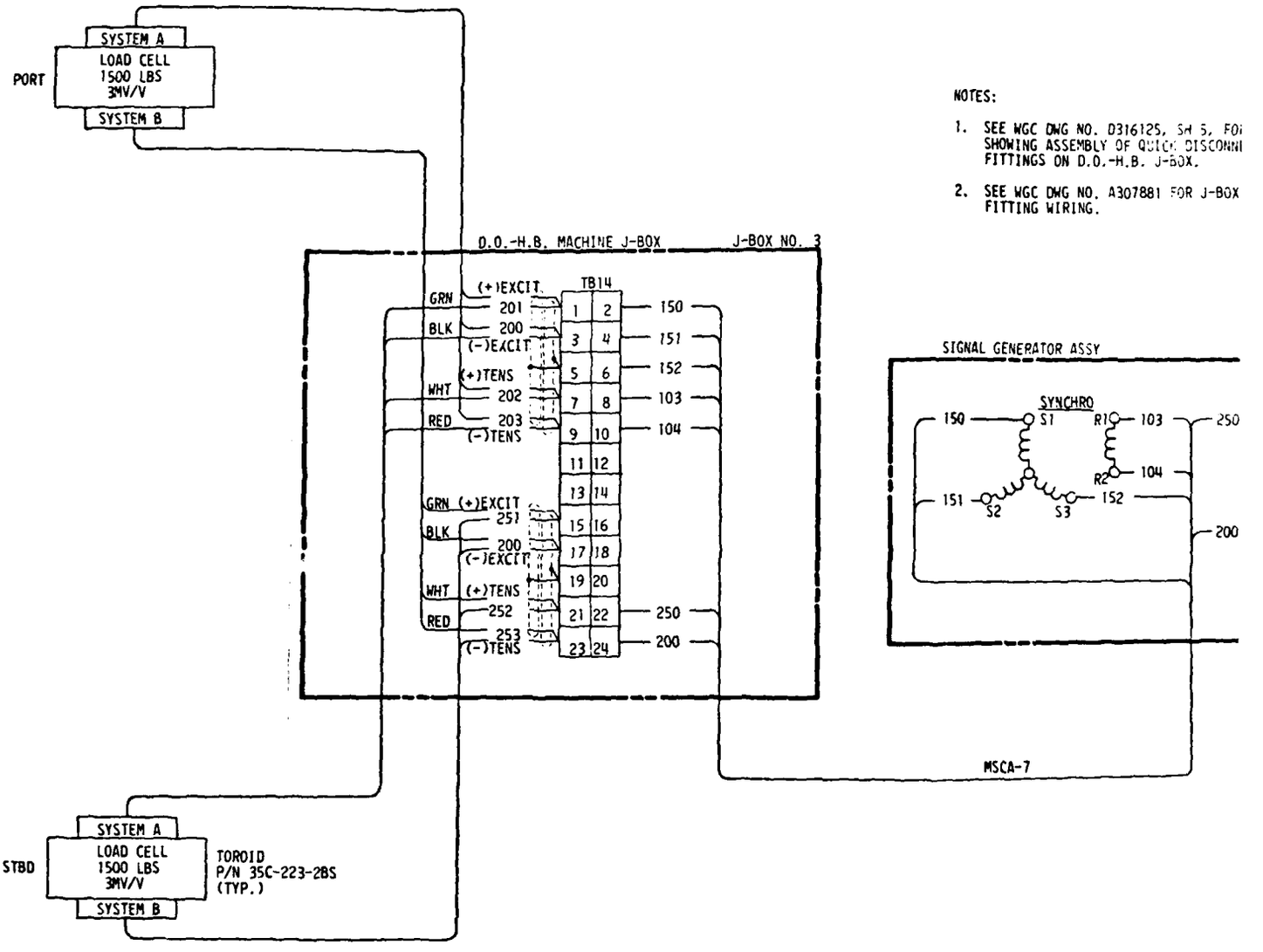


D316129A

Figure 6-10. Power Unit Wiring Diagram (Sheet 2 of 2)



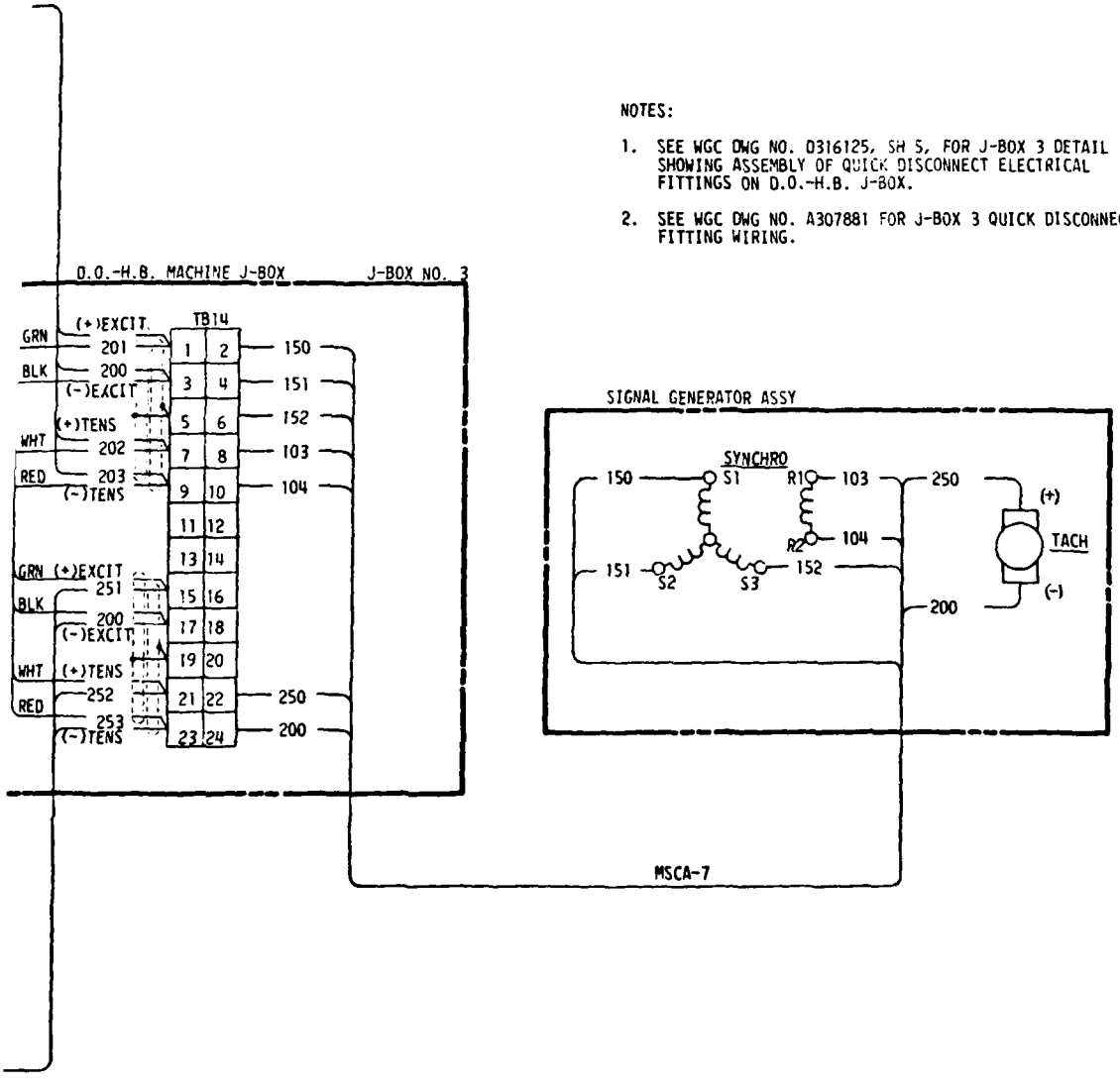
NOTES:

1. SEE WGC DWG NO. D316125, SH 5, FOR SHOWING ASSEMBLY OF QUICK DISCONNECT FITTINGS ON D.O.-H.B. J-BOX.
2. SEE WGC DWG NO. A307881 FOR J-BOX FITTING WIRING.

Figure 6-11. DOHB Machine

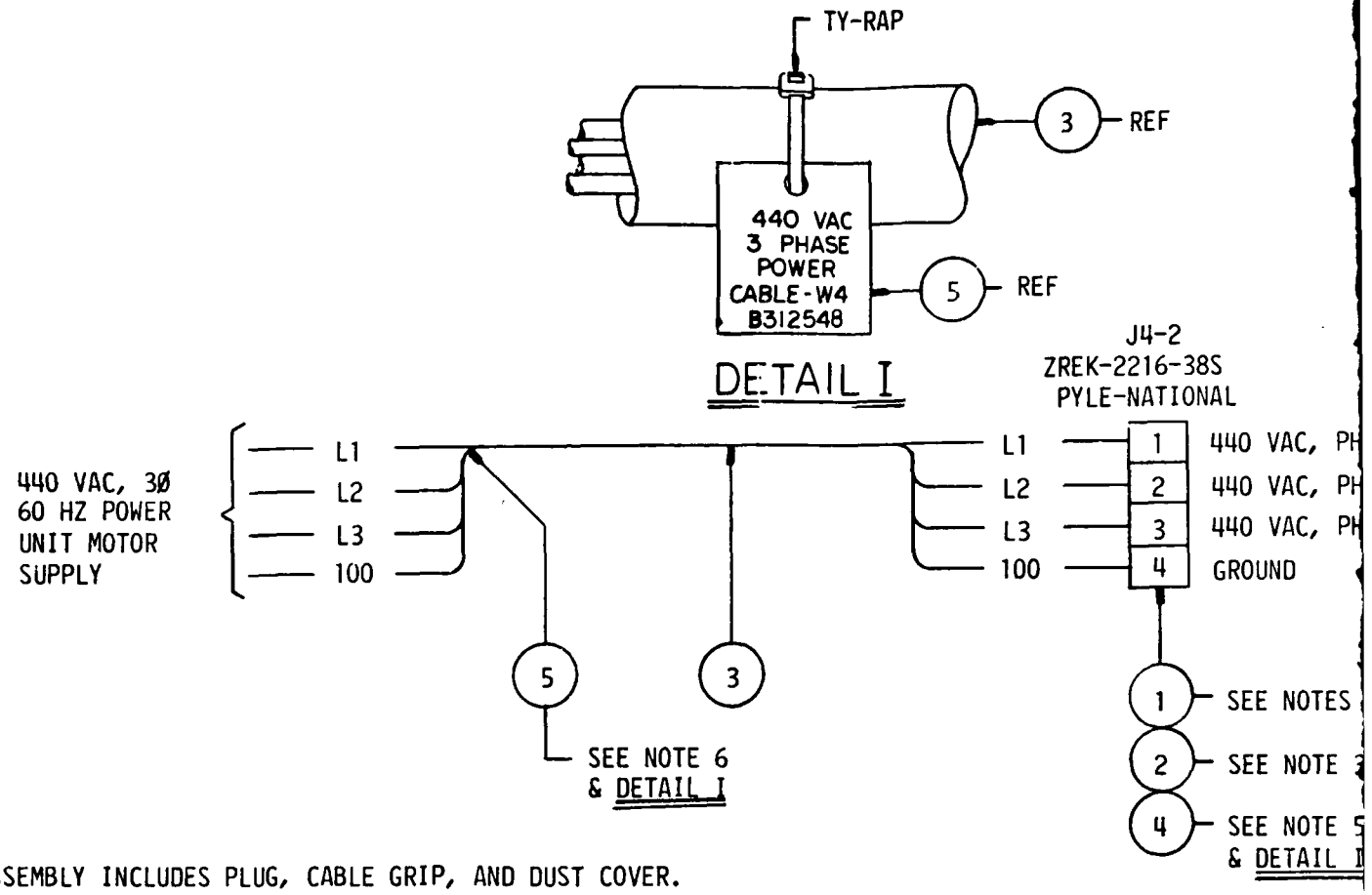
NOTES:

1. SEE WGC DWG NO. D316125, SH 5, FOR J-BOX 3 DETAIL SHOWING ASSEMBLY OF QUICK DISCONNECT ELECTRICAL FITTINGS ON D.O.-H.B. J-BOX.
2. SEE WGC DWG NO. A307881 FOR J-BOX 3 QUICK DISCONNECT FITTING WIRING.



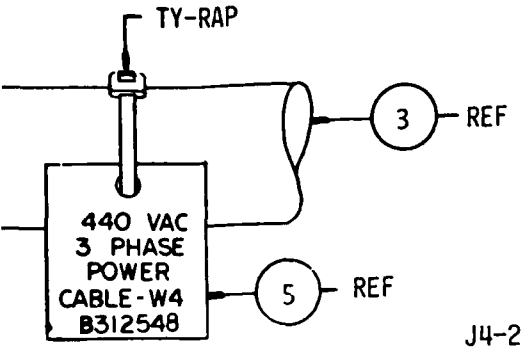
C312802A

Figure 6-11. DOHB Machine Wiring Diagram

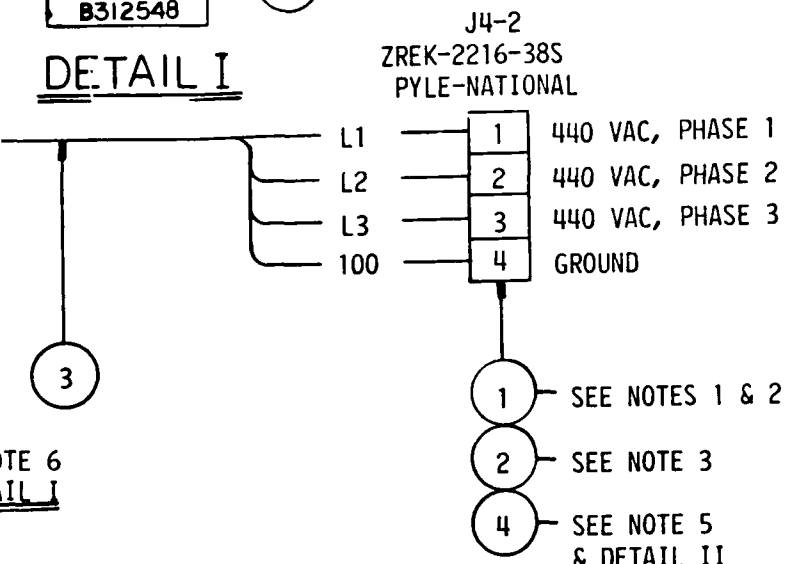


NOTES:

1. ASSEMBLY INCLUDES PLUG, CABLE GRIP, AND DUST COVER.
2. BEFORE SOLDERING WIRES TO THE PINS OF PLUG, VERIFY THAT THE PLUG ASSEMBLY'S RUBBER GROMMET FITS SNUGLY ON CABLE. IF GROMMET FIT IS NOT SNUG, NOTIFY ENGINEERING SO THAT SMALLER GROMMET MAY BE OBTAINED.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSEMBLY, F/N 2.
4. TAG OR MARK WIRES WITH WIRE NUMBERS.
5. THE LEGEND ON THIS LABEL SHOULD READ:
   "J4-2"
   "CABLE-W4"
   "B312548"
6. THE LEGEND ON THIS LABEL SHOULD READ:
   "440 VAC" "B312548"
   "3 PHASE"
   "POWER"
   "CABLE-W4"



DETAIL I



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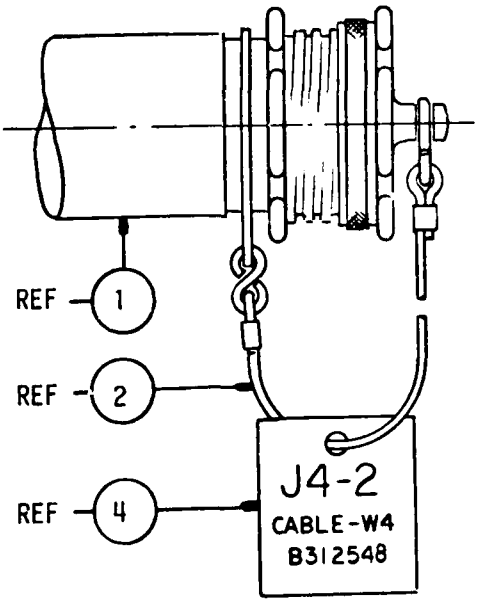
.
THAT THE PLUG
F GROMMET FIT IS
ET MAY BE OBTAINED.
2.



DETAIL II

B312548A

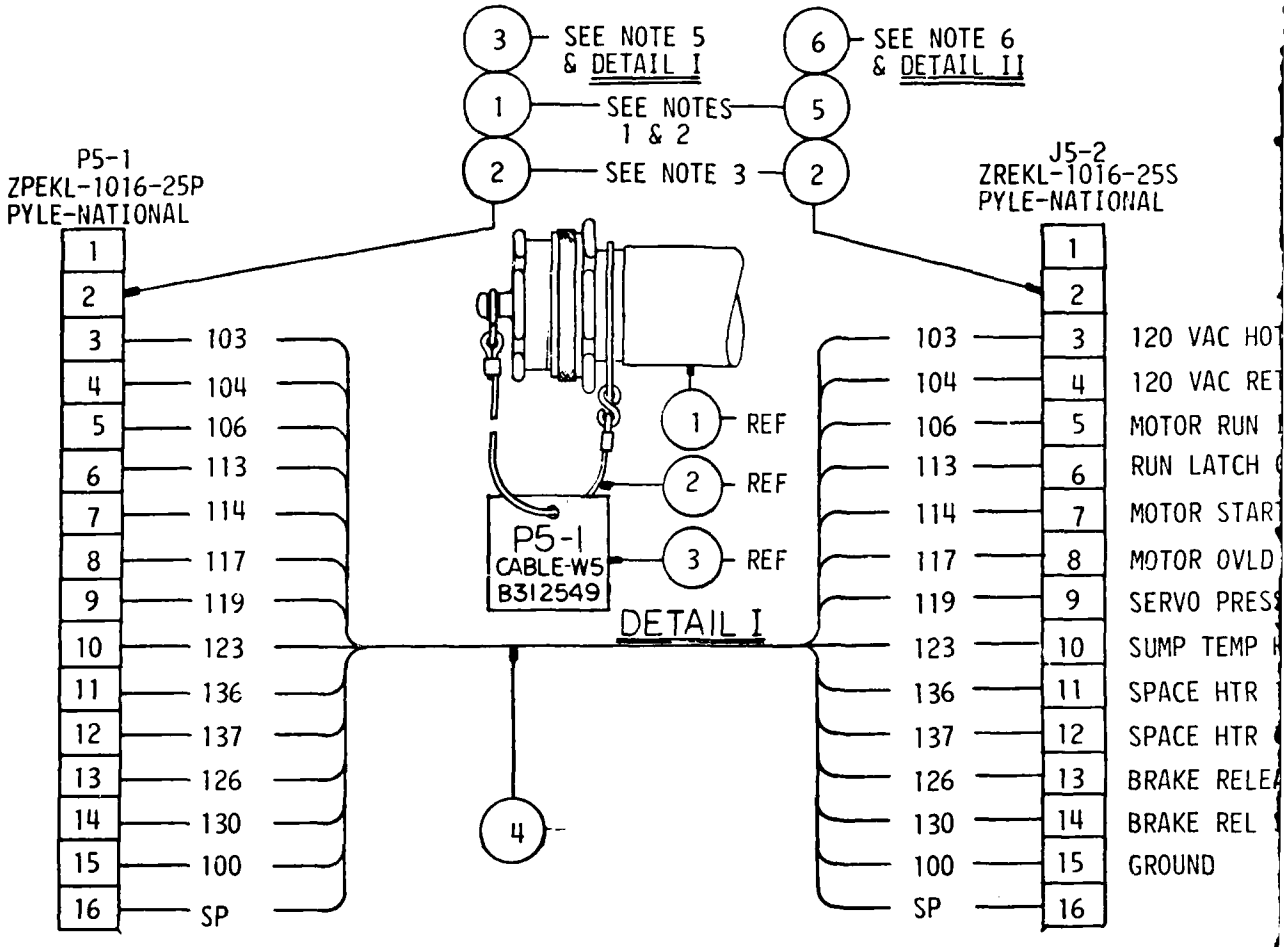
Figure 6-12. W4 Cable Assembly
(Sheet 1 of 2)

P/L NUMBER	ENG REV	P/L NOMENCLATURE	CODE IDENT
B312548	-	W4 CABLE ASSEMBLY	16603

FIND NO	ITEM NUMBER	ENG REV	ITEM NOMENCLATURE	QUANTITY REQUIRED
1	ZREK-2216-38SR		RECEPTACLE-W/BASKET WEAVE CABLE GRIP PYLE-NATIONAL	1 EA
2	CL-22-KA-6.0		CABLE ASSY CARR LANE MFG	1 EA
3	B312548-3		CABLE (FHOF-42) 100 FT LG	1 EA
4	A308569-8		LABEL-ELECTRICAL CABLE	1 EA
5	A308569-7		LABEL-ELECTRICAL CABLE	1 EA

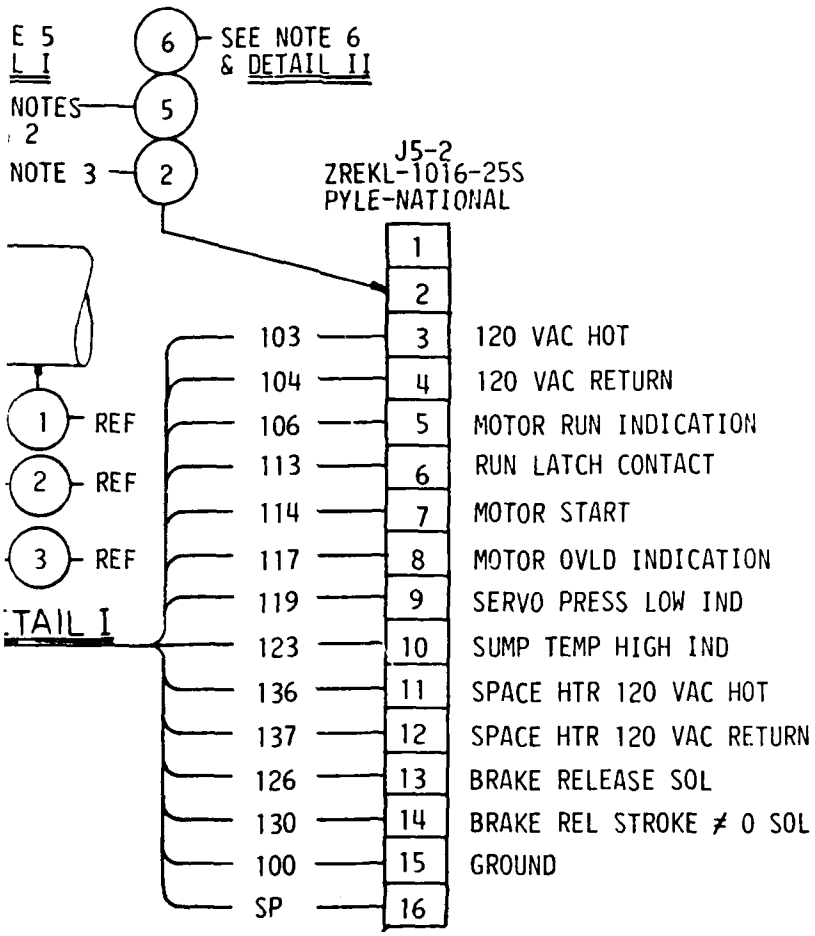
B312548

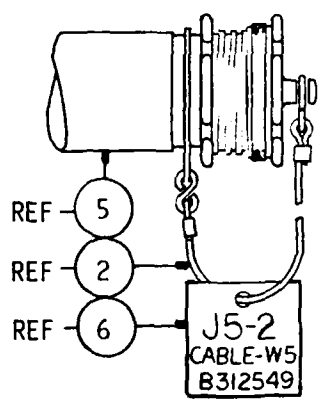
Figure 6-12. W4 Cable Assembly (Sheet 2 of 2)



NOTES:

1. ASSEMBLY INCLUDES PLUG, CABLE GRIP, AND DUST COVER.
2. BEFORE SOLDERING WIRES TO THE PINS OF PLUG, VERIFY THAT THE PLUG ASSEMBLY'S RUBBER GROMMET FITS SNUGLY ON CABLE. IF GROMMET FIT IS NOT SNUG, NOTIFY ENGINEERING SO THAT SMALLER GROMMET MAY BE OBTAINED.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSEMBLY, F/N 2.
4. TAG OR MARK WIRES WITH WIRE NUMBERS.
5. THE LEGEND ON THIS LABEL SHOULD READ:
   "P5-1"
   "CABLE-W5"
   "B312549"
6. THE LEGEND ON THIS LABEL
   "J5-2"
   "CABLE-W5"
   "B312549"





DETAIL II

HE PLUG
IET FIT IS
BE OBTAINED.

6. THE LEGEND ON THIS LABEL SHOULD READ:
"J5-2"
"CABLE-W5"
"B312549"

B312549

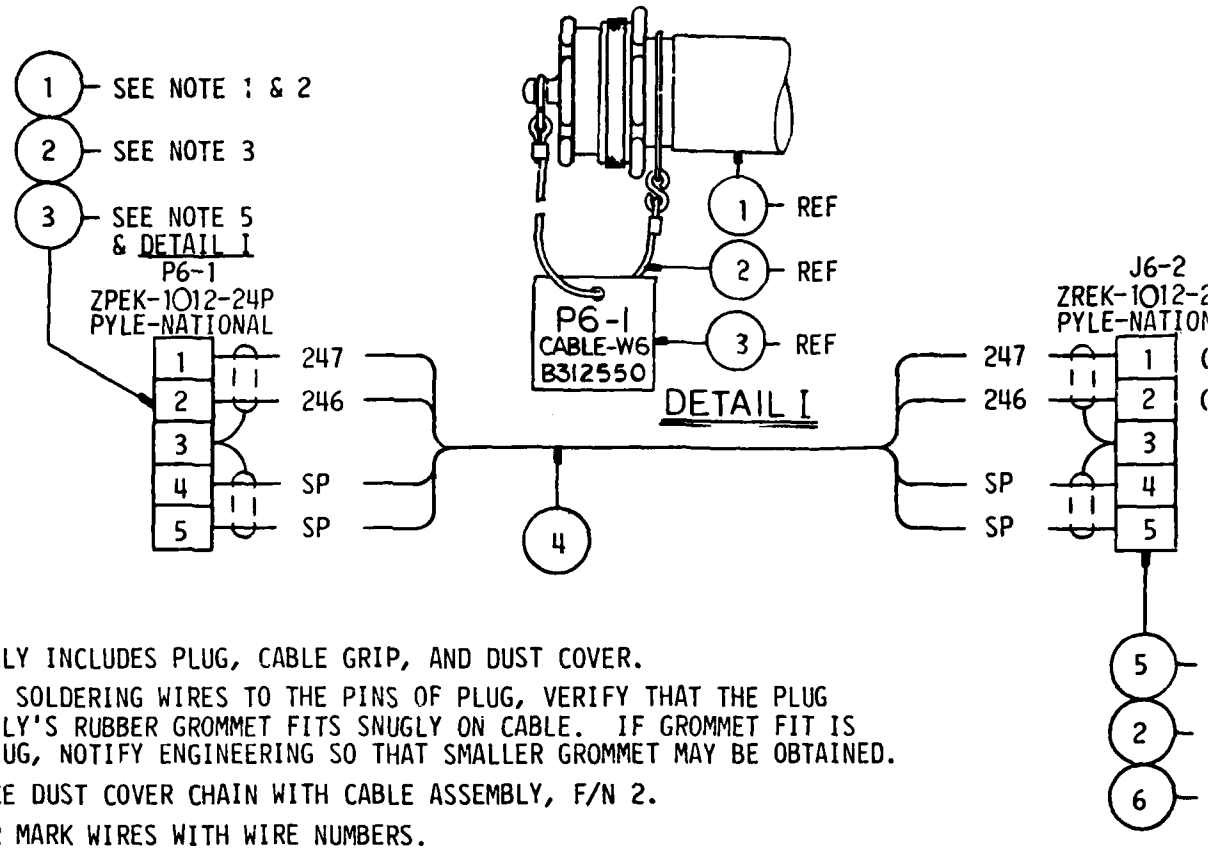
Figure 6-13. W5 Cable Assembly
(Sheet 1 of 2)

P/L NUMBER	ENG REV	P/L NOMENCLATURE	CODE IDENT
B312549	-	W5 CABLE ASSEMBLY	16603

FIND NO	ITEM NUMBER	ENG REV	ITEM NOMENCLATURE	QUANTITY REQUIRED
1	ZPEKL-1016-25P		STR PLUG WITH CABLE GRIP PYLE-NATIONAL	1 EA
2	CL-22-KA-6.0		CABLE ASSY CARR LANE MFG	2 EA
3	A308569-11		LABEL-ELECTRICAL CABLE	1 EA
4	B312549-4		CABLE (MHOF-14) 50 FT LG	1 EA
5	ZREKL-1016-25S		RECEPTACLE-W/BASKET WEAVE CABLE GRIP PYLE-NATIONAL	1 EA
6	A308569-12		LABEL-ELECTRICAL CABLE	1 EA

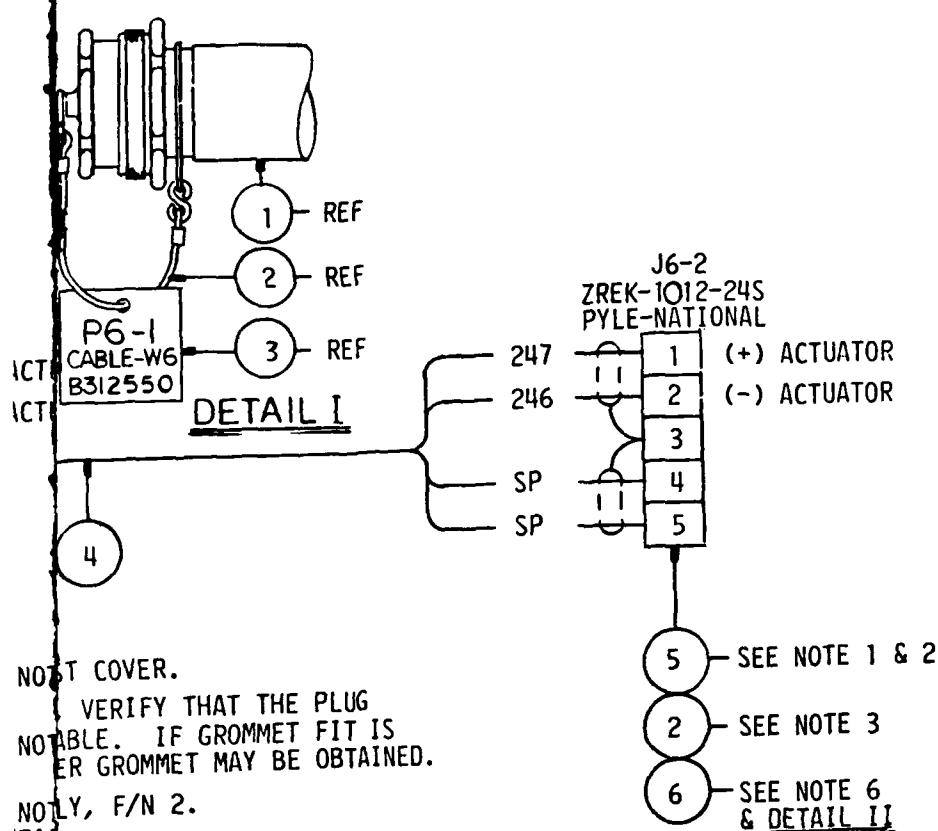
B312549

Figure 6-13. W5 Cable Assembly (Sheet 2 of 2)



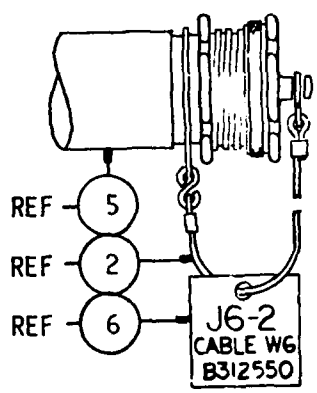
NOTES:

1. ASSEMBLY INCLUDES PLUG, CABLE GRIP, AND DUST COVER.
2. BEFORE SOLDERING WIRES TO THE PINS OF PLUG, VERIFY THAT THE PLUG ASSEMBLY'S RUBBER GROMMET FITS SNUGLY ON CABLE. IF GROMMET FIT IS NOT SNUG, NOTIFY ENGINEERING SO THAT SMALLER GROMMET MAY BE OBTAINED.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSEMBLY, F/N 2.
4. TAG OR MARK WIRES WITH WIRE NUMBERS.
5. THE LEGEND ON THIS LABEL SHOULD READ:
   "P6-1"
   "CABLE-W6"
   "B312550"
6. THE LEGEND ON THIS LABEL SHOULD READ:
   "J6-2"
   "CABLE-W6"
   "B312550"



NOT COVER.
VERIFY THAT THE PLUG
NOTABLE. IF GROMMET FIT IS
ER GROMMET MAY BE OBTAINED.

NOTLY, F/N 2.



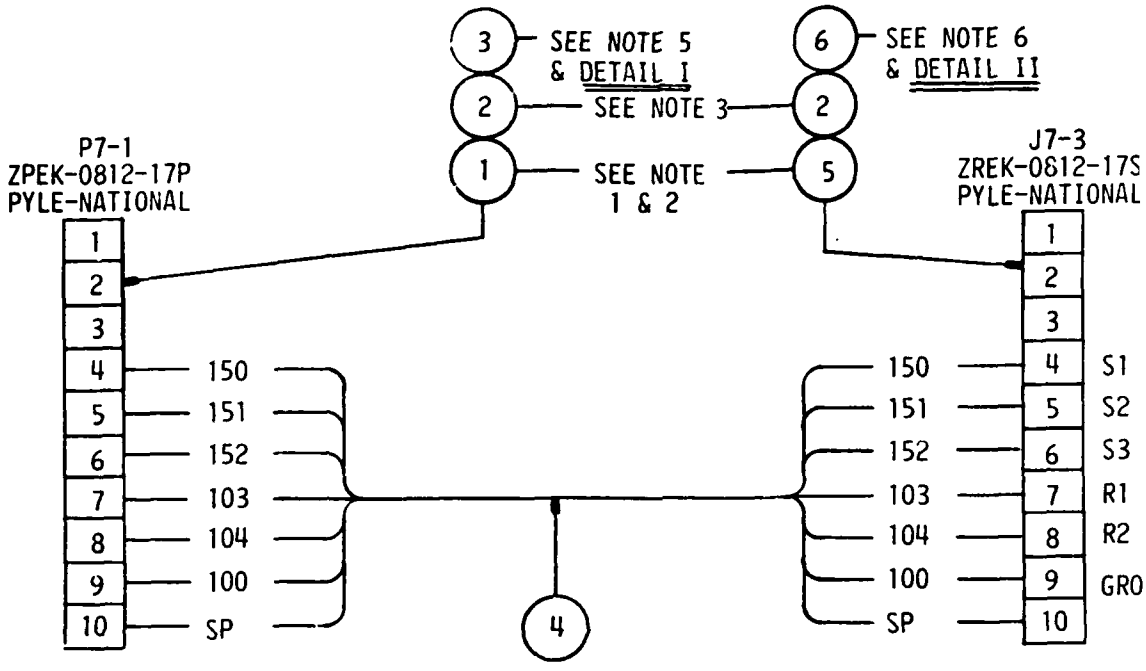
B312550A

Figure 6-14. W6 Cable Assembly
(Sheet 1 of 2)

P/L NUMBER	ENG REV	P/L NOMENCLATURE	CODE IDENT
B312550	-	W6 CABLE ASSEMBLY	16603

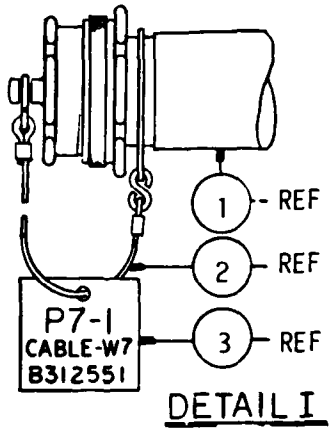
FIND NO	ITEM NUMBER	ENG REV	ITEM NOMENCLATURE	QUANTITY REQUIRED
1	ZPEK-1212-24P		STR PLUG WITH CABLE GRIP PYLE-NATIONAL	1 EA
2	CL-22-KA-6.0		CABLE ASSY CARR LANE MFG	2 EA
3	A308569-15		LABEL-ELECTRICAL CABLE	1 EA
4	B312550-4		CABLE (TTRS-2) 50 FT LG	1 EA
5	ZREK-1212-24S		RECEPTACLE-W/BASKET WEAVE CABLE GRIP PYLE-NATIONAL	1 EA
6	A308569-16		LABEL-ELECTRICAL CABLE	1 EA

Figure 6-14. W6 Cable Assembly (Sheet 2 of 2)

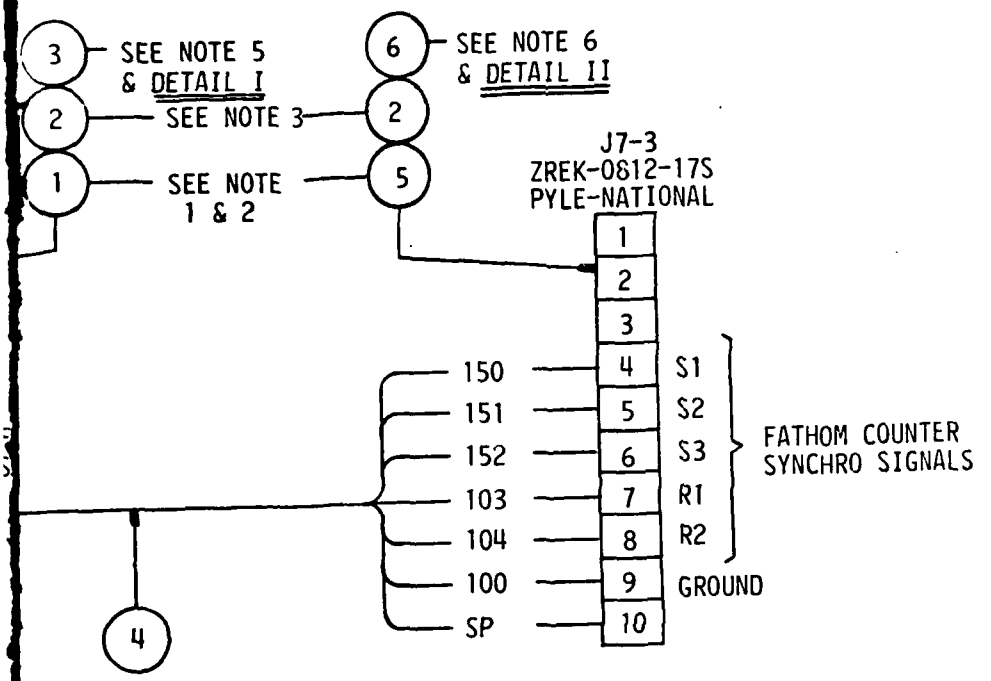


NOTES:

1. ASSEMBLY INCLUDES PLUG, CABLE GRIP, AND DUST COVER.
2. BEFORE SOLDERING WIRES TO THE PINS OF PLUG, VERIFY THAT THE PLUG ASSEMBLY'S RUBBER GROMMET FITS SNUGLY ON CABLE. IF GROMMET FIT IS NOT SNUG, NOTIFY ENGINEERING SO THAT SMALLER GROMMET MAY BE OBTAINED.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSEMBLY, F/N 2.
4. TAG OR MARK WIRES WITH WIRE NUMBERS.
5. THE LEGEND ON THIS LABEL SHOULD READ:
   "P7-1"
   "CABLE-W7"
   "B312551"
6. THE LEGEND ON THIS LABEL SHOULD READ:
   "J7-3"
   "CABLE-W7"
   "B312551"



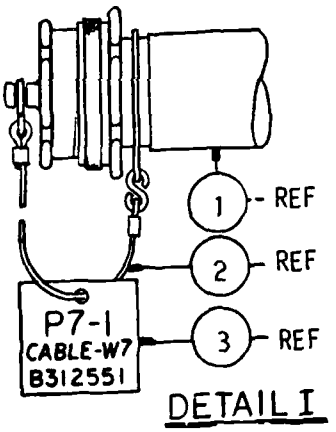
DETAIL I



ST COVER.

VERIFY THAT THE PLUG
ABLE. IF GROMMET FIT
ALLER GROMMET MAY BE

LY, F/N 2.



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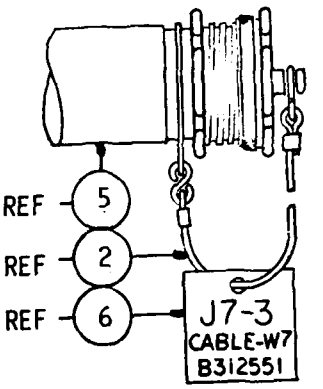


DETAIL II

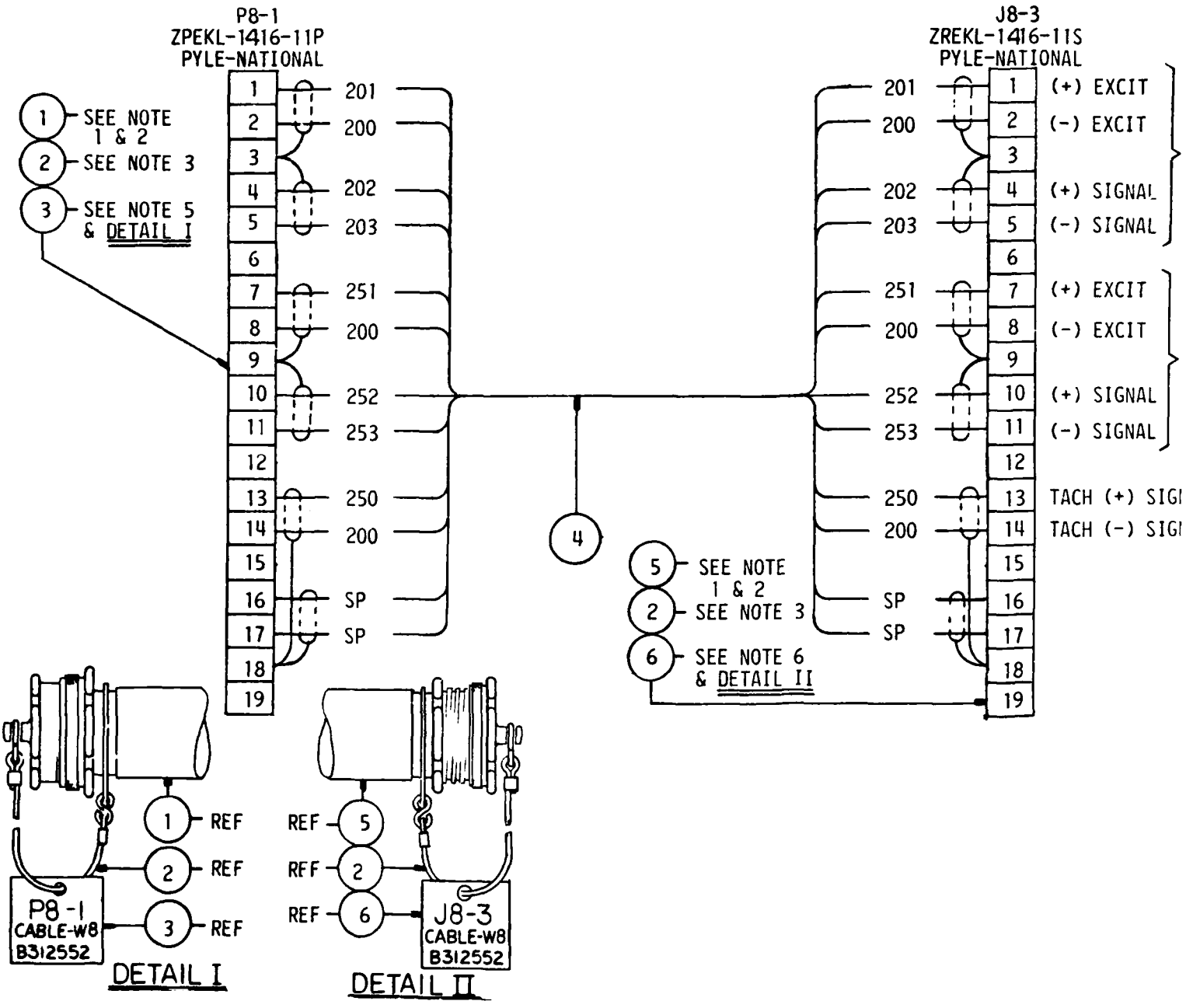
B312551

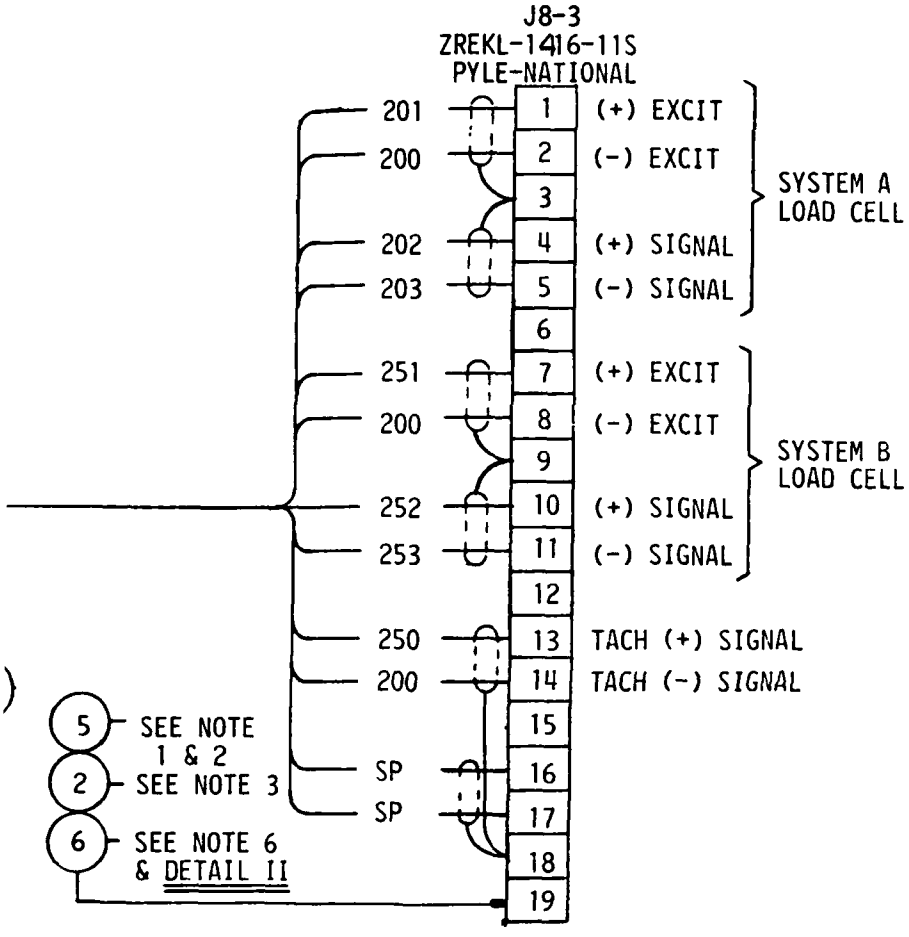
Figure 6-15. W7 Cable Assembly
(Sheet 1 of 2)

P/L NUMBER	ENG REV	P/L NOMENCLATURE	CODE IDENT
B312551	-	W7 CABLE ASSEMBLY	16603

FIND NO	ITEM NUMBER	ENG REV	ITEM NOMENCLATURE	QUANTITY REQUIRED
1	ZPEK-0812-17P		STR PLUG WITH CABLE GRIP PYLE-NATIONAL	1 EA
2	CL-22-KA-6.0		CABLE ASSY CARR LANE MFG	2 EA
3	A308569-19		LABEL-ELECTRICAL CABLE	1 EA
4	B312551-4		CABLE (MHOF-7) 50 FT LG	1 EA
5	ZREK-0812-17S		RECEPTACLE-W/BASKET WEAVE CABLE GRIP PYLE-NATIONAL	1 EA
6	A308569-20		LABEL-ELECTRICAL CABLE	1 EA

Figure 6-15. W7 Cable Assembly (Sheet 2 of 2)


P8-1
ZPEKL-1416-11P
PYLE-NATIONAL
J8-3
ZREKL-1416-11S
PYLE-NATIONAL
1 SEE NOTE 1 & 2
2 SEE NOTE 3
3 SEE NOTE 5 & DETAIL I
4
5 SEE NOTE 1 & 2
2 SEE NOTE 3
6 SEE NOTE 6 & DETAIL II
201
200
202
203
251
200
252
253
250
200
SP
SP
(+) EXCIT
(-) EXCIT
(+) SIGNAL
(-) SIGNAL
(+) EXCIT
(-) EXCIT
(+) SIGNAL
(-) SIGNAL
TACH (+) SIGI
TACH (-) SIGI
P8-1 CABLE-W8 B312552
REF
REF
REF
DETAIL I
J8-3 CABLE-W8 B312552
REF
REF
REF
DETAIL II



NOTES:

1. ASSEMBLY INCLUDES PLUG, CABLE GRIP, AND DUST COVER.
2. BEFORE SOLDERING WIRES TO THE PINS OF PLUG, VERIFY THAT THE PLUG ASSEMBLY'S RUBBER GROMMET FITS SNUGLY ON CABLE. IF GROMMET FIT IS NOT SNUG, NOTIFY ENGINEERING SO THAT SMALLER GROMMET MAY BE OBTAINED.
3. REPLACE DUST COVER CHAIN WITH CABLE ASSEMBLY, F/N 2.
4. TAG OR MARK WIRES WITH WIRE NUMBERS.
5. THE LEGEND ON THIS LABEL SHOULD READ:
   "P8-1", "CABLE-W8", "B312552"
6. THE LEGEND ON THIS LABEL SHOULD READ:
   "J8-3", "CABLE-W8", "B312552"

B312552A

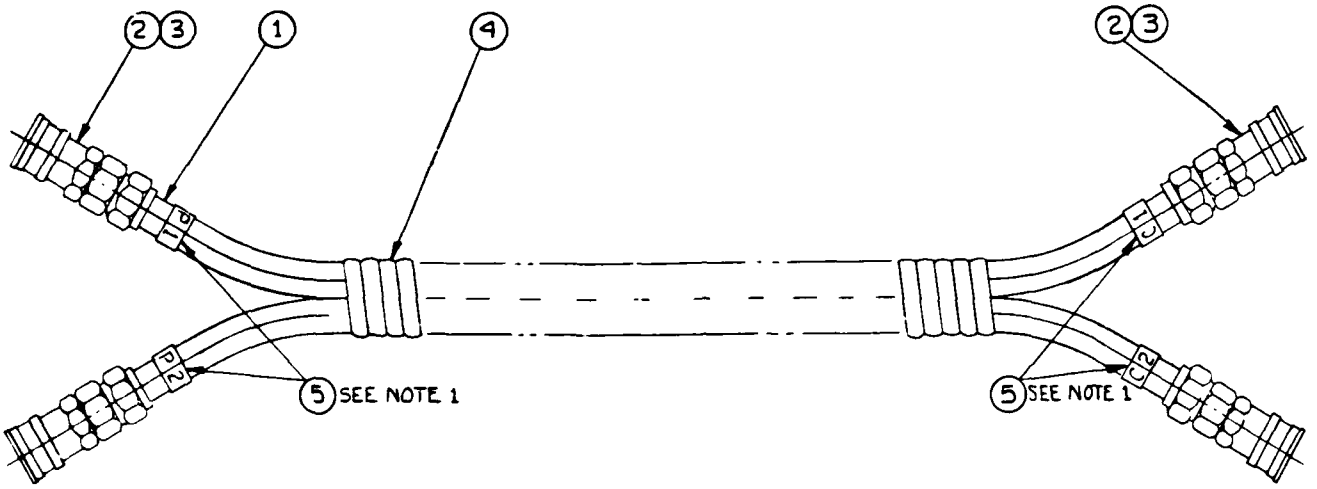
Figure 6-16. W8 Cable Assembly
(Sheet 1 of 2)

P/L NUMBER	ENG REV	P/L NOMENCLATURE	CODE IDENT
B312552	-	W8 CABLE ASSEMBLY	16603

FIND NO	ITEM NUMBER	ENG REV	ITEM NOMENCLATURE	QUANTITY REQUIRED
1	ZPEKL-1616-11P		PLUG-W/BASKET WEAVE CABLE GRIP PYLE-NATIONAL	1 EA
2	CL-22-KA-6.0		CABLE ASSY CARR LANE MFG	2 EA
3	A308569-23		LABEL-ELECTRICAL CABLE	1 EA
4	B312552-4		CABLE (TTRS-6) 50 FT LG	1 EA
5	ZREKL-1616-11S		RECEPTACLE-W/BASKET WEAVE CABLE GRIP PYLE-NATIONAL	1 EA
6	A308569-24		LABEL-ELECTRICAL CABLE	1 EA

B312552

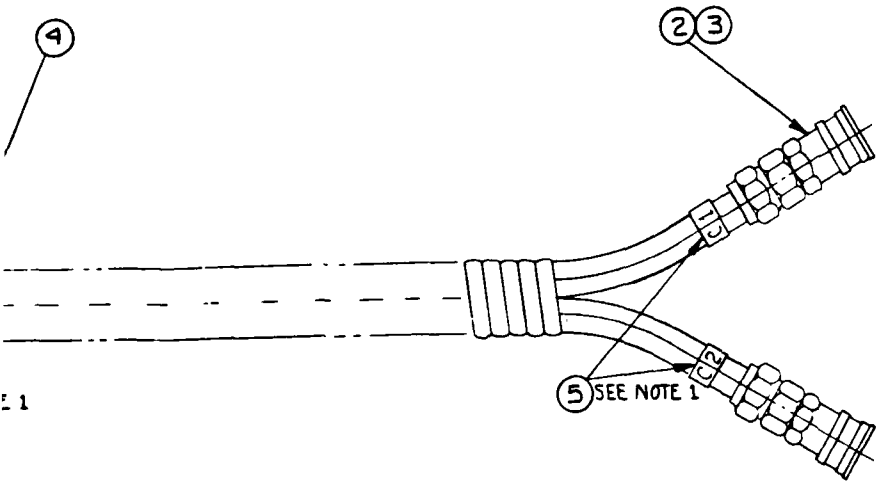
Figure 6-16. W8 Cable Assembly (Sheet 2 of 2)



NOTES:

1. STEEL STAMP .25 HIGH LETTER HOSE DESIGNATIO
   ON F/N (5) AS SHOWN, AT ASS'Y.

Figure 6-17. Hose Bun
(Sheet 1 of 2)



NOTES:

1. STEEL STAMP .25 HIGH LETTER HOSE DESIGNATIONS ON F/N (5) AS SHOWN, AT ASS'Y.

C313737

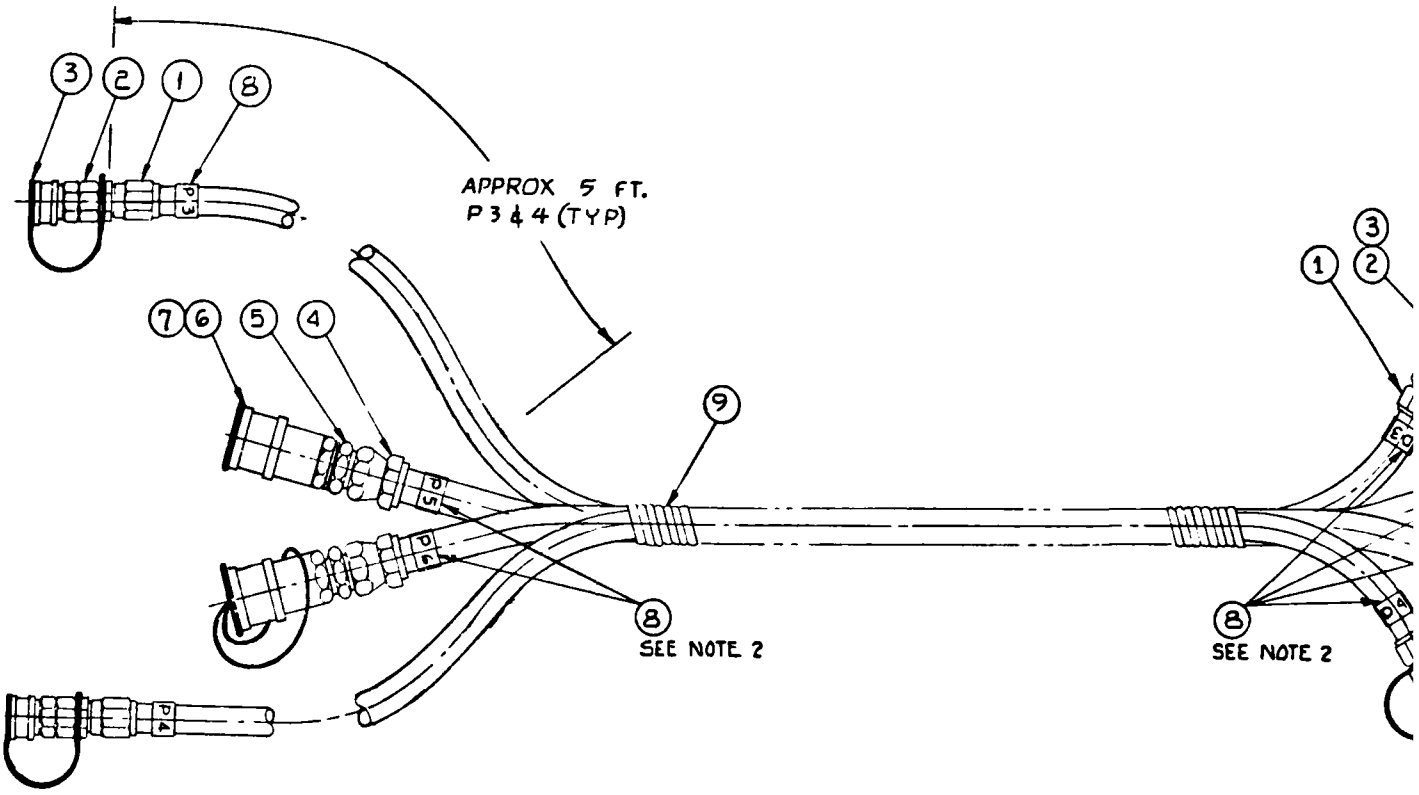
Figure 6-17. Hose Bundle Assembly
(Sheet 1 of 2)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS						
					PART OR DWG NO.	NAME			C	P	H	C/C	N/D	N	
1		HOSE ASS'Y	2		HAA06N06 N06-600	WGC	VAR	COML							
2		QUICK DISCONNECT COUPLER END	4		SVHC6-6EF	SNAP-TITE	STAINLESS STL	COML							
3		DUST PLUG	4		PDP-6	SNAP-TITE	PLASTIC	COML							
4		PLASTIC COIL SLEEVE	3		4554-22000	SYNFLEX	PLASTIC	COML							
5		HOSE MARKER	4		T-1009-SST	METAL MARKER MFG CO	STL	COML							

NUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
	NAME			C	P	H	C/C	N/D	N				
6 0	WGC	VAR	COML										PER D317257
F	SNAP-TITE	STAINLESS STL	COML										
	SNAP-TITE	PLASTIC	COML										
0	SYNFLEX	PLASTIC	COML										20 FT LENGTH
	METAL MARKER MFG CO	STL	COML										

C313737

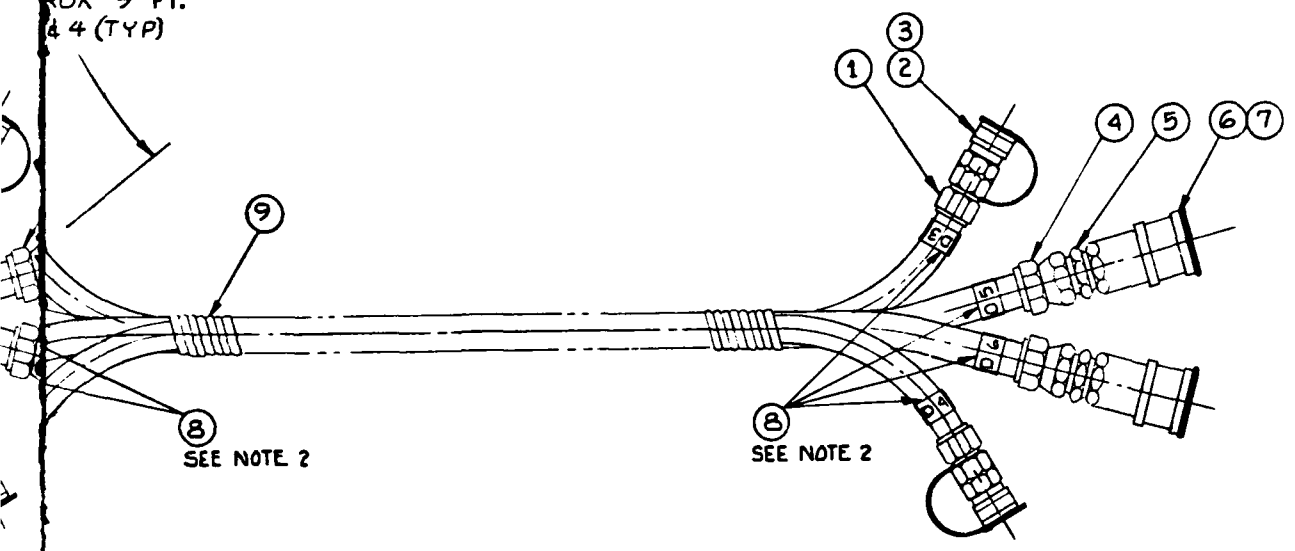
Figure 6-17. Hose Bundle Assembly
(Sheet 2 of 2)



NOTES:

1. DO NOT ASSEMBLE PARTS UNTIL HOSE LENGTH HAVE BEEN CONFIRMED BY FITTING TO UNITS.
2. STEEL STAMP .25 HIGH LETTER HOSE DESIGNATIONS ON F/N (8) AS SHOWN AT ASS'Y.

Fi
(S



HOSE LENGTH HAVE
UNITS.

DESIGNATIONS

C313738A

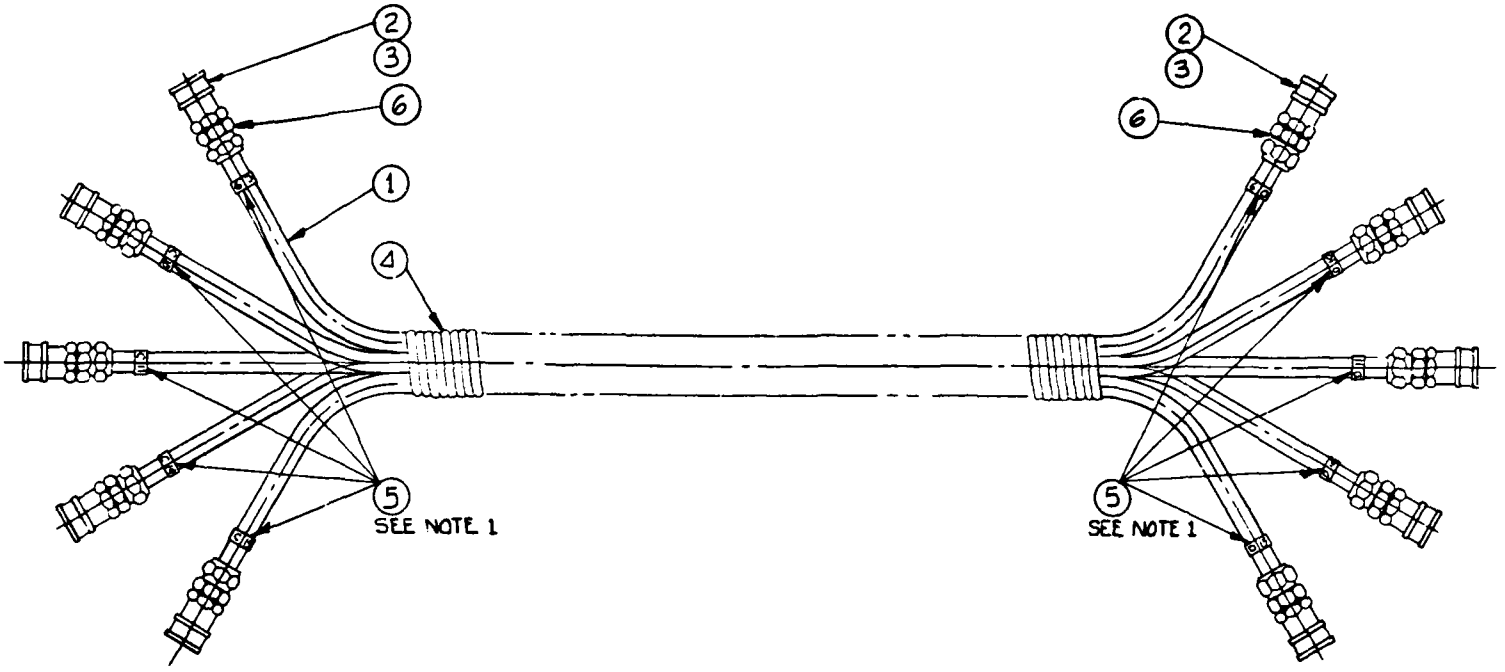
Figure 6-18. Hose Bundle Assembly
(Sheet 1 of 2)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS						
					PART OR DWG NO.	NAME			C	P	H	C/C	N/D	N	
1		HOSE ASS'Y (57')	2		HAAI2N12. N12-681	WGC	VAR	COML							
2		QUICK DISCONNECT COUPLER END	4		SYHC12-12EF	SNAP-TITE	ST. STL	COML							
3		DUST PLUG	4		PDP-12	SNAP-TITE	PLASTIC	COML							
4		HOSE ASSY (52')	2		HAK20A20 H20-624	WGC	VAR	COML							
5		CONNECTOR BODY	4		134281	WGC	STL	COML							
6		QUICK DISCONNECT COUPLER END	4		71C16-20EF	SNAP-TITE	STL	COML							
7		DUST COVER	4		71CC16	SNAP-TITE	RUBBER	COML							
8		HOSE MARKER	8		T-1009.SST	METAL MARKER MFG CO	STL	COML							
9		PLASTIC COIL SLEEVE	6		4554-22000	SYNFLEX	PLASTIC	COML							

MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
	NAME			C	P	H	C/C	N/D	N				
?.	WGC	VAR	COML										PER D317257
EF	SNAP-TITE	ST. STL	COML										
	SNAP-TITE	PLASTIC	COML										
0	WGC	VAR	COML										PER D317257
	WGC	STL	COML										20 F50X-S PARKER
EF	SNAP-TITE	STL	COML										
	SNAP-TITE	RUBBER	COML										
ST	METAL MARKET MFG CO	STL	COML										
00	SYNFLEX	PLASTIC	COML										20 FT LENGTH

C31373EA

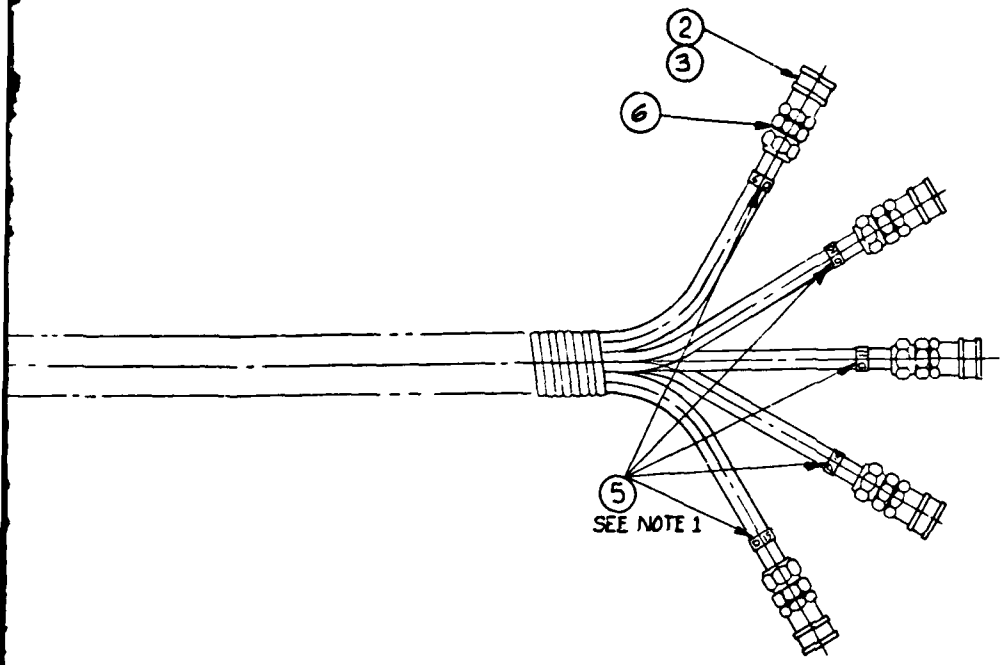
Figure 6-18. Hose Bundle Assembly
(Sheet 2 of 2)



NOTES:

1. STEEL STAMP .25 HIGH LETTER HOSE DE
   ON F/N (5) AS SHOWN, AT ASS'Y.

Figure 6-19.
(Sheet 1 of



NOTES:

1. STEEL STAMP .25 HIGH LETTER HOSE DESIGNATIONS ON F/N (5) AS SHOWN, AT ASS'Y.

C313739A

Figure 6-19. Hose Bundle Assembly
(Sheet 1 of 2)

FIND NO.	ZONE	NOMENCLATURE	QTY.	CODE IDENT.	MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS							ALTERNATE SPEC FOR GOVT REFERENCE
					PART OR DWG NO.	NAME			C	P	H	C/C	N/D	N		
1		HOSE ASSEMBLY	5		HAM08H08 H08-600	WGC		COML								
2		QUICK DISCONNECT COUPLER END	10		SPHC6-6 F	SNAP-TITE	STL	COML								
3		DUST PLUG	10		PDP-6	SNAP-TITE	PLASTIC	COML								
4		PLASTIC COIL SLEEVE	5		4554-22000	SYNFLEX	PLASTIC	COML								
5		HOSE MARKER	10		T-1009-SST	METAL MARKER MFG CO	STL	COML								
6		MALE CONNECTOR	10		8 FTX-S	PARKER	STL	COML								

MANUFACTURER		MATL	MATL SPEC	REQ'D CERTS						ALTERNATE SPEC FOR GOVT REFERENCE	WT LBS	REMARKS
PART OR DWG NO.	NAME			C	P	H	C/E	M/D	N			
108H08 B-600	WGC		COML									PER D317257
C66 F	SNAP-TITE	STL	COML									
P-6	SNAP-TITE	PLASTIC	COML									
64-22000	SYNFLEX	PLASTIC	COML									20 FT LENGTH
009-SST	METAL HARKER MFG CO	STL	COML									
FTX-S	PARKER	STL	COML									

C313739A

Figure 6-19. Hose Bundle Assembly
(Sheet 2 of 2)

APPENDIX A

PNEUMATIC AND HYDRAULIC PIPING

FABRICATION AND INSTALLATION PROCEDURES

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	Add time limit to 4-3, 66 page 17	6-9-77	
	B	Sht 17: Para 4-4. Added to PICKLING--- "AND CLEANING". After "steel pipe" added "Corrosion resistant..."	3-4-81	
	C	Eliminated socket weld fittings; revised Sht 5, 8, 10, 12, & 13; deleted Sht 9 & 14.	7-30-81	
	D	Revised Sht 6,8,10,11,12,&13 to reflect new welding procedure as described in Note 2A, sht 6.	2-2-82	
	E	Added Rev status to Sht 1. Clarified Sht 9 and 14.	3-22-82	

PNEUMATIC AND HYDRAULIC PIPING

RECOMMENDED FABRICATION, CLEANING, TESTING AND INSTALLATION PROCEDURES

FOR INTERCONNECTION OF WESTERN GEAR SUPPLIED EQUIPMENT.

F/N	NEXT ASSY	QTY	USED ON
APPLICATION			

REV	-	-	-	-	-	-	-	-	-	-							
SHT	19	20	21	22	23	24	25	26	27	28	29						
REV	E	-	-	-	-	D	-	D	E	D	D	D	D	E	-	-	B	-
SHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

LIMITS ON MACHINED DIMENSIONS EXCEPT AS NOTED
ANGULAR ± 1°0'
LINEAR
X = ± .1
XX = ± .03
XXX = ± .010
FRACTIONAL ± 1/32

BREAK ALL SHARP EDGES

2-2-77

DRAWN C. LARSEN
CHECK C. LARSEN
ENGR C. LARSEN

APPROVED

WESTERN GEAR CORPORATION
HEAVY MACHINERY DIVISION
EVERETT, WASHINGTON

PNEUMATIC AND HYDRAULIC PIPING

SIZE	CODE IDENT NO.		REV
A	16603	A305765	E
SCALE	WT	LB	SHEET 1 OF 29

MICROFILMED

APPROVAL SHEET

		DATE
QUALITY CONTROL MANAGER	E. C. [illegible]	3-12-77
PRODUCT SERVICES MANAGER	[illegible]	3-3-77
ENGINEERING MANAGER	[illegible]	2-14-77
PRODUCT SAFETY COMMITTEE CHAIRMAN	R T Hanley	3-1-77

Western Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765
	SCALE		SHEET 2

TABLE OF CONTENTS

western Heavy Machinery Division
EVERETT, WASHINGTON 98201

SIZE A | CODE IDENT NO. 16603 | A305765

SCALE | SHEET 3

1-0. INTRODUCTION

The purpose of this document is to provide guidance for construction and cleaning of Customer Supplied interconnecting piping for Western Gear Corporation (WGC) equipment, thus reducing the potential for contamination problems affecting WGC supplied components.

Satisfactory performance of a hydraulic or pneumatic piping system can be attained only by following proper procedures and methods throughout the construction process. Improper cleaning eventually results in particles of mill scale, sand, and other foreign material being forced into the system. These particles will damage critical parts and impair the operation of the equipment, causing costly component and equipment failures and shutdowns of entire systems.

It is imperative that the end product provide clean and structurally sound piping systems. This objective can be attained by following the basic requirements of this document.

Failure of WGC customers and their customers, in turn, to continually monitor the cleanliness of the entire hydraulic system and to periodically cleanse the system following initial installation and during subsequent operation of the equipment will cause premature and costly equipment failures and shutdowns of entire systems which are not the responsibility of WGC and for which WGC disclaims all liability.

The utilization of the procedures outlined herein can involve certain safety hazards for which certain precautions must be employed, either as expressly set forth herein or as may be customary and usual in the industry. WGC expressly disclaims any responsibility for injury to person or property resulting from the use of the procedures outlined herein.

western Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765	REV
	SCALE			SHEET 4

2-0. PIPING DESIGN AND ARRANGEMENT

1. Piping sizes, allowable stresses and other physical design features must be as dictated by contractual requirements: Codes, ANSI, USCG, USN, ABS, etc. No responsibility for structural design is assumed or intended in these specifications.

2. When cleanliness of the piping system affects the warranty of equipment provided by WGC, it is mandatory that the piping design provide for completely demountable systems.

3. The most practical and widely used material for high pressure hydraulic piping is cold-drawn seamless steel pipe of low or medium carbon content ASTM A 106 GR. B, or MIL-T-20157, Type E. This material is smoother and far easier to clean than hot-drawn seamless or welded steel pipe, which often contains deep pits or scratches in the interior, and usually is coated with mill scale. Other grades of pipe and tubing may also be used if surface finishes are of comparable nature and if all conditions such as factors of safety and material certifications satisfy the applicable job specifications.

4. The most commonly used piping material for high pressure pneumatic service is seamless copper, copper-nickle (70-30 alloy), or stainless steel piping Piping of this material is easy to clean and will not corrode due to condensation and moisture in the air supply system.

5. Except for watertight deck and bulkhead penetrations, each length of pipe must be so constructed and arranged that it can be removed for pickling and cleaning after fabrication.

6. Air vents should be installed in high points of hydraulic piping runs Air pockets in the lines may cause erratic response and operation.

7. Provision for temporary jumpers at ends of the pipe runs must be provided to facilitate flushing of the lines and pressure testing prior to operation.

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	SCALE		SHEET 5

3-0. FABRICATION

1. **The equipment and components should be finally located and fixed in place before fabrication of the interconnecting piping is started. All case breathers and shaft seals should be tightly masked, no units disassembled nor opened for inspection nor any hydraulic piping attempted while welding, chipping, sandblasting or painting is being done in the immediate area.**

2. **Welding and brazing must be performed by qualified welders using Customer Specification procedures.** These procedures, if properly followed, shall produce welds which are free of defects that would adversely affect the service of the weld joint.

2A. It is required that the pipe be purged with inert gas during the root pass. This practice reduces the possibility of root pass embrittlement due to atmospheric contamination.

3. All inside edges of pipe and tubing must be reamed or deburred to remove all sharp or feather edges remaining after cutting the pipe to length.

4. All stress relieving if required must be done after fabrication and prior to the cleaning process.

5. It is desirable to have not more than one bend in each length of pipe. The entire length of pipe should be visible for inspection. Flange or union joints must be provided in pipe runs which include more than one bend (see figure 1).

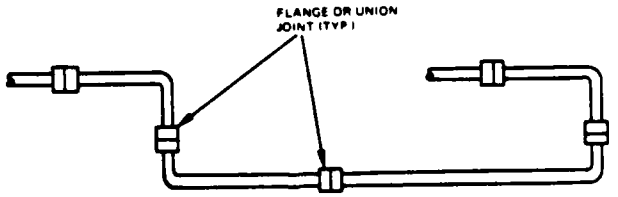
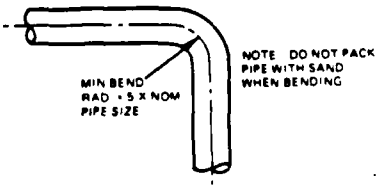


FIG 1

western GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765 REV D
	SCALE		SHEET 6

3-0. (Cont)

5. Cold bends in the piping are preferable to welded elbows. The bend radius should be a minimum of five times the nominal pipe size as shown in figure 2. However, any contract specifications relating to minimum bend radius, flattening at bends, thinning of walls at bends, etc., must be adhered to.



PREFERRED METHOD

FIG 2

western Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	REV
	SCALE	A305765	SHEET 7

3-0. (Cont)

7. When elbows must be used due to space limitations, use long radius butt weld elbows of the same size and wall thickness (schedule) as the piping. Do not use socket weld elbows.

Butt welded elbows with backup rings are to be avoided unless the rings are completely removed after welding. The backup rings catch foreign material that cannot be dislodged during cleaning, yet often will be dislodged during hydrostatic testing or when operating the equipment (figure 3).

Butt welded elbows without backup rings can be welded successfully by using gas tungsten arc welding (heliarc welding) for the first pass with inert gas purging as previously described.

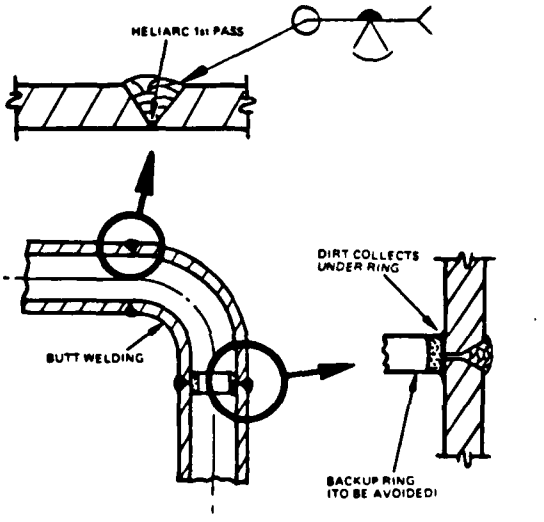


FIG 3

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765 REV D
	SCALE		SHEET 8

3-0 (continued)

8. DELETED

western GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765	REV E
	SCALE		SHEET 9	

8314

3-0. (Cont)

9. Water tight deck or bulkhead penetrations should be straight lengths of pipe or tubing not more than 18 inches in length, with a flange or fitting on each end. See figures 7 and 8 for suggested design details. These methods will allow pickling of the pipe assembly prior to final installation, permitting visual inspection and cleaning if required after installation.

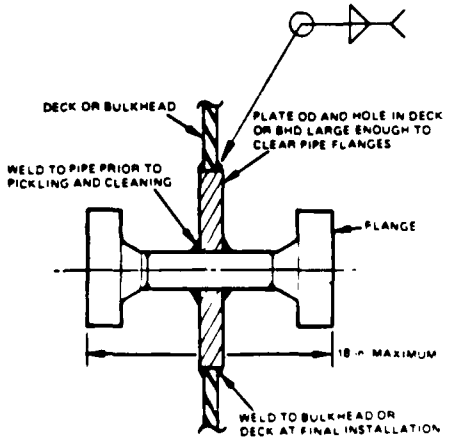


FIG 7

western Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CC IDENT NO. 16603	A305765 REV D
	SCALE		SHEET 10

3-0. (Cont)

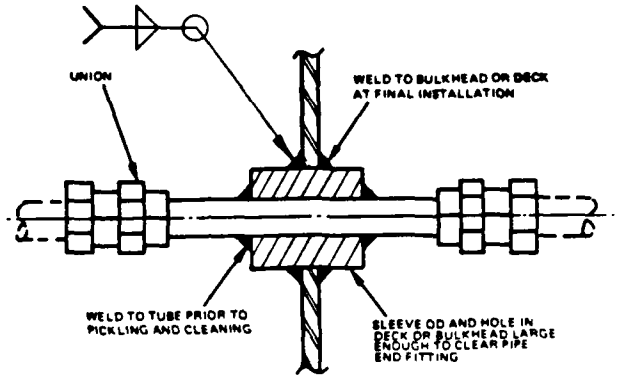


FIG 8

10. Non-watertight deck or bulkhead penetration methods are suggested in figures 9 and 10. All piping components must be pickled and cleaned prior to final installation.

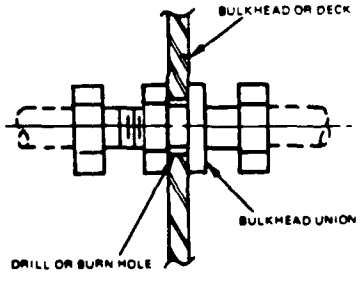


FIG 9

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765 REV D
	SCALE		SHEET 11

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3-0. (Cont)

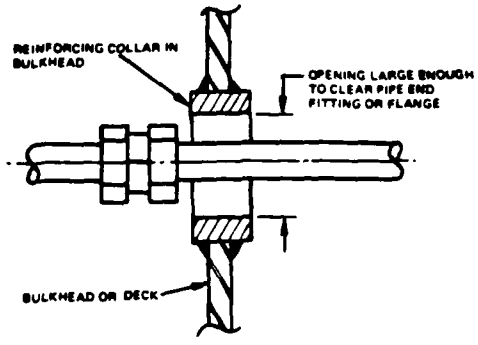

FIG 10

11. Flange connections, O-ring unions, or Grayloc type couplings must be used to join all high pressure assemblies. The flanges must fit squarely on the mounting face and be drawn up evenly to avoid distortion or uneven compression of the sealing elements, and to prevent the formation of pockets that will hinder the flushing operation.

12. Use butt weld (weld neck) flanges instead of the socket weld type. Butt weld flanges provide a more uniform transition between pipe and flange as compared to socket weld fittings, and thus avoiding stress concentrations at the joint. The interior of the pipe and flanges must be carefully cleaned to remove all welding slag or spatter, brazing flux, scale under a surface weld, and other contaminants. If backing rings are used with butt welds to attach flanges, the backing rings should be completely removed after welding (figure 11). Butt-welded joints without backup rings may be welded successfully by using heliarc (GTAW) welding for the first pass (figure 12) and inert gas purging as noted earlier.

Western Gear Corporation Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765 REV D
	SCALE		SHEET 12

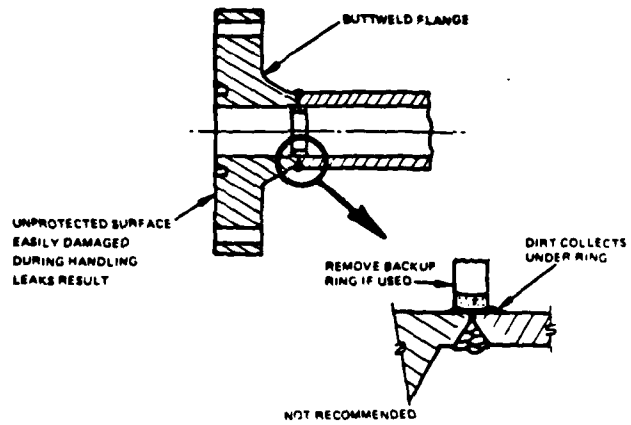

FIG 11

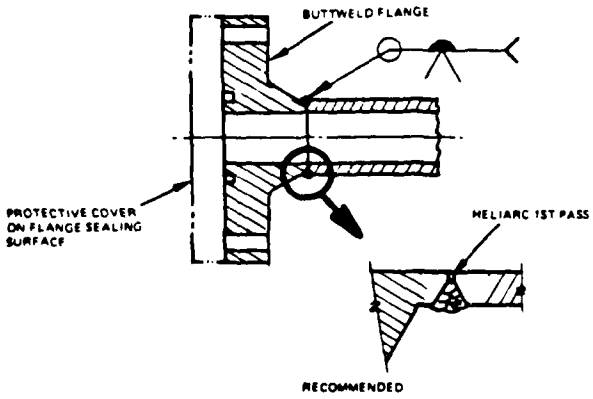

FIG 12

western Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765	REV D
	SCALE			SHEET 13

3-0 (continued)

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western GEAR CORPORATION Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765	REV E
	SCALE		SHEET 14	

8314

3-0. (Cont)

13. It is imperative that blanking material be installed between pump or motor openings and their respective flanges during the pipe fabricating process to keep weld spatter and other contaminants out of the previously cleaned hydraulic system components. All pump, motor or valve ports and ends of all completed piping must be kept closed and protected at all times except when fitters are making final joints at assembly.

14. All piping should be fitted so that when each section of pipe is in place, all fittings and connectors align with their corresponding fittings and connectors without forcing. This will reduce stress on the pipe and the possibility of damage to components.

15. After the piping is fabricated, fitted, and supported in place, each pipe section should be identified prior to cleaning and inspection. The inspector should keep record of the pipe assemblies as they are processed through cleaning and final installation to assure conformance to all cleaning, installation and hydrostatic testing procedures for all piping components.

Western Heavy Machinery Division EVERETT, WASHINGTON 98201	SIZE A	CODE IDENT NO. 16603	A305765
	SCALE		SHEET 15

4-0. CLEANING AND PICKLING

4-1. Cleaning and pickling of interconnecting piping is required to fully remove foreign substances such as oil, grease, paint, soil, mill scale, etc., which would otherwise cause damage to equipment components. These components have undergone a similar cleaning and pickling process at the factory and must not be contaminated by dirty piping.

The pickling process for interconnecting piping should be accomplished immediately prior to hydrostatic testing, installation and charging of the system.

Many different products and processes are available which will effectively clean and pickle pipe, provided the manufacturers' instructions are followed. No preference for a given product is implied; however, the following basic steps must be taken to ensure that the piping is cleaned and is kept clean.

4-2. CLEANING. Prior to fabrication the piping should be cleaned by wire brushing, including the interior, and blasted with high pressure air to remove loose particles. Boiler tube brushes or commercial cleaning apparatus may be used for this purpose

4-3. PICKLING CARBON STEEL PIPE. See appendix A for suggested makeup and temperature of cleaning and pickling solutions.

WARNING

Face shield, protective gloves and other protective clothing must be worn when working with pickling solutions to prevent injury to personnel.

1. Immerse in a caustic bath solution for 15 minutes or longer to remove paint, varnish, grease, etc.
2. Rinse in clean water.
3. Immerse in acid solution and exercise caution with respect to duration of immersion. Leave pipe in bath only long enough to permit adequate pickling as determined visually. This caution is necessary to ensure and protect the mechanical properties of the pipe, tubing, and end fittings.
4. Rinse in a clean water bath immediatly following completion of the previous step.
5. Immerse in a hot water neutralizer bath for several minutes.
6. Rinse in a clean water bath.
7. Allow to drain and dry. Drying by air blasting is not recommended because it will contaminate the piping

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4-3 (Cont)

8. Inspect the pipe for cleanliness. One suggested method is to pull a clean, lint-free cloth soaked in kerosene through the pipe. Another method, especially if the pipe is not straight, is to tape the ends closed and with the taped end down, tap the pipe with a hammer in various places. If foreign material is found on the cloth or tape, the pipe must be repickled. Inspection tion and preservation should be completed with a maximum time delay of one hour.

9. Coat the inside of ferrous piping with clean preservative fluid (solution determined by consideration of the fluid used in the system.) Cap the ends and wrap the end fittings (flanges) with protective material.

4-4 PICKLING AND CLEANING CORROSION-RESISTANT STEEL PIPE. Corrosion-resistant steel pipe that is not to be welded may require only steam cleaning, and where adherent contaminants persist, interior and exterior steel wire brushing and blasting with high pressure air is required. See Appendix B for suggested makeup and temperature of cleaning and pickling solutions.

WARNING

Face shield, protective gloves and other protective clothing must be worn when working with pickling solutions to prevent injury to personnel.

1. Immerse in a caustic bath solution for 15 minutes or longer to remove paint, varnish, grease, etc.

2. Rinse in clean warm water.

3. Immerse the piping assembly for 10 to 15 minutes in the acid solution and rinse in a clean warm water bath immediately following.

4. Allow to drain and dry. Drying by air blasting is not recommended because it will contaminate the piping.

4-5 PICKLING NONFERROUS PIPING (copper, copper-nickel, bronze). See Appendix C for suggested makeup and temperatures of cleaning and pickling solutions.

WARNING

Face shield, protective gloves and other protective clothing must be worn when working with pickling solutions to prevent injury to personnel.

1. Immerse in a caustic bath solution for 15 minutes or longer.

2. Rinse in clean warm water bath.

3. Immerse in acid solution at room temperature.

8-5. (Cont)

4. Rinse in a clean warm water bath.
5. Immerse in a neutralizer solution for several minutes.
6. Rinse in a clean warm water bath.
7. Allow to drain and dry. Drying by air blasting is not recommended because it will contaminate the piping.
8. Additional flushing of the assembled equipment is required to remove the brazing fluxes. Suggested solutions for this are given in Appendix C

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5-0. HYDROSTATIC TESTING PRIOR TO INSTALLATION.

WARNING

Observe appropriate safety precautions to prevent injury to personnel and damage to equipment during testing procedures.

A hydrostatic test should be performed prior to installation using clean filtered preservative fluid for hydraulic lines and water for corrosion-resistant pneumatic lines.

The pipe assemblies may be tested individually or in groups. If leaks occur, they must be repaired and the pipe recleaned, repickled and retested. After the hydrostatic test, drain the lines and cap the ends, being careful to avoid introducing contamination. Allow pneumatic piping to dry before capping the ends.

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6-0. INSTALLATION

1. The piping should be installed as soon as possible after pickling and hydrostatic testing. Hydraulic piping should be filled with the recommended operating fluid within one week after installation. A shorter period is preferred in especially humid areas.

2. No abrasive blasting, chipping, grinding or use of air tools may be permitted in the area during installation. Airborne dust must not be permitted in the area while the clean pipes are uncapped and installed.

3. No turning, drilling, tapping, welding (except deck or bulkhead penetrations) nor heating of pipe, will be allowed. If any rework of the pipe is necessary during installation, the pipe sections must be cleaned, pickled and hydrostatic tested again before final installation.

4. When welding deck or bulkhead penetration sections in place, make sure that the openings are covered and that the end fittings are protected from weld spatter.

5. When installing and joining pipe sections make sure that the sealing surfaces are clean, free from nicks and scratches and that O-rings and gaskets are new and compatible with the fluid to be used in the system.

6. Tighten flange bolts evenly.

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7-0. HYDROSTATIC TESTING AND FLUSHING AFTER INSTALLATION.

7-1. GENERAL. The entire piping system must be pressure tested before connecting to WGC equipment. The opening of and connecting to WGC components should take place in the presence of customer inspection personnel and a WGC representative.

7-2. HYDRAULIC PIPING. The pressure test and flushing operation should be accomplished using a separate (commercially available) hydraulic power unit. The pump must have adequate capacity to provide at least 20 feet per second flow velocity in the lines when flushing. Use the same fluid that will be used in operation of the hydraulic system.

When practicable, more than one pipe run may be tested and subsequently flushed at the same time. See figure 15.

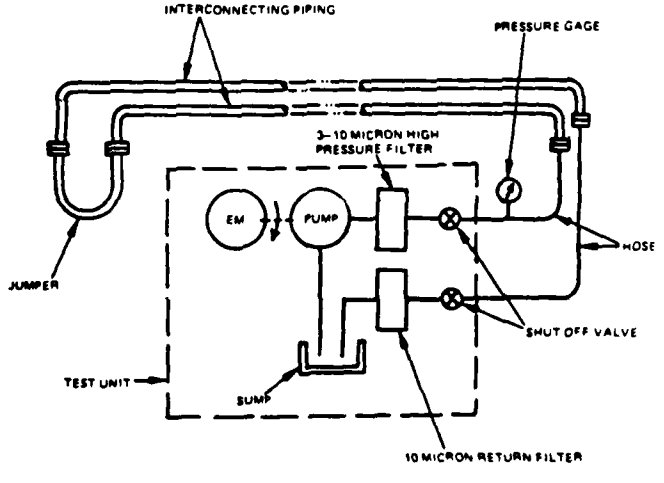

FIG 15

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7-2. (Cont)

Inspect the return filter element frequently and replace elements as required. When the elements appear clean and free of particles, take a fluid sample from the return end of the piping. A particle count of the sample should meet NAS Class 7* (noted below) for piping that serves piston pumps. For piping serving vane pumps and gear pumps the cleanliness level should be Class 9*. Keep flushing until the cleanliness level is met. When flushing hydraulic lines it is good practice to switch the supply and return hoses from the test unit at least once, thus reversing the flow in the pipe runs.

TABLE 1. MAXIMUM CONTAMINATION LIMITS PER NAS 1638 (BASED ON A 100 ML SAMPLE SIZE)

Particle Size Range (Microns)	CLASSES							
	5	6	7*	8	9*	10	11	12
5 to 15	8,000	16,000	32,000	64,000	128,000	256,000	512,000	1,024,000
15 to 25	1,425	2,850	5,700	11,400	22,800	46,800	91,200	182,400
25 to 50	253	506	1,012	2,025	4,050	8,100	16,200	32,400
50 to 100	45	90	180	360	720	1,440	2,880	5,760
Over 100	8	16	32	64	128	256	512	1,024

*unless otherwise specified on system drawings or specifications.

7-3. PNEUMATIC PIPING. The hydrostatic pressure test and flushing of corrosion resistant steel piping should be accomplished using clean fresh water and dried with clean filtered air.

Flushing of nonferrous piping (copper, copper-nickel, bronze) is required to remove all brazing fluxes. Suggested solutions for this are given in Appendix C

When hydrostatic testing and flushing operations are complete, connect the piping to respective components. When opening the port or any component, first clean the immediate area around the port. Use extreme caution when connecting to a previously cleaned system to prevent foreign material from entering the system

8-0. Charging Hydraulic System.

1. To repeat, the purpose of this document is to provide guidance for construction and cleaning of customer supplied interconnecting piping for Western Gear Corporation equipment, thus reducing the potential for contamination problems affecting WGC supplied components.

2. Where WGC supplied components are not shipped charged with appropriate fluid they must also be flushed and inspected prior to charging

3. Customer supplied reservoirs where used must be similarly prepared.

4. When the system interconnecting piping has been properly assembled, hydrostatic tested and flushed and all other components prepared as noted in steps 2 and 3 above, the equipment can be plumbed and system charging begun.

5. All hydraulic fluid added to the system must be filtered through a 3-10 micron filter. Good housekeeping procedures must be followed to minimize all potential contamination problems in transferring fluid from the shipping containers to the hydraulic reservoir.

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APPENDICES

Appendix A - Carbon Steel Pipe Pickling and Treatment

Appendix B - Corrosion Resistant Steel Pipe Pickling and Treatment

Appendix C - Nonferrous Pipe Pickling and Treatment (copper, copper-nickel, bronze)

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APPENDIX A

Carbon Steel Pipe Pickling & Treatment

1. Caustic Bath (Grease and Paint Removal)

Solution:	Roprepp R (R. O. Hull Co.	2 Pounds
	Water:	1 gallon
Temperature:	180 ± 5 degrees (82 ± 3 degrees C)	
Time:	15 minutes or longer, depending upon degree of contamination.	
Neutralizer:	Rinse in clean water.	

2. Acid Solution Pickling (Scale and Rust Removal)

CAUTION

The acid should always be added carefully to the water. Do not add the water to the acid.

Solution:	Hydrochloric Acid (35 to 36.5 % assay) with commercial inhibitor	.43 gallons
Water		1 gallon
Temperature	Ambient	

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Leave pipe in bath only long enough to permit adequate pickling as determined visually.

Time: As visually determined by removal of scale and rust

3. Treatment Following Pickling

Solution:	Soda Ash (as required to maintain a 9 to 10 P_h)	2 - 4 ounces
	Non-ionic wetting agent VWR9N9 (VanWaters and Rogers Co.)	3.8 ml
	Water.	1 gallon

Temperature: Ambient

Caution. The maintenance of the P_h value noted above is critical and must be frequently monitored. The product of neutralization of acid carry-over from the pickling tank is common salt (NACL) which if allowed to accumulate will promote flash rusting of the pickled pipe.

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APPENDIX B

Corrosion Resistant Steel Pipe Pickling & Treatment

1. Caustic Bath (Grease and Paint Removal)

Solution:	Trisodium Phosphate (TSP) or Sodium Hydroxide (lye):	7-10 ounces
	Detergent, *nonionic (Polyethylene-glycol Monoalkylaryl ether)*	1 fluid ounce
	Water	1 gallon
Temperature:	200 ± 10 degrees F (94 ± 6 degrees C)	
Time:	15 minutes or longer, depending upon degree of contamination.	
Neutralizer:	Rinse in clean warm water, 120 degrees F (48 degrees C) or higher	

2. Acid Solution-Pickling (Passivation)

CAUTION

The acid should always be added carefully to the water. Do not add the water to the acid.

Solution:	Nitric Acid	13-20 Fluid Ounces
	Hydrofluoric Acid (60%)	1-2 Fluid Ounces
	Water	1 gallon
Temperature:	130 ± 10 degrees F (55 ± 6 degrees C)	
Time:	10 to 15 minutes	
Neutralizer:	Rinse in a clean warm water bath	

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APPENDIX C

Nonferrous Pipe Pickling and Treatment (Copper, Copper-nickel, Bronze)

1. **Caustic Bath (Grease and Paint Removal)**

Solution:	Trisodium Phosphate (TSP) or Sodium Hydroxide (lye)	7-10 ounces
	Detergent, nonionic (Polyethylene-glycol Monoalkylaryl ether)	1 fluid ounce
	Water:	1 gallon
Temperature:	200 ± 10 degrees F (94 ± 6 degrees C)	
Time:	15 minutes or longer, depending upon degree of contamination.	
Neutralizer:	Rinse in clean warm water, 120 degrees F (48 degrees C) or higher	

2. Acid Solution - Pickling

CAUTION

The acid should always be added carefully to the water. Do not add the water to the acid.

Solution:	Sulfuric Acid, 66 degrees Baume, Specific Gravity 1.83	7-14 fluid ounces
	Water.	1 gallon
	Note If red stains appear add 2-4 ounces per gallon of water of sodium dichromate to above solution	
Temperature.	Room Temperature	
Time	As visually determined by removal of surface contaminants.	

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Appendix C (Cont)

3. *Treatment Following Pickling*

   a. Rinse in clean water bath

   b. Immerse for several minutes in an alkaline bath containing four ounces (per gallon of water) of soda ash

   c. Rinse in clean warm water bath

4. Flushing of installed system for removal of brazing fluxes

Solution:	Glacial Acetic Acid	5 gallons
	Water	95 gallons
Temperature:	120-140 degrees F (49-60 Degrees C)	
Time:	Circulate for one hour	
Neutralizer:	Flush with warm water. Repeat flushing procedure as necessary. Drain and dry piping upon completion.	

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APPENDIX B

ARP 598

Fluid Contamination Particle

Count Procedure

PROCEDURE FOR THE DETERMINATION OF PARTICLE CONTAMINATION
OF HYDRAULIC FLUIDS BY THE PARTICLE COUNT METHOD
(Extract from ARP 598 Society of Automotive Engineers, Inc.)

1. SCOPE:

This test describes a self-checking procedure for the determination of particulate contaminant five microns or greater in size in hydraulic fluids by the particulate count method. A maximum variation of two to one (±33% of the average of two runs) in results should be expected for replicate counts on the same sample, providing that the procedure is followed closely and the precautions presented in paragraphs 18 through 21 of the procedure, regarding manipulation, check samples and self-checking aspects, are observed.

2. OUTLINE OF METHOD:

A fluid is filtered through a type HA Millipore filter disc using vacuum to impinge the contained contamination particles upon the surface of the filter. The filter disc is examined microscopically (using oblique incident lighting) to determine the amount of contaminant present in stated size ranges.

3. APPARATUS:

Pyrex filter holder, Millipore Cat. No. XX 10047 00, or equivalent, which includes:

a. A fritted glass base and rubber stopper.

b. A holding clamp.

c. A 250 ml Pyrex glass funnel

d. A filter cover for the glass funnel to minimize contamination from the air passing through the funnel during the vacuum filtration process.

e. The optimum cover would incorporate a Millipore filter in the cover device.

f. 0.45-micron Membrane Filter, type HA Black Grid 047 mm diameter Millipore or equivalent. These to have an imprinted grid on 3.08 mm centers. Each grid square is equal to 1/100th of the total effective filtering area of the filter disc when used in the Millipore Pyrex filter holder (above).

g. Vacuum flasks.

h. Aspirator or Vacuum Pump, capable of pulling a minimum 26" of mercury.

i. Plastic Petri Dishes, disposable, Millipore Cat. No. PD 10 047 00, or equivalent.

j. Forceps with unserumed tips.

k. Sample bottles, small mouth, glass, etched or otherwise permanently marked to indicate 100 ml sample size.

l. Microscope with mechanical stage, capable of magnification of approximately 45X and 90X. For 90X magnification, the recommended objective is 10 to 12X but at least 1X with a numerical aperture of at least 0.15. The optimum equipment is a binocular microscope with a micrometer stage. A stereo microscope should not be employed with this procedure.

m. Measuring eyepiece - Ocular Micrometer - Baush & Lomb Cat. No. 31-16-01, or equivalent. (See figure 1 following paragraph 17.)

n. Stage micrometer, 0.1 to 0.01 mm calibration.

o. Microscope lamp, high intensity, variable. This lamp is to be used as a source of oblique incident light; Leitz microscope lamp "Monla"[1] (or equivalent); 5,000-6,000 candlepower at filter surface.

p. Wash bottles, Pyrex glass.

q. Mylar plastic films, 2" x 2" x .002".

4. REAGENTS:

a. Distilled water.

b. Acetone free, reagent grade isopropyl alcohol.

c. Petroleum ether 30°-60° boiling range (Freon TF or equivalent may be substituted where explosive vapors are not accepted.)

5. FILTRATION OF REAGENTS:

a. Filtration Process: (for initial establishment of clean conditions for filtration of reagents).

b. Clean all apparatus as follows:

(1) Wash with self-rinsing type detergent and water.

(2) Thoroughly rinse with hot soft tap water.[2]

c. Assemble Pyrex filter holder with filter disc in place.

---

[1] "Monla"--6V-5. A microscope lamp with focusing illuminating lens on pillar stand with separate transformer.

[2] When filtered distilled water, filtered isopropyl alcohol, and filtered petroleum ether have been obtained, the apparatus should be cleaned as outlined in paragraph 7.

d. Filter 100-200 ml of isopropyl alcohol into the filter flask. Remove entire Pyrex Filter assembly and rinse the filter flask with the filtrate.

e. Repeat paragraph 5d three times.

f. Filter a 100-200 ml volume of petroleum ether into filter flask. Remove the funnel assembly and rinse the filter flask with the filtrate.

g. Repeat paragraph 5f three times.

h. Filter the desired volume of the solvent.

6. CONTROL ANALYSIS FOR REAGENT CLEANLINESS:

a. Clean a Pyrex filter holder and a wash bottle using the process outlined in paragraph 7.

b. Place 500 ml of the filtered reagent in the cleaned wash bottle.

c. Rinse the upper surface of the filter disc with the filtered reagent from the wash bottle. Place the disc on the fritted glass base and complete the assembly of the filtration apparatus.

d. Pour a 150 ml portion of the filtered reagent into the funnel directly from the filter flask. Filter the sample using the method for processing a blank described in paragraph 15a, except that the filter disc is to be rinsed only once and with a 50 ml volume of the filtered reagent from the wash bottle. If the desired cleanliness level is not obtained,[3] repeat the cleaning and filtration process using the filtered reagents on hand for the cleaning process.

7. CLEANING METHOD FOR APPARATUS AND SAMPLE BOTTLES:

8. GENERAL INSTRUCTIONS: Lint-free coats should be worn by personnel performing cleaning operations to preclude excessive fiber contamination.

9. CLEANING METHODS: Each item of filtration apparatus will be cleaned before each run of samples and each sample bottle and cap will be cleaned before each use by the following method:

a. Rinse with two successive rinses of petroleum ether.

b. Wash thoroughly in a solution of detergent and hot water. Rinse twice in hot tap water (soft).

c. Rinse with filtered distilled water twice.

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[3] Contamination content of a 150 ml sample of filtered reagent, so processed, should be greater than the values specified for a blank analysis. See footnote 6, page B-6 for blank analysis specifications.

d. Rinse with filtered isopropyl alcohol to remove water.

e. Rinse with filtered petroleum ether.[4]

(1) Filtration Apparatus: After rinsing with petroleum ether, hold in an inverted position for 15 seconds to allow drainage and evaporation of the petroleum ether.

(2) Sample Bottles: After rinsing with petroleum ether, allow a small quantity of petroleum ether to remain in the bottle since the vapor pressure will help to preclude contamination when the bottle is opened. Rinse a previously clean 2" x 2" plastic film with filtered petroleum ether. Place the plastic film over the top of the bottle and install the bottle cap.

10. SAMPLES:

11. A 100±5 ml sample is to be used for this procedure.

12. SAMPLING PROCEDURE: Samples for this test method should be as representative as possible of the fluid being sampled. Procedures for procuring such samples will, of necessity, have to be established by individual plants or laboratories. Extreme care should be taken to preclude the introduction of external contamination at this point. To assure reproducibility, the sampling program should be checked at the outset by the testing of replicate samples from the sampling port.

13. TEST PROCEDURES:

14. TEST INFORMATION:

a. Personnel performing contamination analysis should wear lint-free laboratory coats.

b. Samples are to be obtained in accordance with specified sampling procedures.

c. The filtration apparatus is to be cleaned just prior to use by the method outlined in paragraph 7.

d. The microscope and its accessories should be maintained in a state of maximum cleanliness. The microscope and accessories should be protected by a dust cover when not in use.

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[4] When high humidity conditions exist, paragraph 9e may be followed by an additional isopropyl alcohol rinse to prevent condensation.

e. The processing and microscopic analysis of samples should be performed in as clean an area as possible within the confines of a modern, air-conditioned laboratory. A dust control room[5] is desirable, but not essential for validity and reproducibility. Smoking should be prohibited, both as a safety factor and to prevent the extra contamination of samples. The ingress and egress of personnel in the laboratory area should be limited.

15. FILTRATION PROCEDURES:

a. Procedure for Blanks: Prior to each sample analysis, a blank analysis is to be performed on 50 ml of filtered petroleum ether contained in a regular, clean sample bottle. The procedure used will be identical with that described below, with the exception that step 15b(5) will be omitted. (The total amount of petroleum ether used in the blank analysis should be 200 ml, which is approximately the volume used in the filtration of sample.) The blank analysis is performed to determine the amount of contamination being introduced by the sample bottle, filtering process, filtering equipment, filter disc, and the filtered petroleum ether. Identify the blank as to the sample number or an identification tag and attach it to the lid of the petri dish.[6]

b. Procedure for Samples: Using forceps, remove one filter disc from its container. Rinse the top surface of the filter disc with a stream of filtered petroleum ether from a wash bottle. Place the filter disc printed grid side up on the fritted glass base.

(1) Immediately lower the filter funnel onto the fritted glass base, secure with the holding clamp and place cap on top of the filter funnel. (Do not slide filter funnel over the filter disc during this process.)

(2) Thoroughly agitate the sample bottle to assure that all solid particles are in suspension.

(3) Remove the sample bottle cap and plastic film. Remove the filter cap and pour sample into the filter funnel. Replace the filter cap.

(4) Pour 100 ml of filtered petroleum ether into the sample bottle; replace the plastic film and bottle; agitate and proceed as in 15b(3).

(5) Rinse funnel walls with approximately 50 ml of filtered petroleum ether from wash bottle.

(6) Apply vacuum to the filtering apparatus. When the filtration is APPROXIMATELY ONE-HALF COMPLETE, release the vacuum.

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[5] A hood pressured with filtered air is especially advantageous for both microscopy and filtration. At a minimum, a dust cover such as a polyethylene bag, with appropriate openings, pulled over the barrel of the microscope, is required to preclude fall out of dust from the air.

[6] The maximum particle count value of a blank analysis shall be no greater than 10% of the count of an acceptable sample for a specific laboratory.

(7) While some liquid still remains in the funnel, using the stream from a wash bottle, carefully wash down the sides of the funnel with filtered petroleum ether (approximately 50 ml). Replace the filter cap.

(8) Apply vacuum and allow to operate until the filter disc is completely dry. Do NOT rinse the funnel walls further after the filter has become dry, as this will upset the distribution of particles on the filter surface. Turn off the vacuum and simultaneously remove the holding clamp and filter funnel so that the filter disc remains on the fritted glass base.

(9) Using forceps, carefully remove the filter disc from the top of the fritted glass base. Place the filter disc, grid side up, in a clean petri dish and replace petri dish cover. Identify the petri dish using a sample identification tag. The test may be delayed overnight, if necessary, after completing this step.

16. MICROSCOPE ANALYSIS PROCEDURE: Particles are to be counted and tabulated in the following order: fibers, particles greater than 100 microns, 50-100 microns, 25-50 microns, and 12-25 microns, and 5-15 microns. Particles smaller than 5 microns are not to be counted by this method. Fibers are defined as any particle whose length to diameter ratio exceeds 10 to 1 regardless of composition. Fibers are counted as particles and not differentiated unless their length exceeds 100 microns. The size of a particle is determined by its greatest dimension. [See paragraph 16d(7).]

a. Place petri dish under the microscope dust cover and remove petri dish cover.

b. Adjust the microscope lamp intensity to obtain maximum particle definition.

c. A magnification of approximately 45X shall be used for counting particles 25 microns or larger; approximately 90X for particles smaller than 25 microns. The recommended objective to obtain the 90X magnification is 10 to 12X power in conjunction with the appropriate eye-piece.

(1) Using a stage micrometer, calibrate the measuring eye-piece (ocular micrometer) for each magnification.

d. Method of Counting Particles: Other statistical methods may be employed provided that the method shows agreement with the values of the certified standard samples as described in section 18.

(1) In obtaining the number of particles of a given particle size range, the number of particles on a representative number of grid squares on the filter disc are counted. From this count, the total number of particles, which would be present on the total effective filtration area of 100 imprinted grid squares, is calculated.

(2) If the total number of particles of a given particle size range is estimated to be between 1 and 50, count the number of particles over the entire effective filtering area.

(3) If the total number of particles of a given particle size range is estimated to be between 50 and 1,000, count the number of particles on 20 randomly-chosen grid squares and multiply the number by 5 to obtain the total statistical particle count.

(4) If the total number of particles of a given particle size range is estimated to be between 1,000 and 5,000, count the number of particles on 10 randomly-chosen grid squares and multiply the number by 10 to obtain the total statistical particle count.

(5) If the estimated total number of particles of a given size range exceeds 5,000, count the particles within at least ten (10) randomly-chosen unit areas.[7] To arrive at the total statistical count, the sum of the particles counted in the areas is multiplied by the calibration factor.[8]

(6) In no case shall the total number of particles in a unit area exceed 50 particles of a size range. See figure 1 for the alternate unit area.

(7) If a particle lies on the upper or left boundary line of a counting area, count this particle as if it were within the boundaries of the counting area.

(8) The largest dimension of the particle determines the size category into which the particle is placed.

17. CALCULATION OF CALIBRATION FACTOR:

a. The calibration factor is the ratio of the effective filtration area (100 grid squares or 9.6 sq cm) to the area counted.

b. To arrive at the calibration factor, start with the microscope adjusted for the power under consideration.

c. Using the stage micrometer, measure the length of the ocular micrometer scale which is used to define the width of the unit area. The length of the unit area is defined by the side of the grid square or 3.08 mm.

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[7] The basic unit area for the statistical count not based on the grid markings on the filter, when using the ocular micrometer, will be the area defined by scanning the length of an individual grid square with the length of the ocular micrometer scale or any appropriate portion of the scale.
[8] Calibration factor defined in paragraph 17.

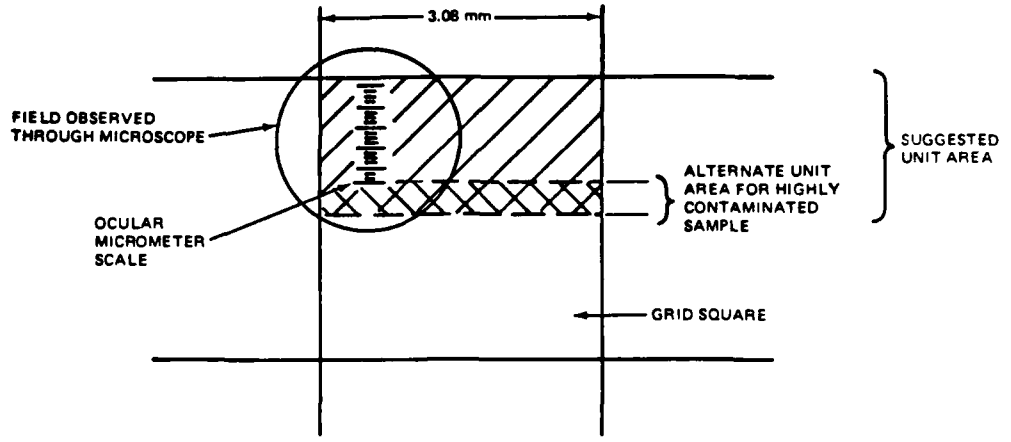


Figure 1

Figure 1 shows two possible unit areas within the grid square for statistical counting. The calibration factor is defined as the effective filter area divided by the total area counted and may be calculated from the following formula:

$$F = \frac{960}{3.08 \times L \times N} \quad \text{or} \quad \frac{312}{L \times N}$$

where F = the calibration factor

N = the number of basic unit areas counted

L = The calibrated length of the ocular micrometer scale or portion of scale used in defining unit area in millimeters

3.08 = the side of a grid square in millimeters

For example: Using a 10X objective and a 5 mm ocular micrometer, counting 10 basic unit areas, the calibration factor would be:

$$F = \frac{312}{0.5 \times 10 = 62.4}$$

and the total number of particles of a size range would be:

$$N_T = 62.4N_C$$

where N_C = the number of particles actually counted in the 10 basic unit area

18. SELF-CHECKING PROCEDURE:

19. MANIPULATION OF THE MICROSCOPE: Facility in the manipulation of the microscope can only be acquired by practice in perfecting focus, adjusting illumination, and sizing particles with the ocular micrometer. In order to obtain accurate results in contamination analysis, the operator must determine the capabilities and characteristics of his optical equipment and be able to use this equipment without hesitation and in such a manner as to take full advantage of these capabilities. The widest variable in results obtained in applying the ARP is caused by the variance between companies in microscope techniques. It is therefore important, in order to establish meaningful and comparable analytical results, that the optical techniques described in the ARP be followed closely, and that these techniques be checked by means of check samples as defined in paragraph 20. Calibration of the ocular micrometer and individual interpretation of the size range limits defined by the ocular micrometer rulings should also be checked by means of calibrated standards.

20. CHECK SAMPLES: Sample filter discs, permanently mounted and containing representative contaminant from hydraulic fluid systems should be used to check the optical portion of the analytical procedure. The actual particle count of these filter discs should be known within the limits of statistical accuracy and, if possible, should be verified by more than one laboratory. The procuring agency may provide these check samples or may recommend a source of suitable samples.

21. SELF-CHECKING ASPECT OF THE PROCEDURE: By employing blank analysis for checking the filtration and mounting techniques, and samples for checking the microscope counting aspect of the ARP, laboratories may provide themselves with a means for checking the repeatability and reproducibility of the procedure. By analyzing replicate samples from the same sampling port, the laboratories may determine the accuracy and reproducibility of sampling procedures.

a. Repeatability: (precision) The precision of results obtained with the ARP should be initially checked and periodically retested by analyzing replicate blanks, samples, and viewing fields in accordance with the ARP. The precision of results obtained in a single laboratory should also be checked by having all operators concerned occasionally analyze duplicate test samples and compare results.

b. Calibration: (accuracy) In order to establish meaningful inter-laboratory acceptable contamination levels and filtration efficiency data, it is important that the accuracy of the analytical procedures as employed in any individual laboratory be established by means of the calibrated industry-wide check samples. In this manner the Aircraft Recommended Procedures as described herein becomes a self-checking procedure on both an individual and inter-company scale, as well as on an industry-wide basis.

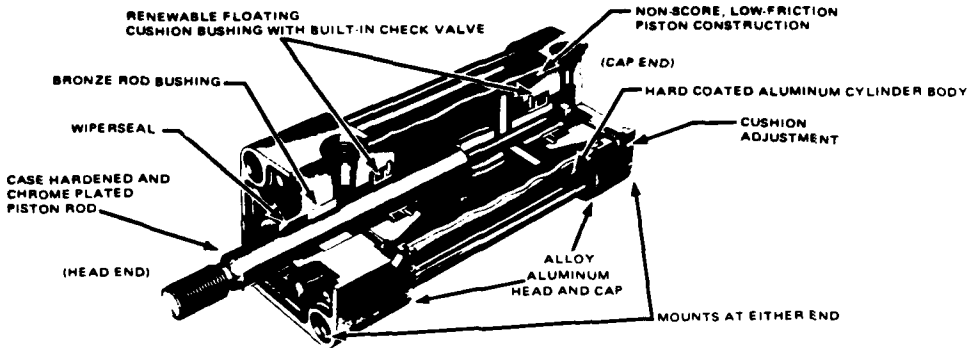
APPENDIX C

VENDOR DATA FOR PNEUMATIC EQUIPMENT

CONTENTS

Parker Series C
Medium Duty Air Cylinders

Design Features
Specifications



Here's how you benefit from using Parker Series "C" cylinders

These are standard cylinders, designed and engineered with two objectives in mind . . . to provide industry with the best possible air power cylinder at a price; to fuse quality and economy in one basic design.

Day-in, day-out production of a standard item provides the quality construction and quality control that gives you a near-perfect end product . . . an experience-crafted power cylinder.

Mass produced Series "C" cylinders give you the benefits of our research *engineering, tooling and inventory*. There has been no sacrifice in quality; this is a "ready-to-go" cylinder, quickly available in any quantity.

Cycle After Cycle -Long Trouble-Free Life

Day-in, day-out . . . millions of repetitive cycles . . . Parker has taken careful steps to counteract the effects of constant abrasive wear. Piston rods are case hardened, then chrome plated and given a highly polished finish. This prevents rod damage in service, thus increasing seal life. The "Wiperseal" is made of synthetic rubber—acts as both rod wiper and pressure adjusted sealing element to keep air in, dirt out. Friction is minimized by an oil impregnated bronze rod bushing which keeps rod lubricated. Pistons do not make metal-to-metal contact on either the cylinder body or the non-corrosive aluminum head and cap. This is made possible by molding a steel disc into a synthetic rubber compound, making a precision molded piston. Non-score design compensates for wear, assuring long leak-proof service.

Plus Performance -High Efficiency

You get maximum force because of low friction design of piston, gland and rod seal. Better cushioning action due to floating bushing design. These better cushions reduce impact at stroke ends, protecting load and cylinder on fast stroke or heavy load applications. They give better control on "slowdown"—faster "get-away" when moving out.

Optional cushions are furnished when ordered, or may be easily added in the field to any Series "C" cylinder without increasing overall length. Cushions are readily adjustable.

Versatility Choice... Convenience

- Basic cylinder design provides three different mounting positions . . . flush bottom, front and rear
- Additional mountings are provided in kit form . . . end lug, rectangular flange, detachable clevis and detachable eye
- Rod end accessory kits provide long clevis, short clevis and rod button attachments.
- Optional floating cushions are supplied without increase in cylinder length
- Choice of five bore sizes from 1-1/4" through 4-1/2"
- Strokes to 20 inches are standard

Specifications

Bore Sizes: 1-1/4", 1-3/4", 2-1/2", 3-5/8", and 4-1/2".

Strokes: Available to 20" as standard. For longer strokes, consult Parker, Cylinder Division.

Operating Pressures: to 200 p.s.i. maximum.

Operating Temperatures: for best seal life operating temperatures should not exceed 165°F. Cylinder can be operated to 200°F. maximum.

Spring Returned Models: provided to order with spring at either end as specified. Call out end to which pressure will be applied. Cylinder will be longer than standard. Consult factory for addition to dimensions LB or LD.

Force Data: To determine force, multiply your air pressure by these area figures:

BORE	CAP END MAJOR AREA	HEAD END MINOR AREA
1-1/4"	1.23 sq. in.	1.03 sq. in.
1-3/4"	2.40 sq. in.	2.10 sq. in.
2-1/2"	4.91 sq. in.	4.60 sq. in.
3-5/8"	10.32 sq. in.	9.54 sq. in.
4-1/2"	15.90 sq. in.	15.12 sq. in.

Prelubrication

Series C air cylinders are factory prelubricated. Parker Lube-A-Cyl is applied to cylinder bore, piston rod and seals. Lube-A-Cyl is an extreme pressure lubricant which adheres to the surfaces and for medium duty service, additional lubrication is not necessary.

Cylinder Division
501 South Wolf Road
Des Plaines, IL 60016

Parker Fluidpower

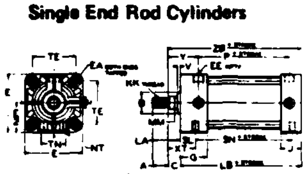
Parker Series C
Medium Duty Air Cylinders

Dimensions

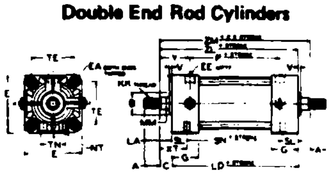
Dimensions

Symbol	Bore Size 1¼"	1¾"	2½"	3¼"	4½"
A	1	1	1	1⅛	1⅛
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BB	⅝	⅝	⅝	1⅜	1⅜
BE	6	6	6	7⅛	7⅛
BF	⅝	⅝	⅝	1¼	1¼
BG	1½	1½	1½	2½	2½
BH	⅜	⅜	⅜	1⅜	1⅜
BJ	¾	¾	¾	1½	1½
C	5/16	⅜	⅜	1	1
CB	¼	½	½	¾	¾
CD	⅜	½	½	¾	¾
CE	1-1/16	1-5/16	1-5/16	2¼	2¼
CH	¼	9/32	9/32	—	—
CJ	½	5/16	5/16	—	—
CK	1-19/64	1-13/64	1-13/64	—	—
CM	23/32	13/16	13/16	—	—
CN	2⅞	3	3	—	—
CP	3/16	½	½	—	—
CQ	13/16	15/16	15/16	—	—
CR	¼	5/16	5/16	⅜	⅜
CW	¼	5/16	5/16	7/16	7/16
E	1¾	2¼	2⅞	4	5
EA	¼-28	5/16-24	5/16-24	⅜-24	½-20
EB	9/32	⅜	⅜	7/16	9/16
EE	¼	¼	¼	½	½
EL	7/16	7/16	⅜	11/16	¾
EO	5/16	7/16	⅜	7/16	½
ET	9/16	⅝	11/16	1	1⅛
EW	¼	½	½	¾	¾
F	⅜	½	½	¾	¾
FB	9/32	⅜	⅜	7/16	9/16
FL	1	1¼	1½	1⅞	2¼
G	1⅜	1⅜	1-5/16	2	1-29/32
J	1⅛	1⅛	1-1/16	1½	1-13/32
KK	5/16-24	½-20	½-20	¾-14	¾-14
L	9/16	¾	¾	1⅛	1⅛
LA	1-9/16	1⅝	1⅝	2⅝	2⅝
LB	3-13/16	3-21/32	3-21/32	4-25/32	4-11/16
LD	4-5/16	4-19/32	4-15/32	5-13/32	5-5/16
MM	½	⅝	⅝	1	1
MR	½	½	9/16	⅞	1
NT	10-24 x⅜	5/16-18 x⅜	5/16-18 x½	⅜-16 x1	⅝-11 x1¼
P	2-3/16	2-19/32	2-9/32	2-29/32	2⅝
R	1.10	1.82	2.10	3.00	3.87
SL	1⅛	1⅛	15/16	1-5/16	1-9/32
SN	2-5/16	2-11/32	2-9/32	2-29/32	2⅝
TE	1.10	1.82	2.10	3.00	3.87
TF	2⅜	3	3-9/16	4⅞	6⅛
TN	⅝	11/16	1¼	1¾	2¼
UF	2⅞	3⅝	4⅜	5⅝	7⅛
UL	1¾	2¼	2⅞	4	5
V	⅛	⅛	⅛	3/16	3/16
W	5/16	¼	¼	¼	¼
XT	1-11/16	1¾	1-15/16	2-5/16	2-9/16
Y	1-9/16	1⅝	1-9/16	2-3/16	2-5/16
ZB	4⅜	4-21/32	4-15/32	5-13/32	5-11/32
ZL	5	5-5/16	4-15/16	6-9/16	6-5/16
ZM	5-5/16	5-21/32	5-9/32	7-13/32	7-5/16

Single End Rod Cylinders



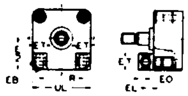
Double End Rod Cylinders

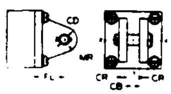


Mounting Kits

Mountings are available in packaged kits. Detachable Clevis is furnished with pivot and cotter pins. See "How To Order" section below.

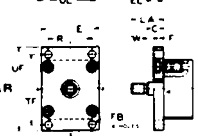
END LUGS
(Head and Cap)

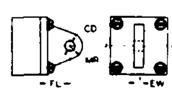




DETACHABLE CLEVIS
(Cap End)

RECTANGULAR FLANGE
(Cap End)





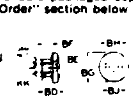
DETACHABLE EYE
(Cap End)

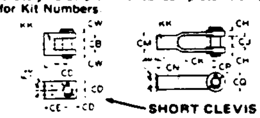
Detachable Clevis and Detachable Eye are mating parts that provide for mounting of cylinder to a structural member.

Rod End Accessories

Accessories are available packaged separately. Clevis furnished complete with pivot and cotter pin. See "How To Order" section below for Kit Numbers.

ROD BUTTON





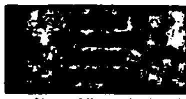
LONG CLEVIS
(Female)

How to order Parker Series C Cylinders

Specify the following:

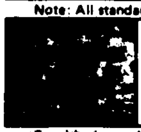
- Bore
- Basic Model Number*
- Stroke Length
- Optional Cushions (if required)—specify cap end, head end or both ends
- Mounting Kits (if required)—specify kit number §
- Rod End Accessory Kits (if required)—specify kit number**
- Spring Returned (if required)—specify end of cylinder to which pressure will be applied. Cylinder will be longer than standard. Consult factory for addition to dimensions LB or LD.
- Quantities
- Shipment Schedule Desired

In line with our policy of continuing product improvement, specifications in this catalog are subject to change.



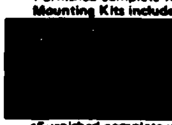
Optional Cushions	Single Rod Cylinders Model Number	Double Rod Cylinders Model Number
None	CO	KCO
At Head End	CCO	CKCO
At Cap End	COC	—
At Both Ends	CCOC	CKCOC

Note: All standard basic cylinders are furnished with a jam nut on the piston rod.



Cylinder Bore Size	End Lugs (Head & Cap) SET OF FOUR PART NO.	Rectangular Flange (Head or Cap End) PART NO.	Detachable Clevis* (Cap End) PART NO.	Detachable Eye (Cap End) PART NO.
1-1/4"	L-4501	L-4506	L-4511	L-4516
1-3/4"	L-4502	L-4507	L-4512	L-4517
2-1/2"	L-4503	L-4508	L-4513	L-4518
3-5/8"	L-4504	L-4509	L-4514	L-4519
4-1/2"	L-4505	L-4510	L-4515	L-4520

*Furnished complete with Pivot pin and cotter pin.
Mounting Kits include fasteners for attaching to basic cylinders



Cylinder Bore Size	Long Clevis* (Female) PART NO.	Short Clevis* (Female) PART NO.	Rod Button PART NO.
1-1/4"	L-4521	L-4523	18153
1-3/4"	L-4522	L-4524	18154
2-1/2"	L-4522	L-4524	18154
3-5/8"	—	L-4525	74718
4-1/2"	—	L-4525	74718

*Furnished complete with pivot pin and cotter pin.

Cylinder Division
501 South Wolf Road
Des Plaines, IL. 60016

Parker Fluidpower

BULLETIN 0920-M1
Revised March, 1964

HANNIFIN® INSTALLATION AND SERVICE INSTRUCTIONS
Series "C" Air Power Cylinders, 1¼"-4½" Bores

Hannifin standard Series "C" Cylinders are medium duty general purpose air cylinders for service at working pressures to 200 psi. They are supplied with Hannifin designed seals (patented).

To protect these seals and other vital cylinder parts, the air supply must be clean, lubricated and free of water, pipe scale, dirt and all foreign materials. Air line filters and lubricators are necessary to provide this protection.

When ordering, always give following information:

Important HOW TO ORDER

1. Serial Number
2. Bore
3. Stroke
4. Model Number

} Shown on cylinder name plate

5. Symbol Number
6. Name of Kit or Part

} Shown on drawing inside this bulletin

The Serial Number is especially important, particularly if there is an "S" in the Model Number.

HOW TO INSTALL

1. Standard Series "C" Cylinders will give excellent service under normal operating conditions. However, care must be exercised in the installation of the cylinder to make certain it will be protected from external abuse — especially paint, welded spatter, and similar materials that could damage the rod finish and result in excessive wear of the seals during operation.

Tie Rod Tap Mounted — Cylinders should be held to mounting plate by fastening high strength bolts directly into the four internal tapped holes in-line with tie rods in head or cap.

Flush Mounted — Two tapped holes are provided in the edges of both heads for mounting cylinders flush to a surface. Shear keys are generally used to resist the major load such as push or pull. Again, use high strength bolts for fastening.

End Lugs — These accessories are fastened onto the head and cap in tapped holes directly in-line with the tie rods. End lugs should be tightened into a position where side and bottom are flush with ends of cylinder head. Cylinder can be mounted by high strength bolts passing through end lugs.

Rectangular Flange — Either cap or head flange is fastened to cylinder by cap screws (Symbol 29) threaded into four tapped holes in-line with the tie rods. The four flange mounting holes are then available for mounting cylinder.

Detachable Clevis or Detachable Eye — Either of these mounting accessories may be attached to the cap by fastening screws (Symbol 30) and lockwashers (Symbol 31) directly into the four tapped holes in-line with the tie rods. For this type of mounting, cylinder must also be pivoted at rod end with either a short or long clevis, or customer's particular type of pivot member. Pivot pin at cap end mounting must be parallel to pivot pin at rod end mounting.

2. Remove protective wrapping from rod and any masking tape from cylinder. Do not remove pipe port thread protectors until you are ready to connect air lines to cylinder. These protectors keep out dirt, chips and other foreign materials that might otherwise get inside cylinder during the mounting process.

3. Mount cylinder and carefully check alignment of piston rod with machine part while piston rod is in both extended and retracted positions. No side load should be put on either cylinder or rod in normal applications. (In running rod in and out, the pipe port thread protectors must be removed.)

4. Now connect the air lines to the ports. Make sure these lines are clean and free of dirt, water and all foreign matter, for such contaminants can severely damage the cylinder. Install an air filter to keep the lines clean at all times.

Cylinder must be properly lubricated at all times. A lubricator in the air line is essential to provide proper degree of lubrication under all operation conditions. If it is desirable to slow speed of piston stroke in either direction, install either a speed control valve to restrict exhaust in that direction — or an air line pressure regulator to reduce inlet pressure.

5. *Cushions* — To adjust cushions: (a) loosen needle valve nut (Symbol 24) and (b) rotate cushion adjusting screw (Symbol 22) to desired setting. Be sure to re-tighten the needle valve nut.

SERVICING THE CUSHIONS

This operation necessitates dis-assembly of cylinder. Disconnect piston rod from its machine attachment and remove cylinder from its mountings. With a screwdriver, unfasten the four tie rod fasteners (Symbol 7) from the head, making certain to release the tension from the tie rods equally, i.e., unfastening, by fractional turns, diagonally opposed fasteners.

INSTALLATION: Simply place cushion bushing with assembled seal (Symbols 16 and 20, or 17 and 21) into cavity provided in head or cap. Be sure that stepped portion of bushing faces piston. After installation, place snap ring (Symbol 18 or 19) into its groove, thus holding cushion bushing in place. Re-assemble cylinder and torque tie rods equally to values shown below. If cushions were added in the field to a cylinder originally purchased without cushions, it will be necessary to remove plug screw and seal (Symbols 42 and 23) and install a cushion adjusting screw (Symbol 22) with a needle valve packing and nut (Symbols 23 and 24) in their place. See cushion adjustment instructions under "How To Install" for varying cushion action.

REMOVAL: Remove snap ring (Symbol 18 or 19) from head or cap and position piston rod so that the tapered end of cushion sleeve (Symbol 9) is just inside of cushion bushing (Symbol 16 or 17). Replace cylinder body into head and cap but do not torque-up on tie rods. For cylinders cushioned at cap end on 1¼" and 1¾" bore sizes, spear on end of piston rod is used instead of a cushion sleeve (Symbol 9). Slight air pressure (about 5 psi) admitted through port will "float" cushion bushing out of its groove and along cushion sleeve from where it can be removed by hand. Never pull cushion bushing out of its cavity by hand because the snap ring grooves will damage the seal lips.

REPLACING THE WIPERSEAL

Before installing a new seal, check surface of rod for scratches, dents, or other damage. A damaged rod surface will quickly damage any seal through which it moves. In order to replace wiperseal, it is necessary to dis-assemble the cylinder. See first paragraph of "Servicing the Cushions." Remove old seal (Symbol 10) with a hooked tool or by hand and simply place a new seal into the groove in the head. Re-assemble cylinder and torque tie rods equally to values shown below.

TIE ROD TORQUE SPECIFICATIONS

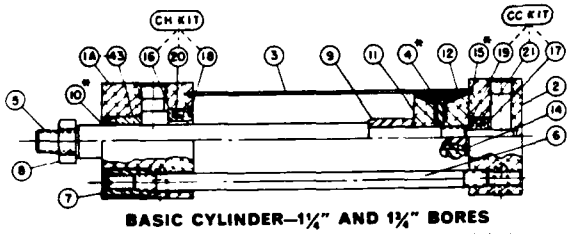
An extreme pressure lubricant (such as molybdenum disulphide) should be used on tie rod threads and fasteners bearing faces to control friction and reduce tie rod twist. Tie rod twist can be eliminated by chalking a straight line on each tie rod before torquing and backing off fastener after torquing so this line is straight again . . . very important on long stroke cylinders.

Using a drag link socket or a screwdriver socket, tighten each tie rod fastener to torque value given in table below. Apply only a partial amount of required torque to a tie rod, then tighten a diagonally opposed tie rod to the same amount. Tightening all four fasteners in this gradually increasing manner will prevent buckling of cylinder body, especially on long stroke cylinders.

Cylinder Bore		1¼	1¾	2½	3¼	4½
Torque lb. ft.	Min.	1.5	2.0	2.0	10.0	20.0
	Max.	2.0	2.5	2.5	13.0	25.0

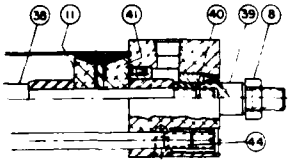
HANNIFIN CYLINDER DIVISION
PARKER-HANNIFIN CORPORATION • DES PLAINES, ILLINOIS, U.S.A.

SERIES "C" PARTS LIST

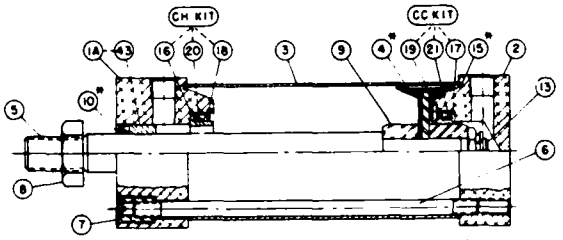


BASIC CYLINDER—1¼" AND 1¾" BORES

*Symbols 4, 10, 14 and 15 comprise Seal Kit SK (see table below)

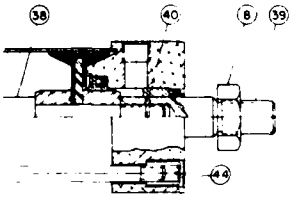


DOUBLE ROD CYLINDER



BASIC CYLINDER—2½", 3⅛" AND 4½" BORES

*Symbols 4, 10 and 15 comprise Seal Kit SK (see table below)

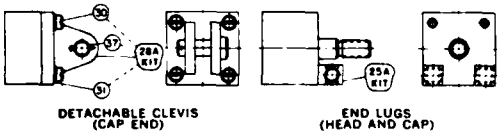


DOUBLE ROD CYLINDER

Symbol	NAME OF PART
SK*	SEAL KIT—Includes Symbols 4, 10, 14 & 15
CH	CUSHION KIT, Head End (Required for Cushion Cyls. Only)—Includes Symbols 16, 18, 20, 22, 23 & 24
CC	CUSHION KIT, Cap End (Required for Cushion Cyls. Only)—Includes Symbols 17, 19, 21, 22, 23 & 24
1A	HEAD ASSEMBLY—Includes Rod Bushing, Symbol 43
2	CAP
3	CYLINDER BODY
4	PISTON (See Kit SK)
5	PISTON ROD
6	TIE ROD, Single Rod Type
7	TIE ROD FASTENER
8	JAM NUT
9	CUSHION SLEEVE
10	WIPERSEAL (See Kit SK)
11	PISTON SPACER, Head End
12	PISTON SPACER, Cap End
13	PISTON RETAINING NUT
14	LOCK PIN
15	GASKET, Cylinder Tube (See Kits CC or CH)
16	CUSHION BUSHING, Head End (See Kit CH)
17	CUSHION BUSHING, Cap End (See Kit CC)
18	SNAP RING, Head End (See Kit CH)
19	SNAP RING, Cap End (See Kit CC)
20	LIPSEAL, Head End (See Kit CH)

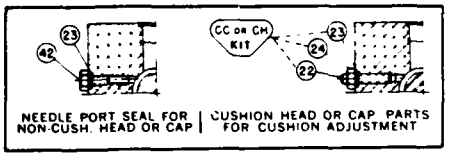
Symbol	NAME OF PART
21	LIPSEAL, Cap End (See Kit CC)
22	CUSHION ADJUSTMENT SCREW (See Kits CC & CH)
23	NEEDLE VALVE PACKING (See Kits CC & CH)
24	NEEDLE VALVE NUT (See Kits CC & CH)
25A	END LUGS KIT (2 Lugs)
26A	DETACHABLE EYE KIT—Includes Symbols 30 & 31
27A	RECTANGULAR FLANGE KIT—Includes Symbol 29
28A	DETACHABLE CLEVIS KIT—Includes Symbols 30, 31 & 37
29	MOUNTING SCREW, Flange (See Kit 28A)
30	MOUNTING SCREW, Eye & Bracket (See Kits 26A & 28A)
31	LOCKWASHER, Bracket (See Kits 26A & 28A)
32	ROD BUTTON
33A	SHORT CLEVIS KIT, Female—Includes Symbol 35
34A	LONG CLEVIS KIT, Female—Includes Symbol 36
35	PIVOT PIN, Short Clevis (See Kit 33A)
36	PIVOT PIN, Long Clevis (See Kit 34A)
37	PIVOT PIN, Detachable Clevis (See Kit 28A)
38	PISTON ROD, Double Rod Type
39	PISTON ROD EXTENSION, Double Rod Type
40	LOCK PIN, Double Rod Type
41	PISTON SPACER, Rod Extension End, Double Rod Type
42	PLUG SCREW
43	ROD BUSHING (See Head Assembly 1A)
44	TIE ROD, Double Rod Type

ACCESSORIES

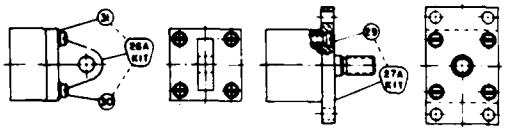


DETACHABLE CLEVIS (CAP END)

END LUGS (HEAD AND CAP)

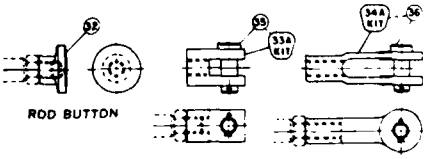


NEEDLE PORT SEAL FOR NON-CUSH. HEAD OR CAP | CUSHION HEAD OR CAP PARTS FOR CUSHION ADJUSTMENT



DETACHABLE EYE (CAP END)

RECTANGULAR FLANGE (HEAD OR CAP END)



ROD BUTTON

SHORT CLEVIS (FEMALE)

LONG CLEVIS (FEMALE)

APPENDIX D

VENDOR DATA FOR HYDRAULIC EQUIPMENT

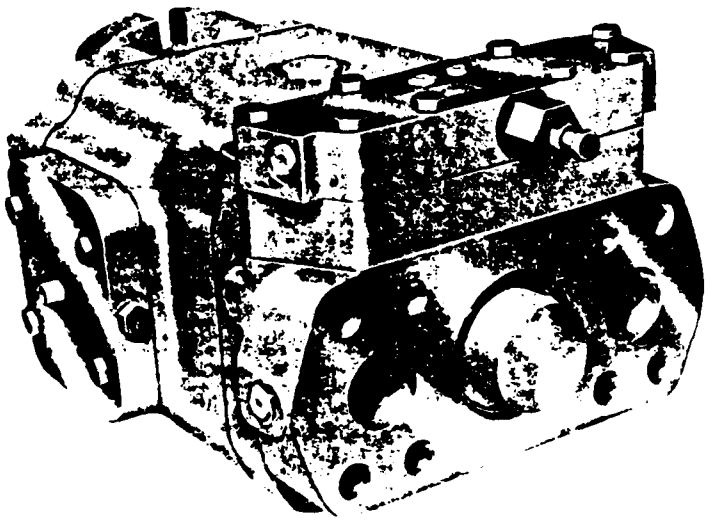
Bulletin SPP-P6-7P

Abex | DENISON | SERVICE LITERATURE

Axial Piston Pump – Variable Displacement with Auxiliary Package

TRIMLINE MODEL P6P
TRIMLINE MODEL P7P

INSTALLATION AND OVERHAUL INSTRUCTIONS

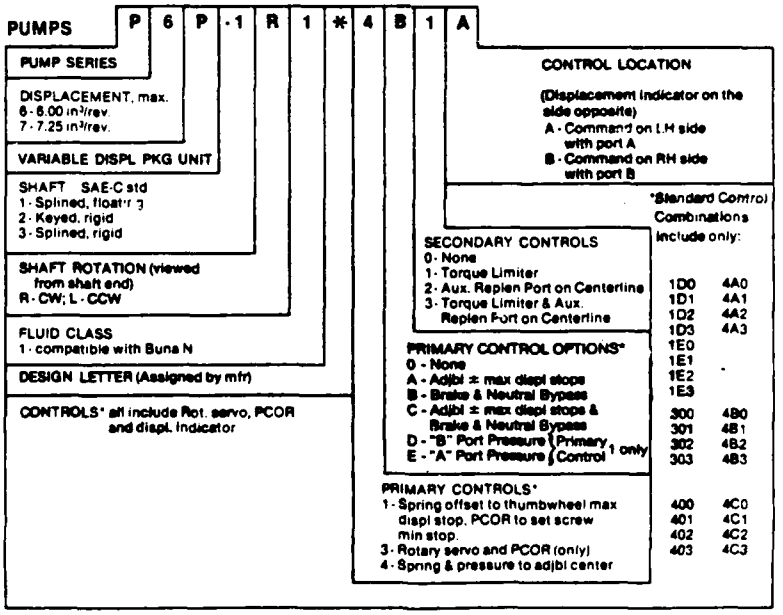


D-3

Table of Contents

Series Model Code

Use these codes to identify standard Trimline pumps and motors from their model numbers. The combinations of the only standard options available are shown on the following pages.



Section I
INTRODUCTION

GENERAL

The Denison Trimline 6 and Trimline 7 axial piston pumps feature advance design concepts which are time proven and provide for advance pumping and control concepts. The instructions contained in this manual cover complete disassembly and reassembly of the unit. Before proceeding with the disassembly or reassembly of any unit, this manual should be studied in order to become familiar with proper order and parts nomenclature.

DESCRIPTION

The use of a rocker cam to control the pump displacement provides a small package size, reduces wear, and speeds control response. The control vane actuator eliminates linkage and backlash inherent in typical stroking cylinder designs.

Standard controls for the Trimline units are Rotary Servo and Compensator Over-Ride. Additional optional controls are also available.

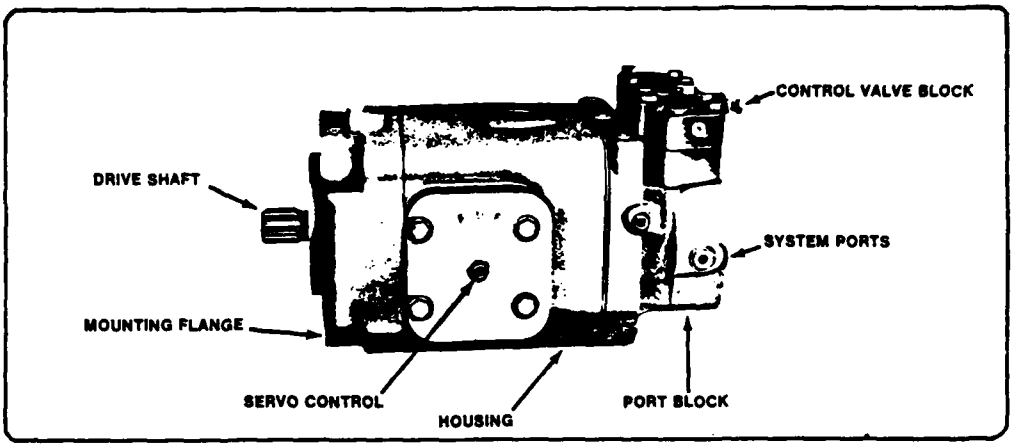


Table 1
TYPICAL CHARACTERISTICS

Specification	Term	Trimline 6	Trimline 7
Displacement (theoretical) zero PSI	in. 3/rev ml/rev	6.00 98	7.25 119
Pressure, Ports A & B max. continuous max. intermittent	PSI bar PSI bar	5000 345 6000 414	5000 345 6000 414
Speed, max. continuous	RPM	3000	3000
Flow, Ports A or B @ 3000 RPM	GPM l/min.	77.9 295	94.2 357
Flow, Replenishing pump @ 3000 RPM	GPM l/min.	13.9 52.6	13.9 52.6
Replenishing Pressure	PSI bar	200 14	200 14
Servo Pressure	PSI bar	335-535 23-37	335-535 23-37
Mounting	SAE	C-2 bolt	C-2 bolt
Shaft	SAE	C Spline or key	C spline or key
Fluid connection Ports A & B 4 bolt pad for split flange	SAE	1½" 6000 PSI	1½" 6000 PSI
Weight w/rotary servo	lbs.	175	175

Section II
INSTALLATION

MOUNTING

The mounting hub and two bolt mounting flange are based on an SAE-C type configuration. The pump should be mounted on a base or bracket of sufficient strength to support the pump without allowing flexing or movement. Close shaft alignment between the pump unit and prime mover is of utmost importance.

When installing the pump, the power source drive should be checked for proper alignment with the mounting pad or bracket that the pump pilots into. It is recommended that a dial indicator be used when checking alignment. The concentricity of the pump shaft and power source shaft must not exceed 0.010 TIR and preferably should be 0.006 to 0.008 TIR maximum. The shaft concentricities are particularly important if the pump shaft is rigidly connected to the power source without a flexible coupling or a coupling that allows only for minor misalignment.

PIPING

All fluid lines, either pipe, tubing, or flexible hose must be of adequate size and strength to assure free flow to and from the pump. Note: DO NOT USE GALVANIZED PIPE. Galvanized coating may flake off after continued use. Fluid lines to and from the pump must be of proper size to prevent restriction of the fluid flow.

If rigid pipe or tubing is used, the workmanship must be accurate in order to eliminate strain on the pump or the fluid connections. Sharp bends, elbows, or reducers in the lines should be eliminated or minimized whenever possible. All system piping must be clean and free of foreign material before connecting to the pump. It is recommended that all piping be cleaned with solvent or equivalent cleaning agent.

SERVICE INFORMATION

These hydraulic products are designed to give long dependable service when they are properly applied and their systems properly maintained. These general instructions apply to typical systems. Specific instructions for a particular machine may be developed from them.

START UP PROCEDURE FOR NEW MACHINE INSTALLATION

1. Read and understand the machine instruction manual. Identify components and their function for the hydraulic schematic.
2. Visually inspect components and lines for possible damage.
3. Check reservoir for cleanliness and drain and clean as required.
4. Check fluid level and fill as required with filtered fluid at least as clean as that recommended. Be sure piston rods and rams are in the correct position relative to fluid level. Fill pump cases as necessary.
5. Check alignment of pump drive.
6. Check oil cooler and activate it. Check fluid temperature.
7. Reduce pressure settings of relief valves and/or compensator. Make sure accurate pressure readings can be made at appropriate places.
8. If electric motor drive, check for correct pump rotation.
9. If solenoids in system, check for actuation.
10. Start pump drives. Make sure pump(s) fill properly.
11. Cycle unloaded machine at low pressure and observe actuation (at low speed if possible).
12. Bleed system of air. Recheck fluid level.
13. Gradually increase pressure settings in steps Check for leaks especially in pump inlet lines.
14. Make correct pressure adjustments.
15. Gradually increase speed. Be alert for trouble as indicated by changes in sounds, system shocks, and air in fluid.
16. Machine is operational.

Table II
TROUBLE-SHOOTING CHART

TROUBLE SHOOTING

Component problems and circuit problems are often inter-related. An improper circuit may operate with apparent success but will cause failure of a particular component within it. The component failure is the effect, not the cause of the problem.

This general guide is offered to help in locating and eliminating the cause of problems by studying their effects:

Effect of Trouble	Possible Cause	Fault Which Needs Remedy
Noisy Pump	Air in Fluid	Leak in suction line Leak at shaft seal Low fluid level Turbulent fluid Return lines above fluid level Gas leak from accumulator Excessive pressure drop in the inlet line from a pressurized reservoir Suction line strainer acting as air trap
	Cavitation in pump or motor rotating group	Fluid too cold Fluid too viscous Fluid too heavy Shaft speed too high Suction line too small Suction line collapsed Suction strainer too small Suction strainer too dirty Operating altitude too high Boost or replenishment pressure too low Replenishment flow too small for dynamic conditions
	Misaligned shaft	Faulty installation Distortion in mounting Axial interference Faulty coupling Excessive overhung loads
	Mechanical fault in pump	Piston and shoe looseness or failure Bearing failure Incorrect port plate selection or index Eroded or worn parts in the displacement control
Erosion on barrel ports and port plate	Air in Fluid	See above
	Cavitation	See above
High wear in pump and motor	Excessive Loads	Reduce pressure settings Reduce speeds
	Contaminant particles in fluid	Improper filter maintenance Filters too coarse Introduction of dirty fluid to system Reservoir openings Reservoir breather Improper line replacement
	Improper fluid	Fluid too thin or thick for operating temperature range Breakdown of fluid with time/temperature shearing effects Incorrect additives in new fluid Destruction of additive effectiveness with chemical aging
	Improper repair	Incorrect parts Incorrect procedures, dimensions, finishes

TABLE II CONTINUED

Effect of Trouble	Possible Cause	Fault Which Needs Remedy
High wear in pump and motor	Unwanted water in fluid	Condensation Faulty breather, strainer Heat exchanger leakage Faulty clean-up practice Water in makeup fluid
Pressure shocks	Cogging load Worn relief valve	Mechanical Considerations Needed repairs
	Worn compensator Slow response in check valves	Needed repairs Replace or relocate
	Servo pressure to low to maintain firm control	Increase pressure and check pressure drop through servo filter
	Excessive decompression energy rates	Improve decompression control
	Excessive line capacitance (line volume, line stretch, accumulator effects)	Reduce line size or lengths. Eliminate hose Bleed air
	Barrel blow-off	Recheck pump hold-down, rotating group, drain pressure
Heating of Fluid	Excessive pump or motor leakage	Recheck case drain flow and repair as required Fluid too thin Improper assembly, port timing
	Relief valve	Set too low (compared to load or to compensator) Instability caused by back pressure, worn parts
	Compensator	Set too high (compared to relief) Worn parts
	Pump too large for fluid needs	Select smaller pump displacement
	Heat exchanger	Water turned off or too little flow Water too hot Fan clogged or restricted Efficiency reduced by mud or scale deposits Intermittent hydraulic fluid flow
	Reservoir	Too little fluid Entrained air in fluid Improper baffles Insulating air blanket that prevents heat rejection Heat pickup from adjacent equipment

Section III
UNIT DISASSEMBLY

The instructions contained in this section cover a complete teardown of the subject pump. Disassemble only as far as necessary to replace or repair any worn parts.

DISASSEMBLY

Position pump unit so that valve block assembly is on top. A bench or similar suitable surface capable of supporting unit should be used. Disassembly area sould be clean.

VALVE BLOCK

See Figure 11

1. Remove the eight hex head cap screws (17) and lift the entire block assembly from the port block.

VALVE COVER

See Figure 10

1. Remove the four screws (39) to separate the cover (21) from the block (11). DO NOT REMOVE THE CHECK VALVES (19) UNTIL THE TWO ORIFICES (20) ARE REMOVED.
2. Remove plugs (43), (36) and pin (40). Remove the 8-32 nut from the bottom of cover (21) to remove filter assembly (34).
3. Remove housing (29). Remove items (30), (31), (32) and (33) as a unit. Insert a small brass rod thru the hole in the housing and tap out piston (27) and O-ring (26).
4. Remove spring (25) and cone (24). Remove seat (23) and O-ring (22). Note: Seat is made for hex wrenching. Use ½" 6 point socket with ¼" drive.
5. Remove O-rings (38) from bottom of cover.

VALVE BLOCK

1. Remove O-ring (37) and replenishing relief valve (41). Inspect orifices (12) visually to insure they are open. Do not remove unless damage or clogging is apparent.
2. Remove springs (16), (17) and (18). Remove retainer (15) and poppets (13) and (14).

RETAINER PLATE

1. Remove the four screws (4) from the plate (6) and (11). Remove gasket (7).
2. Remove seats (8) and (9). Do not remove roll pins (5) and (10) unless replacements are needed.

CONTROLS

See Figure 11

Remove the four screws (14) from the side (16) and remove the input shear seal valve assembly.

Remove the four screws (14) from the side cover (15) and remove the counter balance shear seal assembly.

Remove the two screws (12) and remove the servo stem (9) and plate (10).

BARREL HOLDDOWN AND GEROTOR ASSEMBLY

See Figure 9

1. Remove snap ring (17), end cover (15) and "O" ring (16).
2. Remove cotter pin (14), holddown nut (13), thrust washers (10), bearing (11) and seal ring (12).
3. Remove pressure plate (9), Gerotor side plate (5), "O" rings (7) and (8), needle bearing (5b). Do not remove 6-32 screw (6) from side plate (5a) unless the unit is to be reassembled for the opposite rotation.
4. Remove Gerotor assembly (3), dowel pin (4), key (2), and side plate (1).

PORT BLOCK

See Figure 8

1. Remove four screws (1) the secure the port block (2) to the housing (6). Use caution when removing screws on valve block side to prevent marring valve block face.
2. Remove port block (2) and gasket (5). Remove port plate (4) and face plate pins (3).
3. **See Figure 7**
1. Remove the check valve assemblies (7) from the port block.
2. Remove needle bearing (2) from the port block.
3. Remove two screws (5), lockwashers (6), check rings (3), and clamps (4).

BARREL AND AUXILIARY SHAFT

Remove the barrel assembly by grasping the

auxiliary shaft and lifting the complete assembly out of the housing.

REMOVING DRIVE SHAFT

See Figure 11

Remove the four screws (8) and gaskets (7). Remove seal retainer (6), and the stationary part of the shaft seal (4).

See view of item 4.

Carefully remove the carbon ring and the remainder of the shaft seal from the shaft.

Remove snap ring (3) and the shaft and bearing assembly (1). Remove spacer or ring (2).

HOUSING REMOVAL

After shaft assembly has been removed, position the unit on end with the mounting flange turned down.

1. Push the ends of the small tube lines away from the housing.
2. Lift the housing from the mounting flange, remove the gasket, and dowel pins from the mounting flange.
3.

Do not remove the roll pins and the bearing from the housing unless the bearing is damaged and must be replaced.

ROCKER CAM AND CONTROL STROKING ASSEMBLY

See Figure 4

Remove the complete assembly from the mounting cap and position on a clean flat surface with the two tubes (2) in a horizontal position and located at the top. Mark the cam (24) and cradle (20) as indicated in Figure 3. *These marks will determine positioning of parts during reassembly.*

Carefully remove the small tube lines (3) and (4) from the cradle.

DO NOT BEND THESE LINES

See Figure 3

Position the assembly in an upright position on the flat surface of the cradle (20). Remove the retaining ring (1), thrust washer (2), and bearing flange (3). Remove the piston and shoe assembly (4) and the creep plate (5) from the cam (24). Carefully remove the two differential screws (6) (CAUTION: These must be alternatively removed one turn at a time) from the rocker cam (24), and remove the servo input parts (7), (8) and (9).

Remove the four 7/16" screws (10) and eight ¼" screws (11) and (12) from the control covers (15R) and (15L). Remove the four dowel pins (16) and remove the two chambers (17). Remove the two special seals (18) and the four steel balls (19).

Remove the two Vane Seal Cartridge Assemblies and the four holddown vanes (22) from the rocker cam (24).

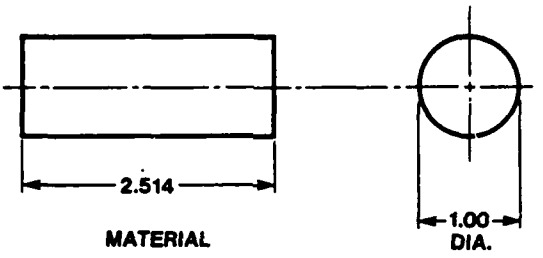
(Note: Some units may have thin shims under the holddown vanes).

Remove the rocker cam (24) from the cradle (20).

DO NOT REMOVE THE PLUGS FROM THE ROCKER CAM OR THE ROLL PINS IN THE CRADLE.

Section IV
ASSEMBLY TOOL DRAWINGS

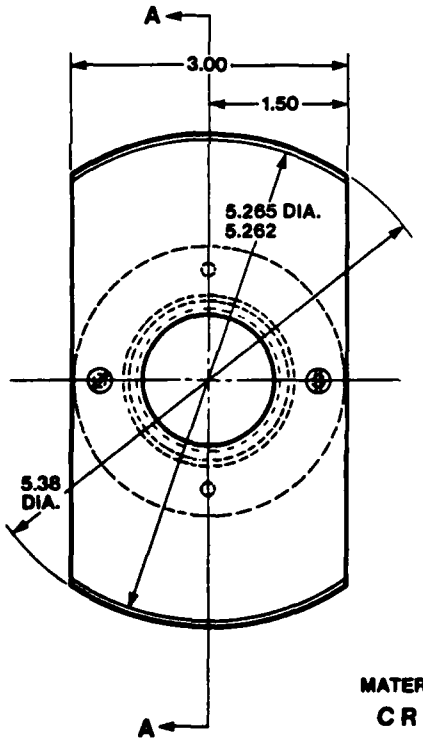
T-1



MATERIAL

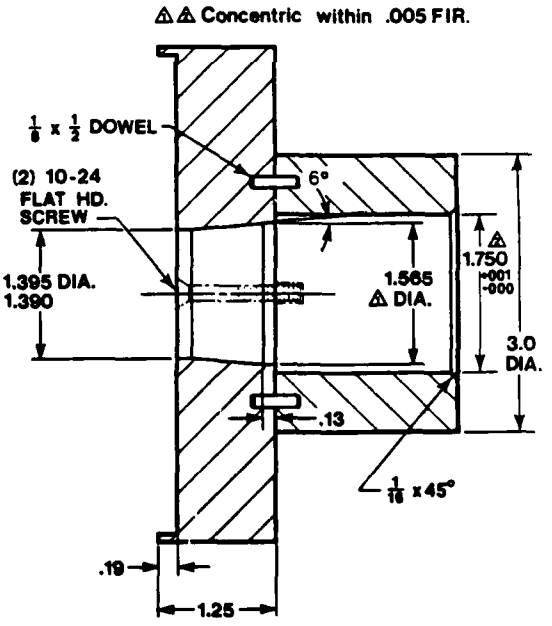
C R S 1" DIA. x 2⅝"

T-2



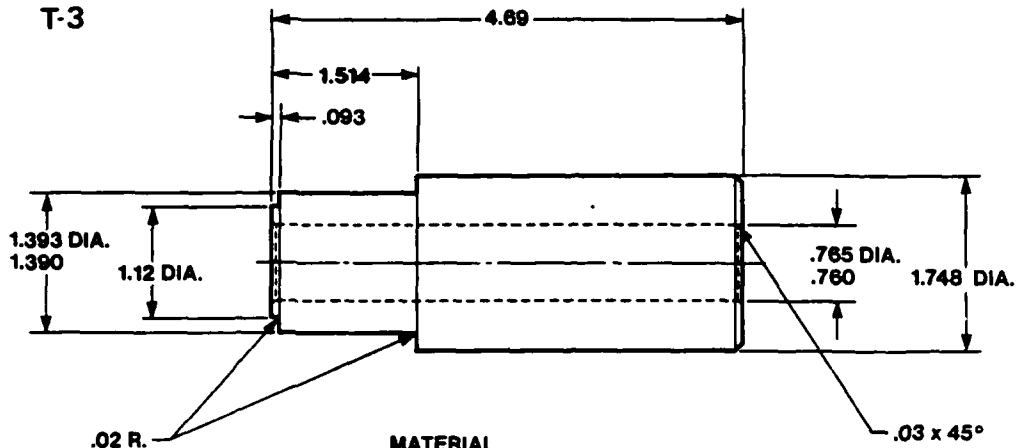
MATERIAL

C R S



SECTION A-A

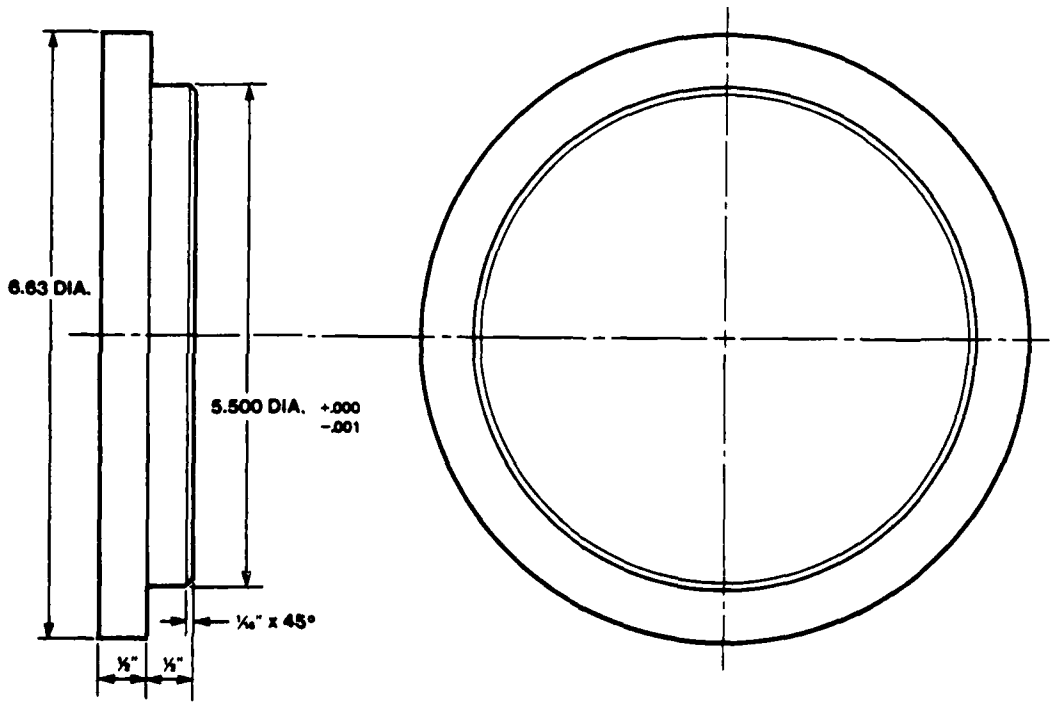
T-3



MATERIAL

4150 STEEL (HD'N. TO Rc 45-50)

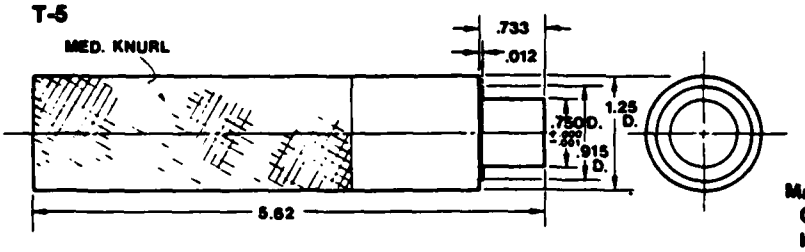
T-4



MATERIAL

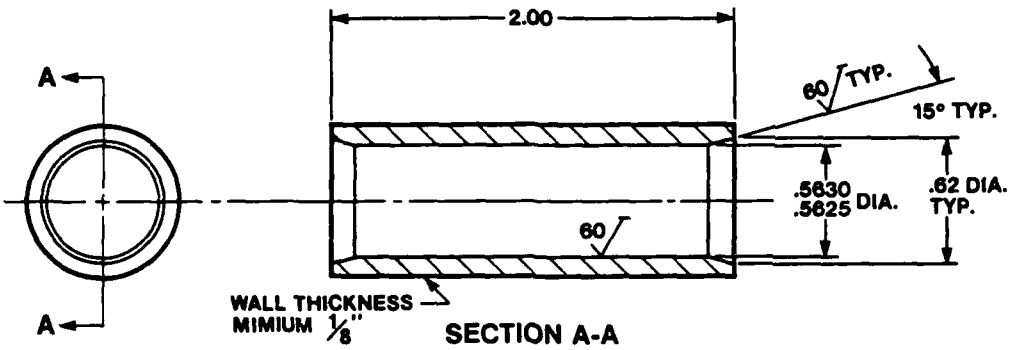
C R S 1⅛" x 6¾" DIA.

T-5



Material:
OHTS $5\frac{5}{8} \times 1\frac{1}{4}$ DIA.
Hardened Tip RC 58-62

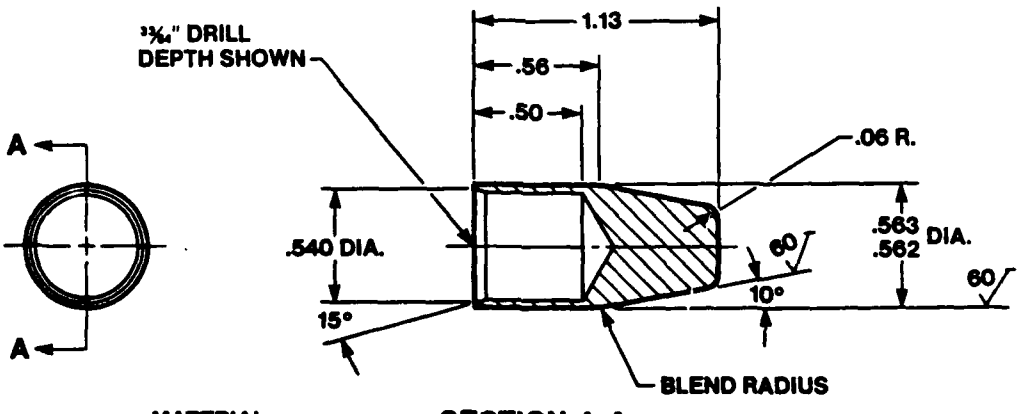
T-6



MATERIAL

HRS–CRS

T-7



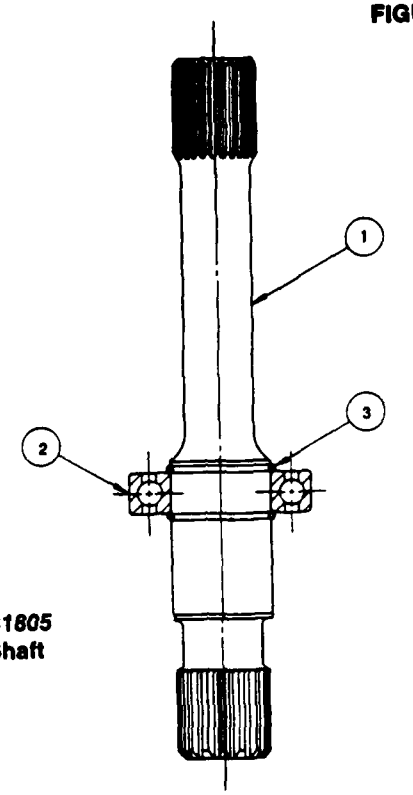
MATERIAL

HRS–CRS

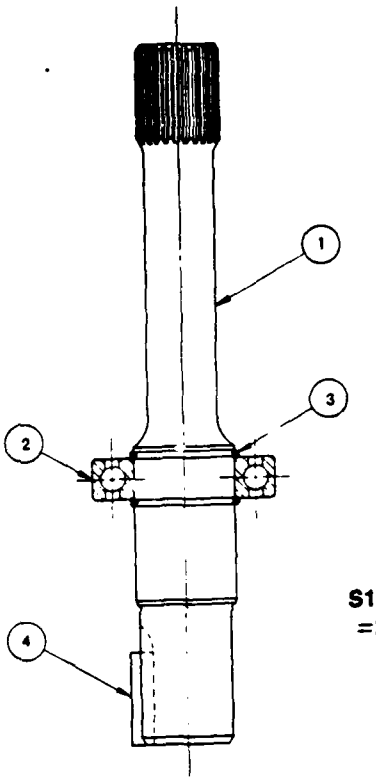
SECTION A-A

Section V
ASSEMBLY PROCEDURES

DRIVE SHAFT ASSEMBLY
FIGURE 1



S15-41805
=1 Shaft



S15-41806
=2 Shaft

1. Pass one retaining ring (3) over the internal end of drive shaft (1) and install in the groove near the shaft seal surface.
   DO NOT PASS THE RING OVER THE SEAL SURFACE.
2. Slide the bearing (2) over the same end of the shaft and seat against the ring.
   Support only the inner race of the bearing and press on the coupling end of the shaft.
   DO NOT USE EXCESSIVE FORCE AND DISTORT OR DAMAGE THE RETAINING RING.
3. Install the other retaining ring (3) in the other retaining ring groove. Be sure that both rings are fully seated.

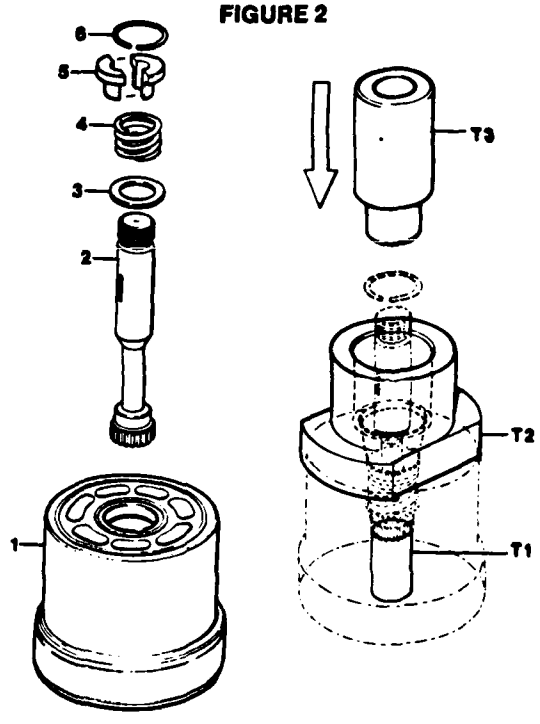
PARTS LIST FOR FIGURE 1

S15-41805 #1 Drive shaft assembly (Splined)
S15-41806 #2 Drive shaft assembly (W/Keyway)

Item	Qty. #1	Qty. #2	Part Number	Description
1	1	—	035-70567	#1 (Splined) Drive shaft
	—	1	035-70579	#2 (W/ 5/16 KW) Drive shaft
2	1	1	230-82140	Shaft bearing MRC-107 KS
3	2	2	035-70817	Retaining ring
4	—	1	035-71348	Square key 5/16 x 1¼

BARREL AND AUXILIARY DRIVE SHAFT ASSEMBLY

FIGURE 2



1. Position the barrel (1) in a press with the large end turned down and insert tool figure T-1 in the splined shaft hole in the barrel.
2. Place thrust washer (3) and spring (4) over shaft (2) in the same sequence as shown.
3. Insert shaft (2) in barrel (1) and rest on tool figure T-1. Position the two spring retainers (5) around the shaft (2) and inside of spring (4).
4. Carefully place tool figure T-2, with the large end of the tapered hole up, over the shaft (2) and against the barrel (1) face. Insert ring (6) around the shaft (2) and in the tool.
5. Position the ring with the gap within 5/8" of the notch in the barrel for easy removal.
6. Place tool figure T-3 over the shaft (2) with the small end against ring (6). Press on the end of the assembly tool and seat the ring (6) in the groove in the barrel (1).
7. Remove the assembly tools. Check to be sure that the ring is properly seated. Check barrel face to be certain it is not marred.

PARTS LIST FOR FIGURE 2

S15-43654 P6P Complete Barrel & Shaft Assembly
S15-42316 P7P Complete Barrel & Shaft Assembly

No.	Qty.		Part Number	Description
	P6P	P7P		
1	1	-	S15-43657	Barrel & Sleeve Assy. P6P Only
	-	1	S15-41221	Barrel & Sleeve Assy. P7P Only
2	1	1	035-70568	Auxiliary Drive Shaft
3	1	1	350-10069	Thrust Washer TRA-1220
4	1	1	035-70493	Barrel Holddown Spring
5	2	2	035-70483	Spring Retainer
6	1	1	035-70494	Retaining Ring

FIGURE 3

CRADLE ASSEMBLY

1. Install the four ¼" roll pins (20b) in the holes provided in the sides of the cradle (20a). THE PINS MUST BE 3/16" BELOW THE SURFACE.
2. Position the cradle assembly (20) on a clean flat surface with the large flat area down.

ROCKER CAM ASSEMBLY

Position the rocker cam (24) on the cradle (20). Mark the cradle and cam to indicate top. (See marks in Figure 3.) Marks will be used for assembly reference.

VANE SEAL CARTRIDGES

1. Place O-ring (23c) around spacer (23d) and insert in the seal vane (23b).
2. Insert check valve (23e) inside of spacer (23d) and assemble between the two backup plates (23a) with the notched V's exposed.
3. Install assembled cartridge in slot in cam as indicated in Figure 3. Repeat steps 1, 2 and 3 on other side of cam.
4. Insert the four holddown vanes (22) and springs (21) in the slots on each side of the control vanes (23).

CONTROL CHAMBER

Position both control chambers (17) on a clean flat surface with seal grooves turned up. Drop the four steel balls (19) in the four counterbored holes at each end of the seal grooves.

Lubricate seals (18) and insert in seal grooves in control chamber (17).

The tapered side of the seals must be pushed into the grooves and the ends must cover the steel balls.

Install the control chamber (17) with seal (18) and steel balls (19) assembled over the control vane (23). The seal must be against the cam. Rotate the chamber until it passes over the control vane assembly, then rotate in the opposite direction until the ¼" dowel pins (16) can be pushed through the chamber (17) and into the cradle (20). Install chamber in the same manner on the other side of the cam.

Two sets of chamber covers are available. The set marked CW must be installed in the right hand rotation pump and the set marked CCW must be used in the left hand rotation pump. (Rotation is determined facing the shaft end of pump.) The covers must be installed with the tubing holes and the tapped holes at the top of the unit. Install chamber covers (15r) and (15l) on the control chambers (17) over the dowel pins (16). *The tapped holes must be at the top.* Refer to the "T" marked on the rocker cam (24) and cradle (20).

Install four ¼-20 screws, two (11) and two (12), in each side and torgue to 10 ft. lbs.

Install two 7/16-14 screws (10) in each side and torgue to 45 ft. lbs.

Install O-ring (14) and plug (13) in each cover.

Install tubes (25) in reamed holes in each cover.These tubes must be a tight fit. If tubes are loose, the ends can be expanded with a tapered punch.

Tap the tubes in place with a plastic mallet.

SERVO ASSEMBLY

Install the 10-32 end of the differential screws (6) in the servo plate (9) from the inside. Allow the screws to extend 11/64" through the stem.

Install two orifice screws (8) in the servo stem (7).

Install servo plate with the long end of the differential screws through the servo stem. The orifice screw end of the servo stem must be against the servo plate.

Position the stem and plate on the rocker cam input side (at 9 o'clock on "B" model or 3 o'clock on "A" models) with the screws positioned over the 10-24 tapped holes. Hold the assembly against the cam and alternately turn the screws ½ turn each until the stem and plate are firmly attached to the cam. Torque the screws (6) to 70 in. lbs.

WARNING
THE SCREWS MUST NOT PROTRUDE FROM THE SERVO PLATE

PISTON AND SHOE ASSEMBLY

Install creep plate (5) over center post on rocker cam. Small O.D. of plate must be turned down.

Insert the seven piston and shoes (4b) in the shoe retainer (4a). Position the assembly (4) over the center post and against the creep plate.

Install flange bearing (3) over center post. Place thrust washer (2) against bearing.

Three different retaining rings (1) are available for the holddown assembly. Each ring is marked; yellow dot .083 thick, green dot .081 thick, and red dot .079. Install the thickest ring (1) with the dot up, that will fit in the groove on the center post and allow a maximum clearance of .0015 between the shoe and creep plate.

The piston and shoe assembly (4) should be free to rotate by hand. (5 ft. lbs. or less).

Install items 6, 7, 8 and 9 on this side of rocker cam if pump model number has "B" suffix. Install on opposite side if "A" suffix.

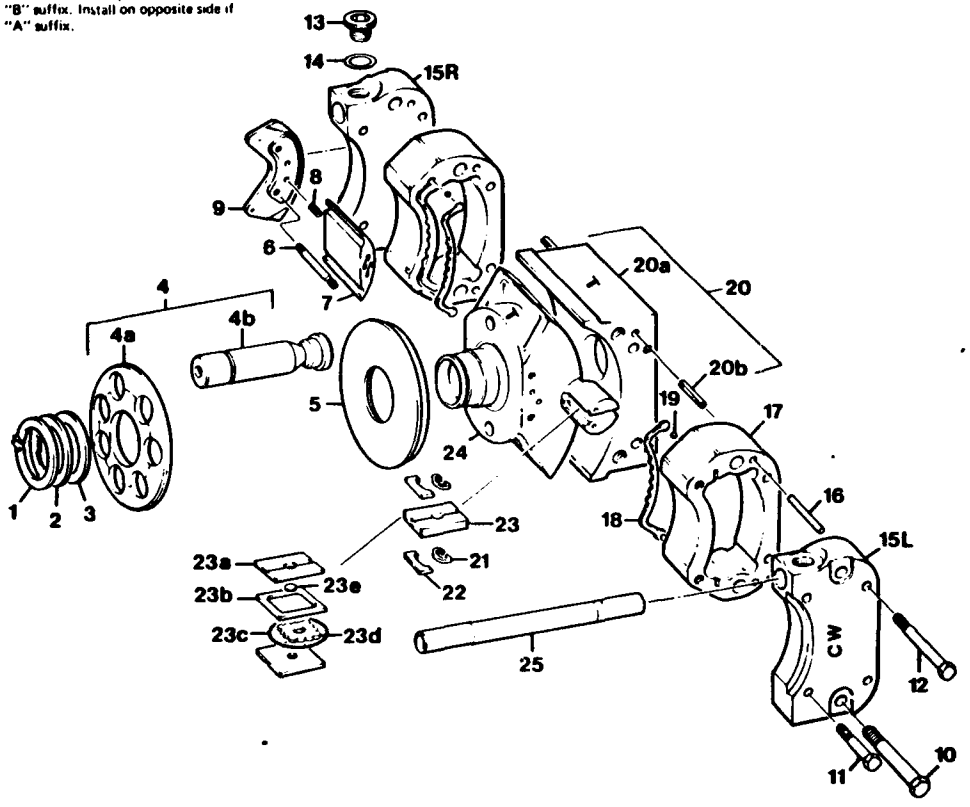


FIGURE 3

PARTS LIST FOR FIGURE 3

No.	Qty.	Part Number	Description
1	1		Retaining ring – USE ONE ONLY
		035-70494	083 thick w/yellow dot
		035-70498	081 thick w/green dot
		035-70500	079 thick w/red dot
2	1	035-70496	Thrust washer
3	1	035-70495	Bearing flange (bronze)
4		See below	Piston & shoe assy. w/retainer
5	1	035-71281	Creep plate
6	2	035-70499	Differential screw 10-32 @ 10-24
7	1	035-71312	Servo stem
8	2	035-70819	Orifice screw
9	1	035-70548	Servo plate
10	4	308-40126	Hex hd. screws 7/16-14 x 2-1/4
11	4	308-40036	Hex hd. screws 1/4-20 x 1-1/4
12	4	308-40034	Hex hd. screws 1/4-20 x 2 1/4
13	2	488 35-001	Hex socket plug SAE-4
14	2	891 00804	O-ring 90-6290-4
15R	1	035-70572	Right side chamber cover CW Rot.
	1	035-70812	Right side chamber cover CCW Rot.
15L	1	035-70571	Left side chamber cover CW Rot
	1	035-70574	Left side chamber cover CCW Rot.
16	4	324 21824	Dowel pin 1/4 x 1⅛
17	2	035-70570	Chamber
18	2	808-25036	Seal
19	4	701-16001	Steel ball 3/16 H.S.G.
20	1	515-41298	Cradle assembly
20a	1	035-70510	Rocker cradle
20b	4	325-16120	Roll pins 3/16 x 3/4
21	4	035-71298	Vane spring
22	4	035-71301	Holddown vane
23	2	515-40295	Vane seal cartridge
23a	2	035-70802	Seal backup plate
23b	1	035-70501	Vane seal
23c	1	891 00120	O-ring 90-914-20
23d	1	035-70519	Spacer
23e	1	035-70803	Check valve
24	1	515-45641	Rocker cam assembly
25	2	035-70524	Pressure tube

No.	Qty.	PSP	PTP	
4	1	515-43856	515-42308	Piston & shoe assy. w/retainer
4a	1	035-70521	035-70521	Shoe retainer
4b	7	515-45880	515-42307	Piston & shoe assy. only

Item 6 thru 24 can be ordered as a complete Rocker Cam & Control Stroking Assembly
515-42307 is for RH pumps w/B suffix (input control on right hand side)
515-42410 is for LH pumps w/B suffix (input control on right hand side)
515-42411 is for RH pumps w/A suffix (input control on left hand side)
515-42412 is for LH pumps w/A suffix (input control on left hand side)

Position the cradle and cam assembly with the piston and shoe assembly attached with T marked on the cradle turned up.

Insert tube line assemblies (3) and (4) in the holes provided in cradle.

Position the mounting flange (7) with the large open end up, and install two dowel pins (6) in the cradle mounting surface of the flange and two dowel pins (6) in the outer edge of the flange.

Install rocker cam and cradle assembly over the two dowel pins (6) in the mounting flange. Be certain that cradle is seated over the pins and against the flange with the tube lines (3) and (4) in the grooves in the flange.

Position the mounting flange with the rocker cam assembly on the top or bottom side and install two or more ¼-20 x 1¼ screws through the seal retainer area into the cradle. Be certain the cradle is fully seated in flange. These screws are required to hold the rocker cam assembly in place and will be removed later.

Return the assembly to an upright position with the mounting flange down.

Tilt the rocker cam to either extreme position in the cradle.

Position the Barrel Assembly with Auxiliary Shaft (1) directly over the pistons. Start with the upper-most piston and guide them one at a time into the barrel. Return the rocker cam to a level position in the cradle.

PARTS LIST FOR FIGURE 4

No.	Qty.	Part No.	Description
1	1	See Fig. 2	Barrel and Auxiliary Shaft Assy.
1	2	035-70524	Pressure Tube
3	1	S15-42402	Tubing Assy. (right side)
4	1	S15-42403	Tubing Assy. (left side)
5	1	See Fig. 3	Rocker Cam and Stroking Assembly
6	4	324-22412	Dowel Pin 3/8 x 3/4
7	1	035-70604	Mounting Flange

Fig. 5 S15-42335 HOUSING ASSEMBLY

No.	Qty.	Part No.	Description
1	1	035-71284	Housing
2	1	035-70580	Bearing
3	4	324-21608	Dowel Pin
4	2	325-16280	Roll Pin
5	1	691-00912	O-Ring 90-6290-12
6	1	488-35014	Hollow Hex Plug SAE-12

PARTS LIST FOR FIGURE 6

No.	Qty.	Part No.	Description
1	2	035-49825	Face Plate Pins
2	1	035-71530	Barrel Face Plate 6 in^3 only
	1	035-71264	Barrel Face Plate 7.25 in^3 only
3	1	035-70576	Housing Gasket
4	1	See Fig. 4	Housing Assembly

Item 2 – Reference only
Arcuate Port Width
6 in^3 is 13/32
7.25 in^3 is 15/32

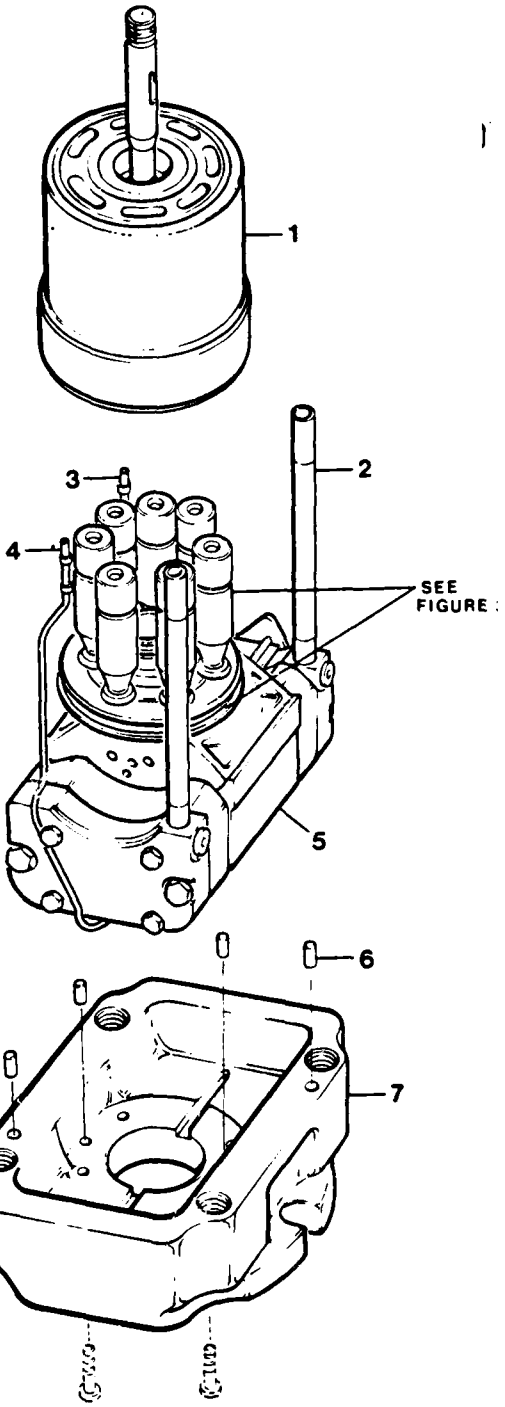


FIGURE 4

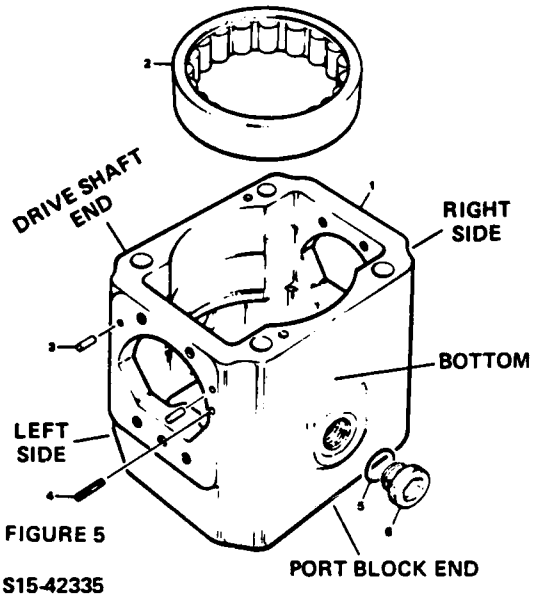


FIGURE 5

S15-42335
HOUSING ASSEMBLY
See Figure 5

1. Position housing (1) on a clean flat surface with the large open end up.
2. Position bearing (2) in the housing bore. Insert Pressing Plug tool (figure T-4) in the bearing. With a smooth and steady force, press the bearing into the housing bore until seated. DO NOT HAMMER OR BEAT INTO PLACE.
3. Turn housing (1) on side and install roll pin (4) in the ¼" through hole in the control cover pad. The pin must be 3/8" below the pad surface. THE PIN END MUST NOT INTERFERE WITH THE INTERNAL BEARING CAGE. Install two dowel pins (3) in the blind holes in the same pad.
4. Repeat operation 3 on the opposite side of the housing.
5. Place O-ring (5) on plug (6) and install the hollow hex plug (5) in bottom of housing (1). (Roll pins (4) are in bottom half of housing.)

ASSEMBLY FOR PARTS IN FIGURE 6

1. Insert the two face plate pins (1) in the holes provided in the barrel face.
2. Apply heavy grease to the face of the barrel and install the face plate (2) over the pins (1) in the barrel.
   Make certain the plate is properly seated on the barrel and pins.
3. Install gasket (3) over the two dowel pins (item 6 on Fig. 4) in the mounting flange.
4. Position the Housing assembly (4) over the Barrel and Auxiliary Shaft assembly and carefully guide the pressure tubes and tube lines (items 2, 3 and 4 on Fig. 4) through the Housing assembly (4).

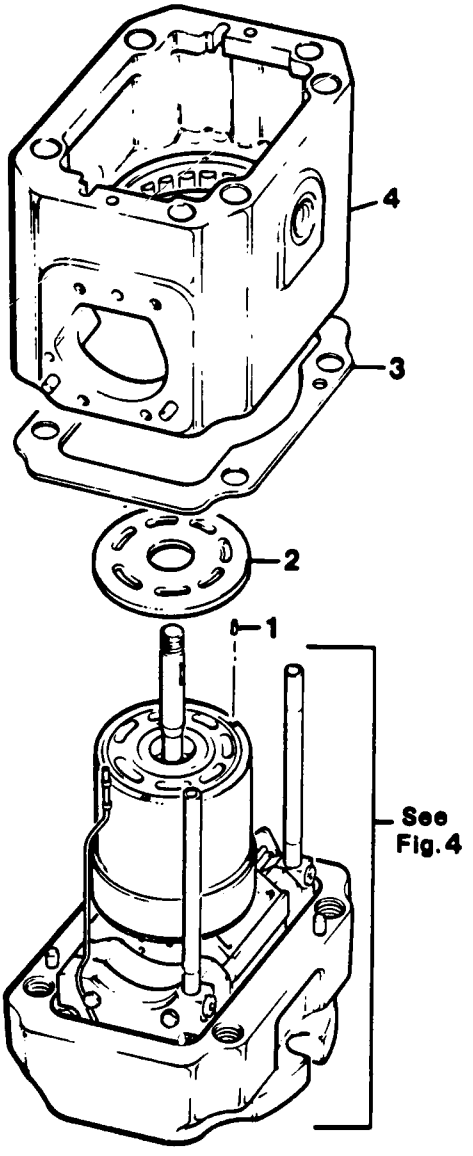


FIGURE 6

S15-42386
PORT BLOCK ASSEMBLY
Figure 7

1. Position the port block (1) on a clean flat surface with the two open ports up. THE OPPOSITE FACE MUST NOT BE SCRATCHED OR DAMAGED. Position needle bearing (2) on tool (Figure T-5) with the marked end of the bearing against the shoulder on the tool and press the bearing (2) into the port block. The bearing must be .010-.025 below the surface.
2. Compress ring checks (3) and slip into the two 1.50" ports and align holes in the ring with the side holes in the port wall.
3. Place lock washers (6) on special screws (5). Insert (5) through port wall and drilled holes in checks (3) and thread into clamps (4). Torque to 10 ft. lbs.
4. Thread socket pipe plugs (8) into port block.
5. Thread two check valve assemblies (7) into valve face of port block.
6. Place O-ring (10) on hollow hex plug (9) and thread into tapped hole in top of the port block.

MOUNTING PORT BLOCK ASSEMBLY
See Figure 8

Position the pump with the unplugged hole in the housing assembly at 12 o'clock.

Install gasket (5) on the housing assembly (6).

Install the two special pins (3) in the face of the Port Block Assembly. Apply petroleum jelly or heavy grease to the steel side of the port plate (4) and position port plate over the pins (3) on the port block.

Slide the Port Block Assembly and port plate over the end of the auxiliary shaft. Be certain that tubes 2, 3 and 4 as shown on Fig. 4 are seated and that the port plate (4) is still on the pins (3).

When the pump is properly assembled, the valve mounting surface will be at the top of the unit.

Install the four bolts (1), and torque to 150 ft. lbs.

CAUTION

USE CARE TO PREVENT DAMAGE TO THE VALVE MOUNTING SURFACE WHILE INSTALLING AND TORQUING THE TWO TOP BOLTS

S15-42386 PORT BLOCK ASSEMBLY

No.	Qty.	Part Number	Description
1	1	035-71296	Port block
2	1	230-82146	Needle bearing
3	2	035-70502	Check ring
4	2	035-70489	Clamp
5	2	035-70908	Special screw
6	2	348-10016	No. 10 Lock washer
7	2	S15-40266	Check valve assy. (3/8-24 ext. thrds.)
8	2	431-90404	1/4" Soc. pipe plugs
9	1	488-35041	Hollow hex plug SAE-6
10	1	691-00906	O-ring 90-6290-6

PARTS LIST FOR FIGURE 8

No.	Qty.	Part Number	Description
1	4	306-40056	Hex head cap screw 5/8-11 x 9
2	1	S15-42386	Port block assembly
3	2	035-49825	Port plate pins
4	1	035-71526	RH port plate 6 in^3 only
	1	035-71525	LH port plate 6 in^3 only
	1	035-71265	RH port plate 7.25 in^3 only
	1	035-71266	LH port plate 7.25 in^3 only
5	1	035-70577	Housing gasket
6	1	S15-42335	Housing assembly
7	1	See Fig. 4	Mounting flange

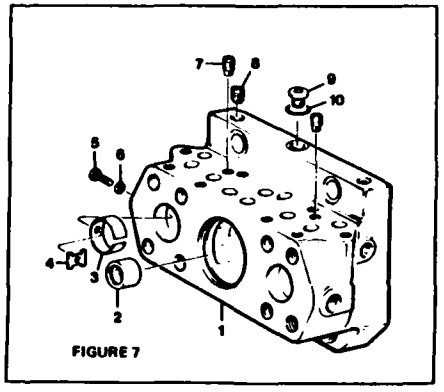
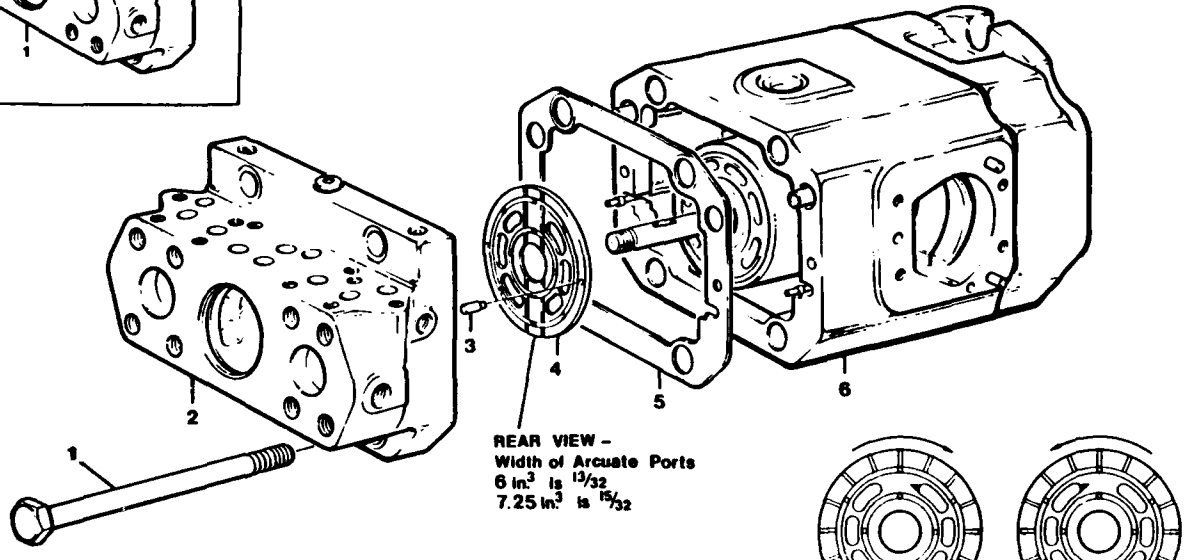
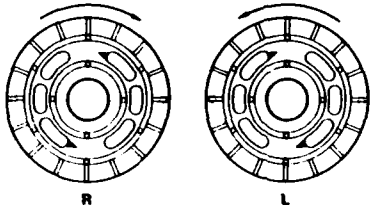


FIGURE 7



REAR VIEW –
Width of Arcuate Ports
6 in.^{3} is $^{13}/_{32}$
7.25 in.^{3} is $^{15}/_{32}$



FRONT VIEW of
PORT PLATE

FIGURE 8

GEROTOR AND BARREL HOLDDOWN
FIGURE 9

Position the unit with the shaft in a horizontal position and the valve block mounting surface turned up. Rotate the shaft until the small keyway in the auxiliary shaft is at 12 o'clock.

If pump is being assembled for right hand rotation (facing coupling shaft end) install dowel pin (4) in hole in port block at the 9 o'clock position; if left hand pump, install at 3 o'clock position.

Install side plate (1), steel side first, over dowel pin. Insert key (2) in shaft keyway. Install the inner gear of the gerotor assembly (3b) on the shaft and over the key (2). Install the eccentric ring (3a) on the dowel pin (4). Install the large outer gear of the gerotor assembly (3b) inside the eccentric ring (3a) and over the inner gear.

Press needle bearing (5b) into gerotor side plate (5a) with the marked end of the bearing against the pressing tool (T-5).

The marked end of the bearing must be .010 to .025 below the lapped face of the inside plate.

If the dowel pin hole in the side plate will be the 9 o'clock position, then the 6-32 screw (6) must be at the 7 o'clock hole in the plate. If the plate is installed at the alternate position, then the screw must be located at 8 o'clock. The unplugged hole in the side plate must be at the uppermost position.

Place O-rings (7) and (8) on side plate assembly. Lubricate the O-rings and slip the pressure plate (9) over the O-rings on the side plate assembly. Slip the two plates over the auxiliary shaft and position the gerotor side plate over the dowel pin (4).

Place seal ring (12) on auxiliary shaft. Position bearing (11) between the two thrust washers (10) and install around the seal ring. (12). Thread holddown nut (13) on the shaft and tighten. No more than 10 ft. lbs. max. Back off the nut (13) until *second slot* is aligned with cotter pin hole in the shaft. Insert cotter pin (14) through nut and shaft and bend one tang over the end of the shaft.

Check the main shaft for smooth rotation. If not smooth, check the gerotor parts for position and holddown nut for forces.

Place O-ring (16) on end cover (15) and lubricate. Place end cover over holddown nut (13). Depress cover and install snap ring (17). Make certain that snap ring is properly seated in groove.

PARTS LIST FOR FIGURE 9

No.	Qty.	Part Number	Description
1	1	035-71492	Side plate
2	1	211-22034	Square key 1/8 x 9/16
3	1	S15-43334	Gerotor and eccentric ring assy.
3a	1	035-71501	- Eccentric ring
3b	1	035-71500	- Inner and outer gerotor
4	1	324-21225	Dowel pin 3/16 x 1-9/16
5	1	S15-43384	Gerotor sideplate and bearing assy.
5a	1	035-71491	- Sideplate
5b	1	230-82146	- Needle bearing BH 1212
6	1	311-06030	Soc set screw 6-32 x 3/16
7	1	671-00144	O-ring 70-914-44
8	1	671-00129	O-ring 70-914-29
9	1	035-70531	Pressure plate
10	2	350-10065	Thrust washer
11	1	230-82131	Bearing NTA-1625
12	1	035-71490	Seal ring
13	1	035-70496	Holddown nut
14	1	322-03320	Cotter pin 3/32 x 1
15	1	035-70535	Solid cover
	1	035-70989	Cover w/SAE-16 inlet
16	1	671-00147	O-ring 70-914-47
17	1	356-65082	Internal snap ring Eaton IN287

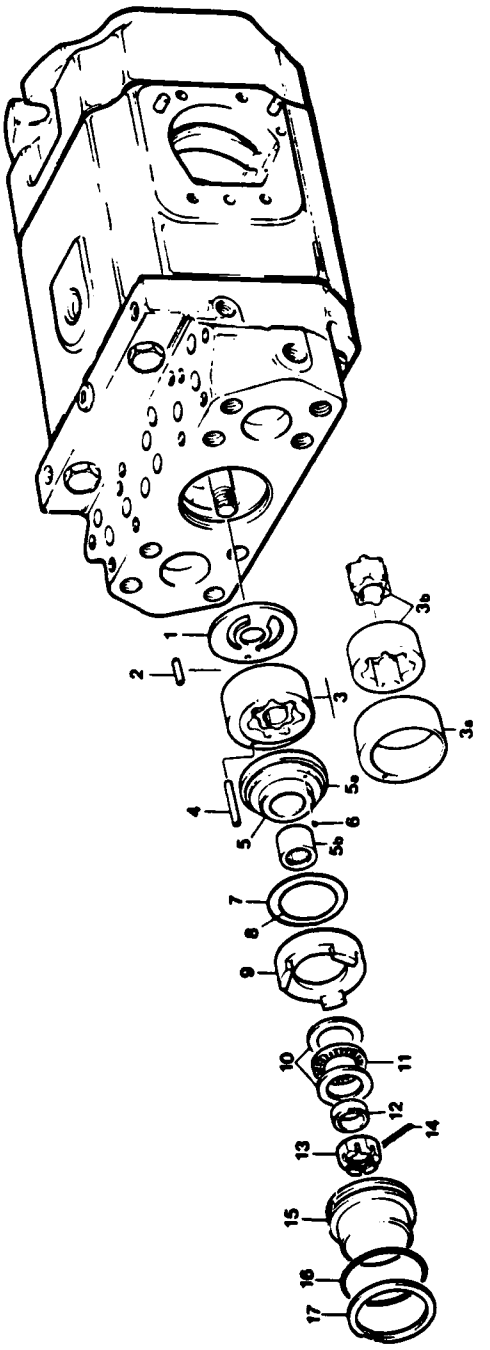


FIGURE 9

S15-45542
VALVE BLOCK ASSEMBLY
FIGURE 10

Lubricate the four orifice plugs (12) and insert in the top of valve block (11).

Check the Pilot valve assembly (41) to be certain that approximately 1⅛ threads are exposed from the small nut on the bottom of the valve assembly. This setting will allow the valve to function at about 100 PSI. Each complete right hand turn of this screw will increase the pressure about 25 PSI. Thread the check valve (41) into the 3/8-24 tapped hole into the valve block (11) as shown.

Press the two dowel pins (10) into the holes provided in the bottom of the valve block (11). The pins (10) must be .12 below the surface.

Place the two sequence seats (8) in the sequence ports SB and SA and the four valve seats (9) in four remaining ports (RB, RA, RV and Servo). Position the gasket (7) and retainer plate (6) over the seats and insert the four screws (4) in the block (11). Torque to 10 in. lbs.

Position the valve block and the attached parts with four orifices (12) turned up. Insert the two 1-7/16 long springs (17) in the two sequence poppets (13) and install (13) and (17) in the block and over the sequence seats (8) in ports SB and SA. Install the four valve poppets (14) in the ports marked RB, RA, RV and Servo. Insert spring retainer (15), large end first, in the Servo poppet. Insert the light weight spring (18) 1½" long in the RV poppet. Insert the three 1" long springs (16) in poppets RB, RA and Servo.

Lubricate the two check valves (19) and install in sides of cover (21). Install the two orifice plugs (20) in the bottom of the cover after the valves (19) are in place and NOT BEFORE.

Lubricate O-ring (22) and place on seat (23) and install in valve cover (21). Use a ½" 6 point ¼" drive socket. Lubricate O-rings (26) and (28) and place on parts (27) and (29). Assemble parts 30, 32 and 33 on (31) and start (31) into housing (29). Push seal piston (27) and O-ring (26) into housing (29) with the small end of the piston exposed. Place spring (25) on cone (24) and insert all these parts in the valve cover (21). Be certain that cone (24) enters seat (23).

Remove the 8-32 nut from Strainer assembly (34) Insert the Strainer assembly in the largest hole in cover (21). Push the 8-32 threads thru the small drilled hole in bottom and attach the 8-32 nut under the cover. Lubricate O-rings 37 & 38. Install (37) in the block (11) and two of (38) in the cover.

Position the cover (21) over the springs and poppets and install the four screws (39). BE CERTAIN THAT THE SPRINGS ARE IN THE RIGHT POSITION BEFORE TIGHTENING THE SCREWS.

Install dowel pin (40) in the hole over the Servo poppet. Lubricate the four O-rings (42) and place on the four plugs (43). Install the four plugs. Lubricate O-ring (35) and place on plug (36) and install.

Invert the complete assembly and install roll pins (5) thru plate (6) and into the valve block. Install O-rings 1, 2 and 3 in the plate (5).

PARTS LIST FOR FIGURE 10
S15-45542 Valve Block Assembly

No.	Qty.	Part Number	Description
1	1	671-00050	O-ring 5-1/4 x 5-1/8
2	2	671-00014	O-ring 70-914-2
3	2	671-00013	O-ring 70-914-1
4	4	353-25023	10-24 x 1/2 Button hd screw
5	2	325-08120	1/8 x 3/4 Roll pin
6	1	035-71322	Retainer plate
7	1	035-70585	Lower gasket
8	2	035-70507	Sequence seat
9	4	035-70500	Valve seat
10	2	325-12120	3/16 x 3/4 Roll pin
11	1	035-71324	Valve block
12	4	035-13786	.036 Orifice plug
13	2	035-70831	Sequence poppet
14	4	035-70830	Valve poppet
15	1	035-70482	Spring retainer
16	3	035-71086	Spring (1 OAL)
17	2	035-70512	Spring (1-7/16 OAL)
18	1	035-22141	Spring (light weight)
19	2	S15-40266	Check valve assembly
20	2	035-13786	.036 Orifice plug
21	1	035-71323	Valve cover
22	1	691-00903	O-ring-6290-3
23	1	035-70608	Seat
24	1	035-12288	Cone
25	1	035-70832	Spring
26	1	671-00012	O-ring 70-6227-7
27	1	035-21767	Seal piston
28	1	691-00910	O-ring 90-6290-10
29	1	035-70545	Housing
30	1	333-13100	5/16-24 Hex nut
31	1	312-13200	5/16-24 x 1-1/2 Soc set screw
32	1	312-09041	10-32 x 1/4 Soc set screw
33	1	035-24504	Control knob
34	1	S15-43240	Servo strainer assembly
35	1	691-00906	O-ring 90-6290-6
36	1	488-35003	Hex plug SAE-6
37	1	671-00050	O-ring 5-1/4 x 5-1/8
38	2	671-00117	O-ring 70-914-17
39	4	306-40167	Hex hd cap screw 10-24 x 1-3/4
40	1	324-20812	1/8 x 3/4 dowel pin
41	1	S15-41219	Pilot relief valve assy.
42	4	691-00904	O-ring 90-6290-4
43	4	488-35001	Hollow hex plug SAE-4

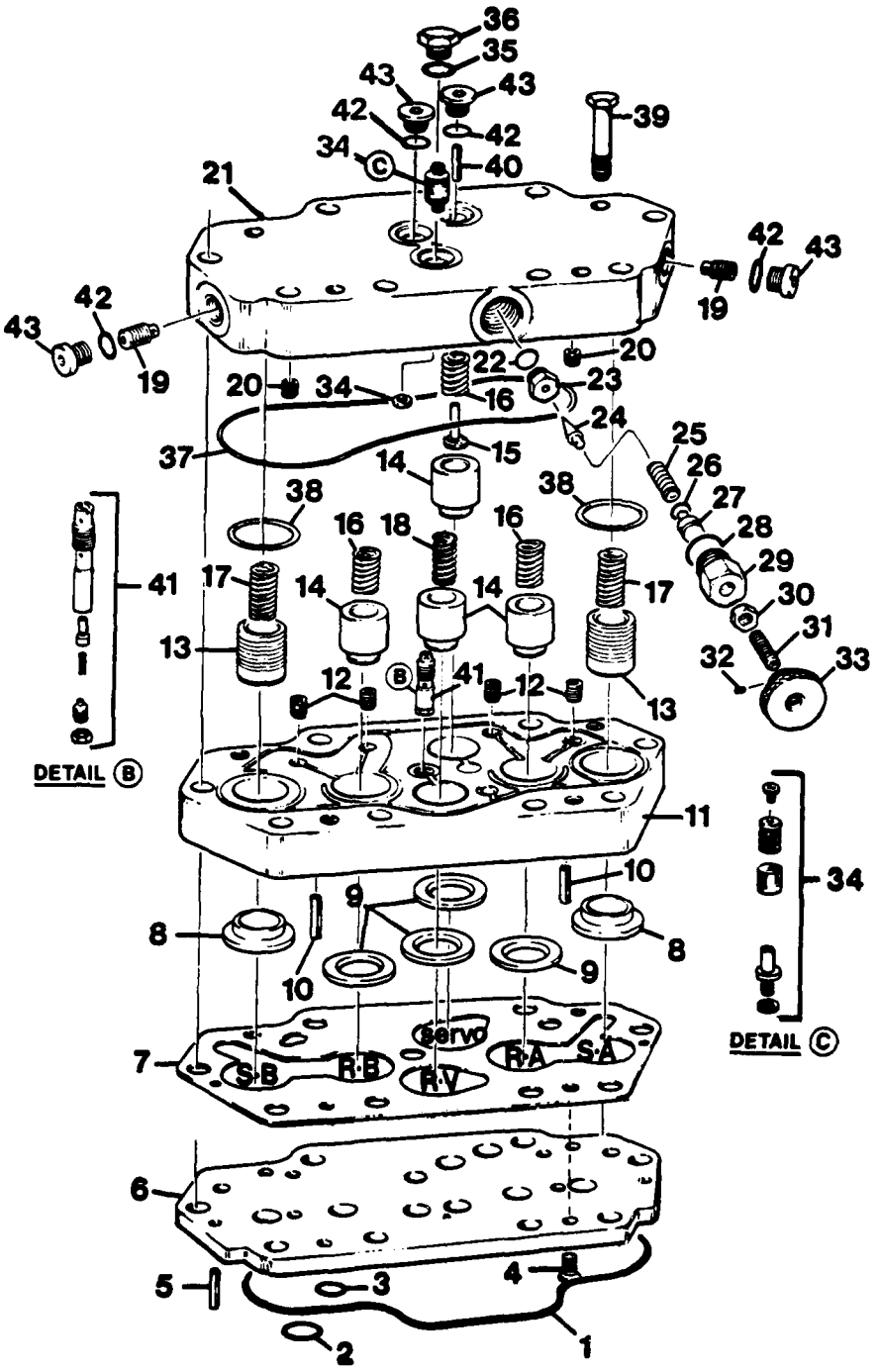

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FIGURE 10

SHAFT AND SEAL INSTALLATION

Stand the pump in an upright position with the port block inlet and outlet pads turned down. Remove the two ¼-20 x 1¼" screws that were temporarily used to hold the cradle in the mounting flange. Install the Shaft and Bearing (1) assembly in the mounting flange and cradle. Be certain that there are no burrs or sharp edges on shaft seal area of the shaft.

Install the nylon bearing spacer (2) around the shaft bearing if the unit is to be used on an application that requires a floating shaft. If the unit is used on a rigid application, use the metal tolerance ring (2) around the bearing.

Install the snap ring (3) in the mounting flange to retain the Shaft Assembly. Be certain that the ring is fully seated in the groove.

SEAL ASSEMBLY

The seal assembly (4) is available as a complete unit only.

CAUTION

(Before installing the seal assembly examine all the parts. The lapped seal seat and the carbon ring have a precision finish that must be handled with care. Be certain that both parts are free of scratches, marks and cracks.)

Place the spring retainer (e) over the shaft and against the retaining ring on the shaft assembly. Place the spring (d) against the retainer (e). Apply oil to the inner surface of the rubber friction ring (f) and position the shell containing the rubber friction ring (f) and carbon ring (c) over the shaft with the carbon ring exposed. Apply heavy grease to the square section rubber seal (a) and install on the cast iron seat (b). Insert the seat and seal in the seal retainer (8) with the lapped side of the seat in position to contact the carbon ring. Place the seal retainer assembly and gasket (5) over the shaft with the lapped surface against the carbon face. Place the four gaskets (7) on the four screws (8) and insert in the seal retainer (6). Depress the seal retainer only far enough to start the four screws and tighten evenly. Torque to 10 ft. lbs.

COUNTER-BALANCE SERVO STEM ASSEMBLY

Place the two spacers (11) on the two screws (12) and insert through the balance plate (10) and servo stem (9).

Insert these parts through the opening in the side of the housing assembly and position the screws over the two 10-24 tapped holes in the rocker cam.

Hold these parts against the cam and alternately tighten the screws (12) to hold the assembly firmly in place. Torque screws to (5) ft. lbs.

PARTS LIST FOR FIGURE 11

No.	Qty.	Part Number	Description
1	1	S15-41805	No. 1 Splined Shaft Assy. See Fig. 1
	1	S15-41806	No. 2 Keyed Shaft Assy. See Fig. 1
2	1	035-70492	Nylon Bearing Spacer
	1	605-10028	Tolerance Ring
3	1	356-30250	Retaining Ring
4	1	623-00006	Shaft Seal
5	1	035-70549	Seal Retainer Gasket
6	1	035-70516	Seal Retainer
7	4	631-45003	Nyltite Gasket
8	4	353-25019	¼-20 x 1-¼ Hex Washer Hd Screw
9	1	035-71312	Servo Plate
10	1	035-70546	Balance Plate
11	1	035-71247	Spacer
12	2	358-10300	10-24 x 2-¼ Soc. Hd Cap Screw
13	8	631-45007	*Nyltite Washer*
14	8	353-25018	3/8-16 x 1-¼ Hex Washer Hd Screw
15	1	S15-42064	Output Balance Control Assy.
16	1	S15-42073	Input Servo Control Assy.
16a	1	S15-29565	- Shaft and link assy.
16b	1	671-00012	- O-ring 70-6227-7
16c	1	679-00004	- Glyd ring 12547-013
16d	1	035-70525	- Shear seal (plate side)
16e	2	671-00017	- O-ring 70-914-5
16F	2	350-10067	- Wavy washer
16g	1	035-71371	- Shear seal (cover side)
16h	1	230-82141	- Thrust bearing NTA-916
16j	1	356-65070	-Retaining ring Waldes 5144-50
16k	1	431-90204	- 1/8 Soc. pipe plug
16l	1	671-00017	- O-ring 70-914-5
16m	1	671-00048	- O-ring 4-¾ x 4-7/8
16n	1	035-70614	- Cover
16p	2	325-12120	- 3/16 x 3/4 roll pins
17	8	306-40169	3/8-16 x 3¼ Hex Hd Cap Screw

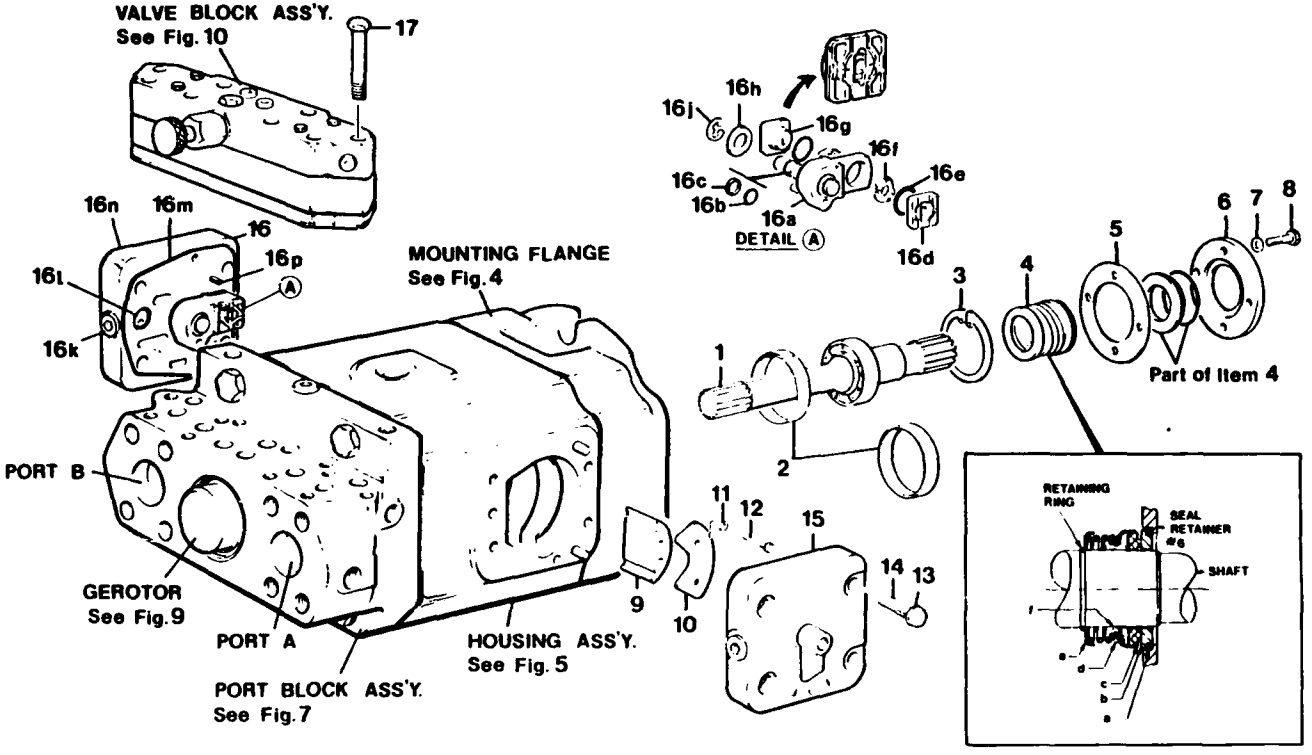

VALVE BLOCK ASS'Y.
See Fig. 10
17
16h
16j
16g
16f
16c
16b
16a
DETAIL (A)
16e
16d
16n
16m
16
16p
16l
16k
MOUNTING FLANGE
See Fig. 4
3
4
5
6
7
8
Part of Item 4
1
2
PORT B
GEROTOR
See Fig. 9
PORT A
PORT BLOCK ASS'Y.
See Fig. 7
HOUSING ASS'Y.
See Fig. 5
9
10
11
12
15
14
13
RETAINING RING
SEAL RETAINER
SHAFT

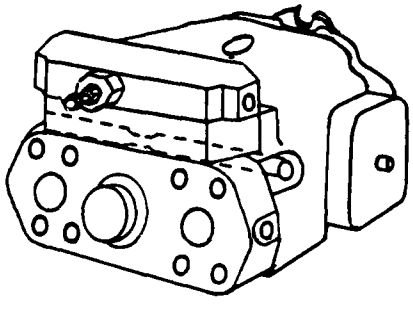
FIGURE 11

INSTRUCTIONS FOR REPLENISHING CIRCUIT ISOLATION PLUG

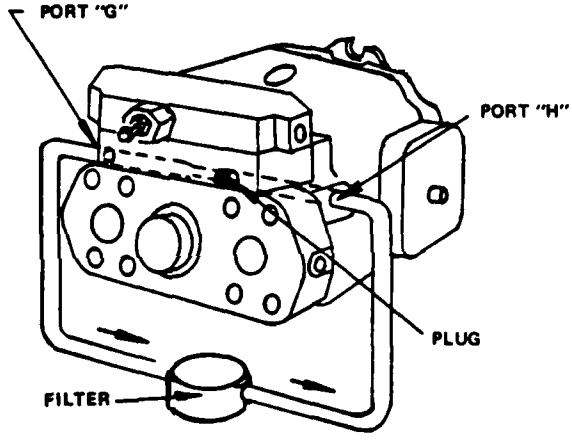
CAUTION
The isolation plug enclosed is to be used ONLY if an external filter circuit is provided. DO NOT operate this unit with the isolation plug installed unless an external line has been provided.

When the external filter circuit is NOT used discard the isolation plug.

When the external filter circuit IS used install the isolation plug between port G and H (refer to appropriate installation drawing): use a 3/16 Hex. wrench by 4" minimum length inserting the isolation plug into port H and tighten to 80 - 120 in.-lb. torque.



WITHOUT FILTER
No Plug



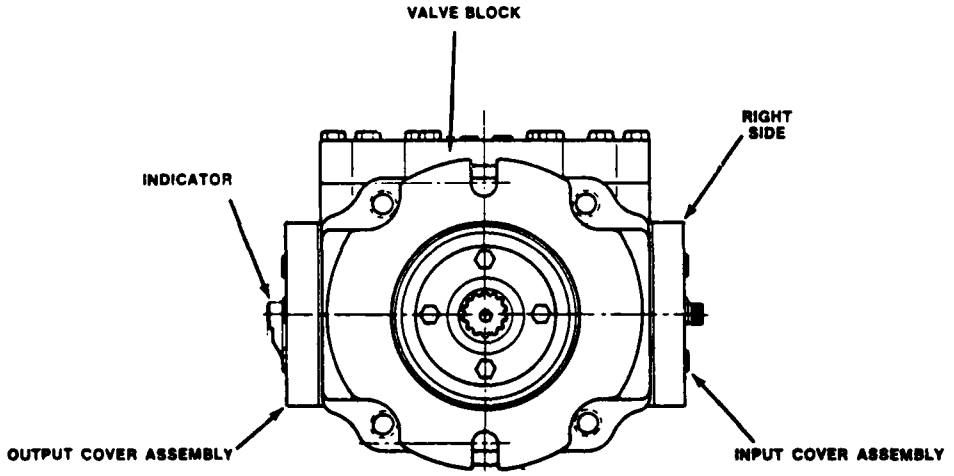
EXTERNAL FILTER
with Plug

IMPORTANT
Instructions for replenishing
Circuit Isolation Plug

CONTROL COVER ASSEMBLIES
S15-42073 Input and S15-42064 Output
See Figure 9

1. Apply thread sealant and install the 1/8" pipe-plugs (16k) in the cover plates (16n). Install the two roll pins (16p) in the two 3/16" holes provided in one cover. (Input cover only.)
   ROLL PINS (16p) ARE NOT REQUIRED IN COVER USED ON THE OUTPUT. SIDE. (S15-42064)
2. Position assembly tool (Thimble) Figure T-7 over the end (tapped hole end) of the servo shaft in the Link and Servo Shaft Assembly. Lubricate O-ring (16b) and slide over the Thimble and install in second groove in the servo shaft. Slide glyd ring (16c) over the Thimble and position on the O-ring (16b). Remove the Thimble and form the glyd ring (16c) on the O-ring (16b) with Tool Figure T-6.
3. Lubricate the O-rings (16l) and install one in the groove on each of the four shear seals Install the shear seals and O-rings in servo stem with the two spring washers (16f) positioned between the parts. Be certain that the shear seals are installed straight and are seated against servo links.
4. Slide thrust bearing (16h) over servo shaft and against the servo link. Push the servo shaft through the cover with the shear seals positioned between the roll pins (16p) on the input cover or roll pin holes on the output cover. Install snap ring (16j) in the groove of the servo shaft extending through the cover plate.
5. Position the indicator over the servo shaft with the pointer line on the indicator in line with the scribed line on the shaft and pointing toward the "FOF" marks on the cover. Support the opposite end of the shaft and install the indicator on the shaft.
   OMIT STEP 5 COMPLETELY ON THE INPUT COVER ASSEMBLY.
6. Lubricate O-rings (16l) and (16m) and install in counterbore and groove in the covers.
7. Position the Cover Assemblies over the two dowel pins on the housing pads and insert the four screws (14) with the seals (13) on the screws. Torque to 30 ft. lbs.

The Input Cover Assembly must be installed on the *right hand side* of the housing on pumps with "B" suffix. Install the Output Cover Assembly on the *right hand side* on models with the "A" suffix.



Shaft end view of pump

COVERS ARE SHOWN IN POSITION FOR STANDARD PUMP

Covers and the internal Servo assemblies must be reversed for models with "A" suffix.

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DYNEX REMOTE PROPORTIONAL ACTUATOR

REPAIR INSTRUCTIONS

The following instructions will aid in the dis-assembly, inspection of parts and re-assembly of the Dynex Remote Proportional Actuator.

We suggest reading the following instructions to become familiar with the correct procedure before proceeding with a repair. For ordering information refer to the Repair Parts Sheet and Parts List.

Filter

A Filter (22) is provided to protect the Actuator in the event of dirt entering the Hydraulic System. This is sized only to protect the Actuator and should not be regarded as the Main System Filter. A 10 micron absolute - non-bypass external filter should also be provided in the system.

The filter is designed to collapse when the pressure differential across the element becomes excessive. This prevents the collected particles from being introduced into the Actuator.

The Filter should be removed and inspected at regular intervals and if damage is evident the element should be renewed.

To remove the Filter, unscrew the Filter Cap (18) allowing the Filter Element (22) to be removed. When replacing the Filter, make certain the Spring (21) and Seal (23) are in position.

Dis-Assembly for Visual Inspection

Remove Actuator from machine, turn ports down to drain oil and place the Actuator on a clean bench. Proceed carefully, referring to these instructions to insure against any unnecessary damage to the parts. Parts can only be removed in the correct sequence.

The position of the Force Motor (1) determines the null position of the Output Rod (29), therefore, the motor must be screwed into the same position on re-assembly. Before unscrewing, mark the position of the motor and count the number of threads exposed. To remove the Force Motor (1), loosen the set screw securing it and unscrew the motor from the actuator body.

Remove the following items next. Spring (3), Pilot Spool (4), Pilot Sleeve (5) and Spring (6). The Pilot Spool and Sleeve must be treated with extreme care to prevent damage to the lands on the spool and aperture in the sleeve. The Plug (7), Spring (8) and Feedback Cone Assembly (9) can now be removed.

Next remove the Circlip (17) and Plug (20). The Plug can be pushed out using the Output Rod (29). The Output Rod should only be removed through the rear end of the unit as there is a lead-in for the Piston Rings (26) to prevent damage to the rings.

Circlip (13) can now be removed and Gland (10) complete with seals is pushed out

Examine all parts and seals for wear and any damaged items should be replaced.

Assembly

Clean parts thoroughly and re-assembly as follows.

Replace Plug (20) and insert Circlip (17). Replace Output Rod (29) through the front end of the unit and carefully fit the Gland Assembly (10), complete with seals, over the output rod. Push the Gland into position and replace the Circlip (13).

Replace the Feed Cone Assembly (9), Spring (8) and Plug (7). Tighten the Plug.

Next fit the Spring (6) into the Sleeve (5) and carefully insert the Spool (4) into the Sleeve. Ensure the Spool is correctly positioned as shown on the drawing. Insert the Spring (3) and screw the Force Motor (1) into the Actuator Body to its original factory set position.

Before tightening the set screw securing the Force Motor the Actuator should be re-connected to the hydraulic circuit to set the precise position of the Force Motor. With the Actuator in the null position (i.e. no electrical connection to the Force Motor) the Output Rod should be in the mid stroke position.

If the Rod is retracted in the null position, the force motor should be slowly unscrewed from the Actuator Body until the output rod moved forward. By very careful adjustment of the Force Motor position the point is reached where the Rod is in mid stroke position.

If the Rod is extended in the null position the Force Motor should be slowly screwed further into the Actuator Body until the mid stroke point is reached.

When the null position has been set, the Force Motor is locked in position by tightening the set screw in the Actuator Body. Electrical connections are now made to the terminals on the Force Motor.

DYNEX

PARTS LIST FOR DYNEX REMOTE PROPORTIONAL ACTUATOR

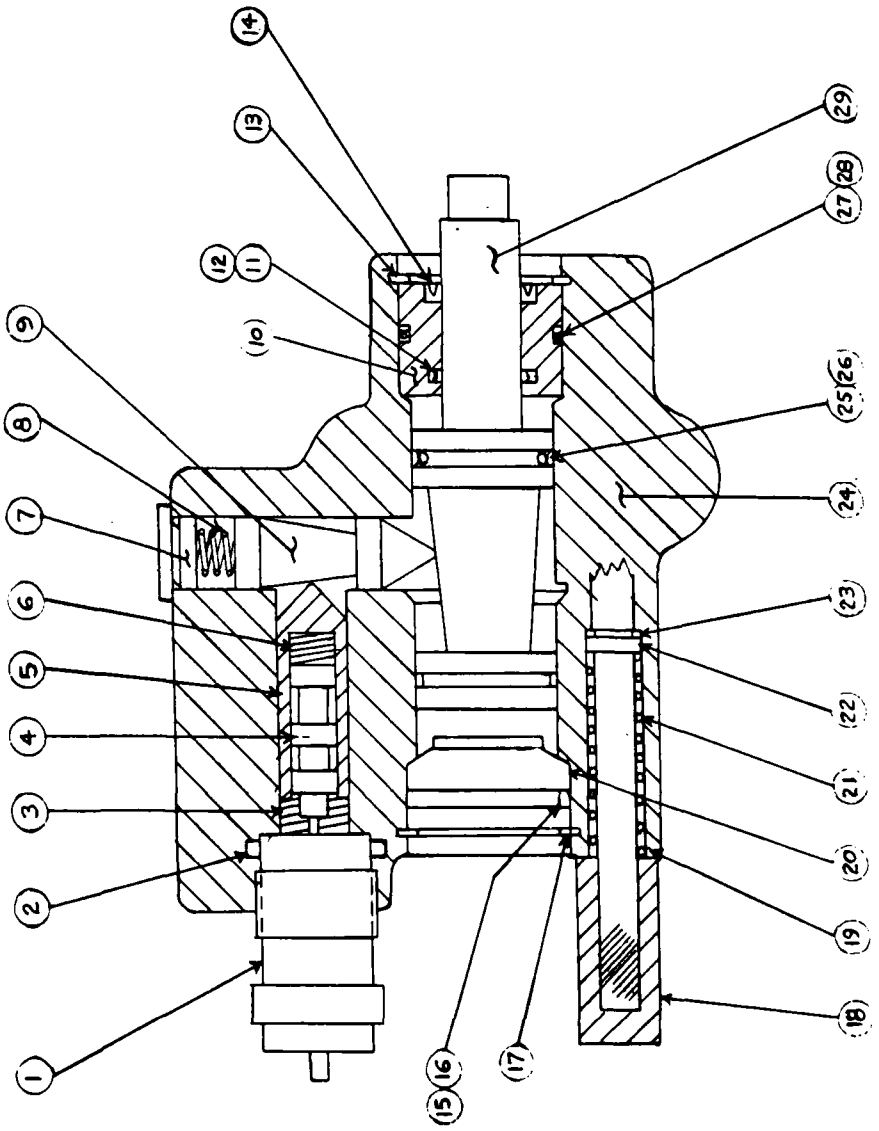
MODEL SA0505-03-00

	PART NUMBER	QUANTITY	DESCRIPTION
1	B5044.900	1	Force Motor Assembly
2	B1232.503	1	O'Ring
3	A5007.110	1	Spring
4	C5002.617	1	Pilot Spool
5	A5022.900	1	Sleeve Assembly
6	A5006.110	1	Spring
7	A1008.006	1	Plug
8	A5008.110	1	Spring
9	A5021.900	1	Feedback Cone Assembly
10	B5006.019	1	Gland
11	A5006.476	1	Seal
12	B1254.503	1	O'Ring
13	A1008.049	1	Retaining Ring
14	A5000 476	1	Wiper Ring
15	A5006.562	1	Back-up Ring
16	B1230.503	1	O'Ring
17	A1008.049	1	Retaining Ring
18	B5001.098	1	Filter Cap
19	B1908 503	1	O'Ring
20	A5002.006	1	Plug
21	A5009.110	1	Spring
22	A8031.018	1	Filter
23	A5000.037	1	Gasket
24	E5001.190	1	Body
25	B1226.503	2	O'Ring
26	Z5007.476	2	Piston Ring
27	A5006.562	1	Back-up Ring
28	B1230.503	1	O'Ring
29	C5004.107	1	Output Rod

WHEN ORDERING PARTS PLEASE INCLUDE THE ACTUATOR MODEL NO. AND SERIAL NO.

ACTUATOR

MODEL SA 0505-03-00



MILLER FLUID POWER DIVISION
7N015 York Road
Bensenville, Illinois

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR MILLER AIR AND HYDRAULIC CYLINDERS

GENERAL PRECAUTIONS: Cylinders which have been in storage for some time should be lubricated and cycled several times before they are installed on machines and subjected to actual working loads. Excessive breakloose and cycling pressures indicate the cylinder may have been damaged during shipment or storage. Costly installation and removal time can be eliminated by following this procedure. Cylinders should be stored in a vertical position with the piston rod up.

A Miller air or hydraulic cylinder is a precision piece of equipment, and therefore, it is recommended that the cylinder be removed from the machine and taken to a general repair area where suitable tools, repair and testing facilities are available.

Dirt protector plugs should be kept in cylinder ports whenever the pipe fittings are removed or while cylinder is in storage. This prevents dirt and other foreign material from entering the cylinder and damaging moving parts.

Be certain that the connecting pipes and fittings are clean before connecting to the cylinder. All pipe ends should be deburred and the insides of the pipe cleaned of scale, rust, dirt, and foreign matter.

Clean oil is essential to long and satisfactory operation of cylinders, pumps, valves, etc. Keep oil tanks covered as even normal room dust causes premature failure, sticking of parts, and needless repairs to hydraulic systems. Provide an adequate oil filter, preferably a micro filter.

AIR CYLINDER LUBRICATION AND INSTALLATION: Provide an oiler, filter, and water separator in the air line, and use a light mineral oil as a lubricant. Use a pressure regulator to conserve air and provide a smoother action. Save air and obtain a greater speed by installing the valve as close to the cylinder port as possible. Air cylinders can be furnished with a grease fitted rod bushing on request. The grease fitting is threaded into the side of the retainer.

CAUTION: When cylinders require servicing, an additional set of seals should be ordered. The original seals may become damaged in servicing, and this precaution will save time and eliminate costly delays. Generally, it is best to replace all seals unless the existing seals are in excellent condition or this is not economical or possible due to availability.

Any seal can be damaged if forced over threads or sharp metal parts of almost the same size. All burrs and damaged areas should be corrected prior to removing piston rod bushing and rod seal.

Accordingly, care in assembly should be exercised. In the case of a rod wiper and rod seal, a simple shield of thin wrapping paper around the threads will permit easy installation of the seals without damage.

DIRT WIPERS: To remove a dirt wiper without taking the rod bushing off, it is necessary to use a pointed tool as the wiper is lodged firmly. It may be necessary to take the wiper out in pieces. Care should be exercised so that the piston rod will not be damaged in removal of the wiper. A new wiper should always be in serted by using a smooth, blunt tool so that the wiper will not be damaged. Whenever the dirt wiper has a tendency to be blown out, it is an indication that the rod seal is leaking, or in the case of a cylinder equipped with a grease-fitted rod bushing, that an excessive supply of grease has been forced into the grease fitting.

The following step-by-step outline will be a valuable aid to personnel qualified to service precision equipment. By exercising only normal care, which any good workman would accord fine machinery, no undue difficulty will be encountered.

1. Wipe all external surfaces clean. Drain excess oil from hydraulic cylinders. Paint or draw a line on one side of the cylinder running from the cylinder cap to the mounting end of the piston rod. This will serve as a reference line when inspecting components and reassembling the cylinder.

2. VISUAL INSPECTION: Visually inspect all exterior surfaces for evidence of damage, and, in particular, damage to the piston rod. Evidence of rod seal leakage can usually be traced to nicks in the piston rod or misalignment. If a slight nick is noticed in the piston rod, it can often be quickly removed by using a No. 400 grit

emery cloth. The rod should then be wiped carefully for removal of any matter. UNDER NO CIRCUMSTANCES SHOULD COMPRESSED AIR BE USED TO REMOVE FOREIGN MATTER, as this practice may tend to drive such particles into close clearances. Misalignment can often be detected by observing the condition of the piston rods for evidence of excessive wear, polishing, burnishing or scoring on the side of the piston rod. Check carefully the end of the piston rod and the area around the flats on the end of the rod for burrs and nicks. If burrs and nicks are present, remove with a file or emery cloth to avoid damage to the piston rod seal, rod wiper, and bushing during removal.

3. REMOVAL OF BOLTED BUSHING:
   - 3 a. Loosen and remove the cap screws that hold the bushing in the cylinder head. Refer to File 4770.
   - 3 b. Lift out the bushing.
   - 3 c. Use step #5 for removal of rod seals.

4. LOOSENING THE CYLINDER TIE RODS:
   - 4 a. Proceed to loosen the four cylinder tie rods, noting if the tie rods were tightened evenly. It may be necessary, in some cases, to grip the tie rods with vise grips to prevent the tie rod from turning.

5. REMOVAL OF ROD SEAL: Normally the rod seal will come out when bushing is removed. If rod seal remains in cylinder head, raise the cylinder head approximately one inch, and then lower it back into original position. This will expose the rod seal for easy removal (BY NO MEANS USE A TOOL TO PRY OR LIFT OUT THE ROD SEAL FROM THE CYLINDER HEAD). See attached File 2861 or 2862 for rod seal arrangement. Refer to File 4770 for Caged Piston Rod Seal Assembly.

6. REMOVAL OF RETAINER HELD PISTON ROD BUSHING:
   - 6 a. Loosen the cylinder tie rods - NOTE: Refer to step #4.
   - 6 b. Removal of retainer plate: Remove retainer plate, (in some cases, this may be a flange mounting plate.) Model "H" cylinders in 8" through 14" bores have a circular retainer holding the bushing and rod seal assembly in place. Model "A" & "J", 8" through 14" bores have a square retainer holding the bushing and rod seal assembly in place.
   - 6 c. Lift out the piston rod bushing.
   - 6 d. Remove rod seal; Refer to step #5.
   - 6 e. Refer to File 4770 for Caged Piston Rod Seal Assembly.

7. REMOVAL OF CYLINDER HEAD: Remove cylinder head from cylinder. Lift out pressure ring, wave spring and cage. See File 2861 and 2861 for parts arrangement.

7 a. On air cylinder remove only rod seal, no cage assembly is used.

8. REMOVAL OF PISTON ROD AND ASSEMBLY: Remove piston rod and piston assembly from cylinder tubing. (If tubing comes off from cap pilot, merely slide piston assembly off from cylinder tubing).

9. REMOVE TIE RODS FROM CYLINDER CAP.

10. INSPECTION OF INTERNAL PARTS: Inspect all cylinder parts on internal surfaces, noting particularly any evidence of foreign matter. (Retain all foreign matter for future study if necessary.) Examine parts for evidence of misalignment as evidenced by excessive or uneven wear on parts.

11. CONDITION OF PISTON, TUBING, PISTON ROD, ETC.: If piston, tubing, piston rod, or piston rod bushing is damaged, the part should be replaced if available: however, correct if necessary, by removing nicks, burrs and other forms of damage. However, do not remove enough material to change the diameters, thus affecting the clearances and fits.

12. REMOVAL OF PISTON ASSEMBLY: Piston assemblies are staked to prevent the parts from coming loose in operation. If the piston assembly must be taken apart, first grind or drill out the stake marks to facilitate disassembly. When removing the upset material caused by the stake mark, lightly touch the tool being used to the stake area and remove only the upset material. To disassemble single end cylinders, you may insert two dowel pins in the spanner pin holes and use a bar to remove the threaded follower, or in the case of double end cylinders, remove taper pin or set screw and use flats on piston rods to disassemble. An alternate method is to clamp the piston assembly by the faces of the followers in a vise and screw out the piston rod using the flat on the end of the piston rod for turning. (BY NO MEANS CLAMP THE PISTON ON ITS OUTSIDE DIAMETER.) The vise should be equipped with bronze or brass jaw protectors if clamping piston rod on chrome plated area.

12 a. 6" bore "H" cylinder and larger have a one-piece type piston assembly. This piston is removed by drilling or grinding the stake marks and removing the piston the same as described in the previous paragraph.

12 b. The cup seals are removed by removing the cap screws from the circular cup retainer ring on both sides of the piston. NOTE: THERE IS NO NEED OF REMOVING THE ONE-PIECE PISTON FROM THE PISTON ROD IF ONLY THE PISTON CUP SEALS ARE TO BE REMOVED.

RECOMMENDED PRE-STRESS TORQUES
FOR PISTONS AND STYLE NO. 2 PISTON RODS

Cylinder Bores			
Models A, J, C	Model H	Thread Size	Torque Ft. Lbs.
1-1/2, 2, 2-1/2	1-1/2	7/16-20	55
3-1/4, 4, 5	2, 2-1/2	3/4-16	185
6, 8	3-1/4	1-14	375
10	4	1/4-12	690
12	5	1-1/2-12	995
14, 16	6	1-7/8-12	1415
18, 20	7	2-1/4-12	1970
	8	2-1/2-12	5050 *
	10	3-1/4-12	7940 *
	12	4-12	12560 *
	14	5-1/2-12	16275 *

NOTE: * When Molycote is used on threads.

13. REASSEMBLY OF PISTON ASSEMBLY: To assemble the piston cup assembly, first assemble to the rod the piston and followers only and tighten the piston assembly tight, metal to metal. Scribe a diametrical line which is common to both the piston rod and the threaded follower, remove the threaded follower and piston, and then place the piston cups into position. In tightening the threaded follower, it must be tightened to the scribed line on the rod or slightly beyond. To restake a piston assembly, use a sharp center punch wherever possible. Stake marks must be in the thread area to be effective. Staking should be accomplished at three points which are different from the original stake marks.

When installing the piston assembly into the cylinder tubing, the piston assembly should be inserted into the cylinder tube with the aid of a tapered starting ring or with a piston ring compressor so as not to damage the lip of the cup.

13 a. If a tapered ring or compressor is not available, assemble the piston assembly in the tubing as follows:
Install only the plain follower, one piston cup and the piston on to the rod, and insert that portion of the assembly into the cylinder tube, keeping the piston rod as parallel to the centerline of the tube as possible. Push the assembly to the opposite end of the tube to within approximately $\frac{1}{2}$" from the end of the tube, and install the second cup and the threaded follower. The piston assembly is tightened and staked as indicated above. Assembling the piston assembly in the tube eliminates the problem of starting the lip of the cup into the tubing, and this alternate method of assembly may be preferred. An ample amount of lubrication should be used when installing piston into tube.

Step seal piston rings used in Miller hydraulic cylinders are stamped "UP" on one side. The "UP" side must be installed to face the pressure it is to seal. Double acting pistons must have an equal number of rings facing both ends of the cylinder. Installation of piston rings into cylinder tubing can be simplified by using a piston ring compressor. If a compressor is not available, the piston should be inserted into the tubing until it meets a ring. Pressure should then be applied to the first ring at positions 90° from the split in the ring. When a ring is compressed, the piston can move forward until the entire piston is completely installed in the tube. Do not use a tool which will damage the piston ring. A non-metallic tool is suggested such as wood, plastic, fibre, etc.

Hydraulic cylinders equipped with followers have a small hole drilled through the follower to the base of the cup seal. This hole permits pressure balancing the cup hydraulically. Under no circumstances is the hole to be permanently closed so that it cannot perform its function.

13 b. If a one-piece piston is used, thread piston on piston rod per instructions in Section 13. Torque piston using torque as indicated in Chart. Install cup seals per Section 13. When cup seal starter is not available, cup seals will have to be assembled in the tube, see Section 13 c.

13 c. Assembly of one-piece piston assembly when starter is not available:
1. Assemble piston to rod with the proper torque applied.

2. Insert piston & rod into tube. NOTE: BE SURE TO GREASE TUBE & PISTON ASSEMBLY.
3. Push Piston Rod to move piston to one end of tube. Install cup seal in position on piston.
4. Install circular retainer over cup seal and bolt in place.
5. Tighten Allen screws in circular retainer to proper torque. Refer to Chart on recommended torque.
6. Push rod through tube to move piston to opposite end of tube.
7. Assemble cup seal on cap end, using same procedure.

RECOMMENDED TORQUE FOR
STEEL - CUP RETAINER SCREWS

MODEL "H"

Cylinder Bore Dia.	SCREW SIZE	TORQUE
5"	10-- 32	7.5 ft. - lbs.
6" thru 14"	$\frac{1}{4}$ - 28	17.5 ft. - lbs.
16" thru 20"	5/16 - 24	35 ft. - lbs.

NOTE: THE ABOVE TORQUE FIGURES ARE FOR STEEL SCREWS USED IN STANDARD CYLINDERS. IF STAINLESS STEEL SCREWS ARE USED, SUCH AS, IN WATER SERVICE CYLINDERS, A LOWER TORQUE FIGURE IS USED BECAUSE OF LOWER STRENGTH OF STAINLESS STEEL. CONTACT MILLER FLUID POWER CUSTOMER SERVICE DEPARTMENT FOR THESE TORQUE FIGURES.

14. INSTALLATION OF TUBING END SEAL: Prior to installing the tube into the cylinder cap or head, install tubing end seal as follows, dependent on the type of tubing and seal:

A. TEFLON STRIP TUBING END SEAL ("SHEF-SEAL")

For complete instructions for installing Miller "SHEF-SEAL" tubing end seal, see attached File No. 2039, Issue 7.

B. CYLINDER "O" RING END SEALS: (HYD. CYLINDERS ONLY)

Step 1. Install cylinder "O" ring in groove.

Step 2. Grease cylinder "O" ring to facilitate installation of tubing, without damage to "O" ring. Make sure end of tubing does not have nicks on I.D. from improper handling as "O" ring may be damaged.

15. INSTALLATION OF WIPER INTO BUSHING: In cases of single wiper bushings, it is convenient to install the wiper into the bushing before assembly of the bushing on to the piston rod. In the case of double wiper bushings, the wipers should be instalied after the cylinder has been completely assembled. In the case of a double wiper, installation of wipers is recommended after the cylinder has been completely assembled and tested so that the one oil wiper does not act as a seal in the event there is a slight leakage of the piston rod seal which might go undetected. The wiper is not intended as a pressure seal but only as an oil wiper. The double wiper design has been discontinued on later models, as the oil wiper is deemed unnecessary due to Miller's leakproof hydraulic rod seal construction.

16. REASSEMBLY OF THE CYLINDER: After the cylinder has been assembled in the reverse order of the disassembly, tighten tie rods snugly with hand wrench and light pressure, and accomplish final tightening gradually, working from one tie rod to the diagonally opposite tie rod to insure evenness of tie rod tightening. DO NOT TIGHTEN ONE TIE ROD COMPLETELY AND THEN THE OTHERS. THIS WILL RESULT IN IMPROPER TIGHTENING OF TIE RODS AND IMPROPER ALIGNMENT OF THE HEAD AND CAP.

TIE ROD PRE-STRESS TABLE

Recommended Torques (Ft. Lbs.)
No Lubrication - 4 Tie Rod Construction

Models A, J, and C			Model H	
Cyl. Bore	Torque Ft. Lbs.	Elongation in 36"	Torque Ft. Lbs.	Elongation in 36"
1-1/2	8	1/16"	21	1/16"
2	15	1/16"	54	1/16"
2-1/2	15	1/16"	54	1/16"
3-1/4	34	5/64"	95	1/16"
4	34	5/64"	150	3/32"
5	62	1/16"	315	5/64"
6	62	1/16"	465	5/64"
7			690	5/64"
8	110	1/16"	850	5/64"
10	185	1/16"	*1340	1/16"
12	230	5/64"	*1740	1/16"
14	356	5/64"	*2200	1/16"
16	373	1/16"		
18	550	1/16"		
20	680	1/16"		

* When 1" dia. multiple tie rods are used on 10", 12", and 14" bore "H" cyls., equivalent torque is 400 ft. lbs. and elongation in 36" is 1/16". NOTE: When Molycote is used on threads, use 2/3 of torque shown in table.

NOTE: WHEN REASSEMBLING CYLINDER, USE THE FOLLOWING TORQUE FIGURES ON BOLTED BUSHING CAP SCREWS: Please refer to File 4770.

RECOMMENDED TORQUE FOR
STEEL - BOLTED BUSHING CAP SCREWS

PISTON ROD DIA.	SCREW SIZE	TORQUE
5/8	20 - 32	7 ft. - lbs.
1" thru 3½"	¼ - 28	15 ft. - lbs.
4" thru 10"	5/16 - 24	30 ft. - lbs.

NOTE: THE ABOVE TORQUE FIGURES ARE FOR STEEL SCREWS USED IN STANDARD CYLINDERS. IF STAINLESS STEEL SCREWS ARE USED, SUCH AS, IN WATER SERVICE CYLINDERS, A LOWER TORQUE FIGURE IS USED BECAUSE OF LOWER STRENGTH OF STAINLESS STEEL. CONTACT MILLER FLUID POWER CUSTOMER SERVICE DEPARTMENT FOR THESE TORQUE FIGURES.

17. TESTING OF CYLINDER: Move rod in and out by hand with cylinder horizontal to determine freedom of movement, or if cylinder is very large and long stroke, use approximately 8 to 15 P.S.I., or slightly more air pressure, to check for freedom of movement of piston assembly. Even small bore cylinders 1½" bore with 3 to 6 foot strokes move at 8 to 23 P.S.I. Break-loose pressures on air cylinders should generally be less than hydraulic cylinders.

Double rod end cylinders and cylinders with oversize rod diameters take more pressure, but in no case more than approximately 45 P.S.I. should be used. If the stroke is longer than 6 ft., it may require slightly more pressure, but if the pressure required to cause the piston assembly to move is substantially above 45 P.S.I., this would indicate improper assembling and functioning from the standpoint of efficiency and could result in either mechanical damage to the piston cups, tubing, bushing, piston rod, etc., or premature seal failure. Therefore, the cylinder should be disassembled, re-assembled after corrective action, and rechecked again before installation into the mechanism.

It is always advisable to test a cylinder before installation into a machine. If the cylinder is equipped with piston cup seals, a short hose should be connected to the head port. The open end of the hose should be submerged in a small container of water. Apply airline pressure at the cap port only, and if more than an occasional bubble appears in the water, the piston assembly is not sealing properly.

The procedure should be reversed with the short hose at the cap end inserted into the water, and airline pressure at the head port. Rod seal leakage may be checked at the same time by depositing a small quantity of oil around the piston rod in the clearance between the rod bushing and the piston rod. An occasional air bubble may appear. If more than an occasional air bubble appears, the cylinder may leak under hydraulic pressure. If in doubt, proceed to test under hydraulic static and cycling conditions to check for rod seal leakage. Hydraulic leakage at rod seal should be checked without installation of wipers in the case of a double wiper bushing. (Seals which will leak an occasional bubble of air are expected to be leak-proof when tested hydraulically.)

18. REMOUNTING PROCEDURE: The ideal method of mounting a cylinder to the machine is to have the point of mounting on the equipment machined to the exact dimensions with proper alignment, so that bolting the cylinder in place insures perfect alignment. In many cases this is not practical from a cost and design standpoint. Therefore, alignment must be secured at the time of installation. Whenever the piston rod is fastened to the machine which confines the cylinder in one position, we have found that it frequently is best to bolt the cylinder down as a last operation of assembly. Alignment can be secured in other ways, but we believe the following sequence of installation steps is quite effective:

A. Assemble the piston rod to the machinery. The piston rod must be fastened and held squarely so its centerline is parallel to the guides of the attached machinery (or parallel to the line of movement of the attached machinery in cases of fixed mounted cylinders.)

B. Insert mounting bolts but do not tighten them.

C. In the case of horizontally mounted cylinders, it is necessary to support the weight of the cylinder body so as to eliminate strain on the piston rod.

D. Use feeler gauges under the mounting and shim at these points equal to the space indicated by the feeler gauges.

E. Finally, tighten the mounting bolts.

F. If possible, the machine operation should be tested with low pressure air to insure that cylinder and attached parts are operating freely. This should be done without machine operating under load conditions.

NOTE: A little extra care in aligning the cylinder properly will pay dividends in terms of long, trouble-free service, and is well worth the additional time and effort.

GENERAL: Whenever possible, damaged parts, especially seals, should be sent to the Miller Fluid Power Division along with a complete report so that a thorough analysis can be made. Your cooperation in this respect will help us to help you overcome service difficulties encountered as a result of adverse operating conditions or improper application.

CAUTION: SPRING RETURN CYLINDERS--An installed spring can injure a person if special precautions are not exercised in removing the tie rods. In some cases, clamps may be used to contain the cylinder assembly while the tie rods are being removed. If such is the case, the clamps should, of course, be designed to permit gradual release of spring compression to its free length. In other instances, it is desirable to prepare two special tie rods which are longer than the original tie rods, and which are threaded for the full additional length over and above the original tie rod length. The special tie rods required to disassemble a standard Miller spring should be 1 -1/2 times the length of the cylinder with the extra half length threaded. Remove two of the original tie rods, bringing the tie rod nuts up snug. The other two original tie rods may then be removed, after which the special tie rods can be used for final safe disassembly by gradually threading the tie rod nuts off, working alternately from one tie rod to another. The special tie rods may be used to reassemble the cylinder as compressing the spring will be easy, positive, and safe.

CAUTION: CYLINDERS WITH NON-SAG RODS--During disassembly or reassembly, exercise extreme care to hold piston rod rigid in position where word stamped "TOP" is facing upward. Piston rod must be concentric with counterbore in head while installing rod seal parts and bushing.

ASSEMBLY INSTRUCTIONS FOR SPRING LOADED TEFLON PISTON CUPS. See File 4632 B or 4618 A for cross-sectional drawing on 3-piece Piston Design Cylinder.

The following instructions give a detailed breakdown on the proper methods to be used when assembling spring loaded teflon piston cups. These instructions should be followed closely to prevent damage to the cups during assembly.

1. Make certain that all parts are free from any contamination or foreign material and that the assembly area is clean.

2. Insert piston pressure ring retainer (Spir "O" Lox) into slot provided in threaded and plain followers. On 1-1/2" and 2" bores, this operation is deleted.

3. Insert rod end cushion plunger on rod with 45° chamfer toward the follower. This is for rod end cushioned cylinders.

4. Assemble plain follower, piston, and threaded follower on rod.

5. Tighten assembly hand tight.

6. Scribe a line across the threaded follower and end of the piston rod. Make certain that the scribed line can be clearly identified.

7. Remove the threaded follower and piston from the piston rod.

8. Insert the teflon follower seal over the rod end and against the plain follower.

9. Place the tube in a vertical position on the bench, if possible.

NOTE: Extreme caution should be taken when performing the following operations to prevent damage to cups, piston, or tube.

10. Position the first cup seal into tube approx. 4" parallel to top of tube, lip of cup seal down or away from assembler.

11. Position the piston into tube and allow to rest evenly against cup seal.

12. Position the 2nd cup seal into tube snugly against the piston. Lip of cup seal up or toward the assembler.

13. Insert one wave spring over plain follower. The plain follower at this point should be on the piston rod. Make certain that the teflon follower seal is in place.

14. Insert one piston pressure ring over plain follower angled side out or to the assembler so that the step side is squarely against the wave spring.

15. Place the tube with both cups and piston carefully over the plain follower and over the rod end.

16. Insert the second cup pressure ring into the cup seal so that the angled side is evenly against the angled side of the cup.

17. Insert the 2nd wave spring over the threaded follower and evenly against the shoulder of the pressure ring retainer (Spir "O" Lox ring).

18. Carefully assemble the threaded follower to the rod end.

19. Tighten threaded follower using torques as specified on Page 5 of these instructions. If using the scribed line method, make certain that the scribed line on threaded follower is approx. 20° to 25° beyond that of the scribed line on piston rod. Occasionally slightly higher torques will permit locating the scribed lines properly.

CAUTION: Care should be taken when tightening the follower to make certain that the tube is not damaged.

20. Stake the threaded follower to the piston rod. Make certain that three punches are evenly spaced 120° apart. Peen all sharp burrs.

21. Proceed with normal assembly of cylinder.

ASSEMBLY INSTRUCTIONS FOR SPRING LOADED TEFLON PISTON CUPS ON AN INTERIM TYPE PISTON. See File 4632B or 4618A for cross-sectional drawing.

1. Make certain that all parts and assembly area are clean.
2. Assemble Interim type piston to rod with the proper torque applied.
3. Place the tube in a vertical position if possible.

   NOTE: Extreme caution should be taken when performing the following operation to prevent damage to cups, piston, or tube.

4. Insert piston and rod into tube, approximately 2".

   NOTE: Be sure to grease tube and piston before assembly.

5. Insert teflon cup seal into tube at rod end on to piston.
6. Insert pressure ring against cup.
7. Insert wave spring flush against pressure ring.
8. Install circular retainer over spring loaded assembly and bolt in place.

   NOTE: Circular retainers must be machined to accept spring loaded assembly.

9. Tighten Allen screws in circular retainer to proper torque.
10. Push rod through tube to cap end approximately 2" from end.
11. Assemble teflon cup and spring loaded assembly. Same procedure as done on the opposite end.
12. Do not take piston rod and assembled parts out of the tube after parts have been assembled.
13. Proceed with normal assembly of the cylinder.

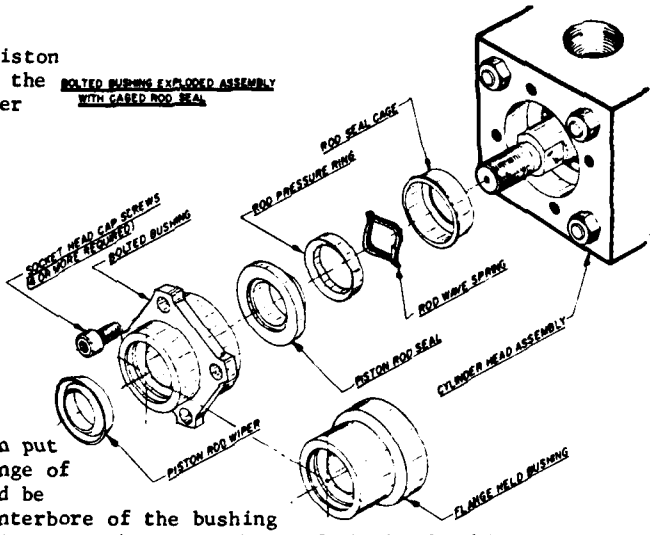
ASSEMBLY INSTRUCTIONS

MILLER "BASE-LOK" HYDRAULIC CYLINDER CAGED PISTON ROD SEAL AND BUSHING ASSEMBLY

This kit contains Miller's new design caged rod seal assembly which includes either a bolted design bushing or a retainer held bushing, both of Base-Lok design. Please Note: The complete caged rod seal assembly is interchangeable with all previous design cylinders. However, the individual parts of the caged rod seal assembly may not be interchanged with previous design rod seal parts. Please follow the assembly instructions carefully.

Step 1 If bushing is retainer held, remove tie rod nuts and retainer. Remove all rod seal parts from cylinder and discard. Remove any dirt, chips, etc. from bushing cavity in head. Inspect piston rod and polish out any nicks or scratches in piston rod.

Step 2 For convenience, extend piston rod partially and install the caged rod seal assembly per assembly drawing and in sequence as follows:



A. Rod seal cage

B. Rod wave spring

C. Rod pressure ring

D. Rod Seal

E. Bushing

Step 3 A. After bushing has been put on piston rod the flange of piston rod seal should be inserted into the counterbore of the bushing before inserting bushing into the counterbore of the head. This is to assure that the piston rod seal is properly mounted in the bushing.

B. The entire caged rod seal assembly and bushing is then inserted into the bushing cavity of the cylinder head.

C. If the bolted bushing is used socket head cap screws are used to hold the bushing in the cylinder head. Use the torque figures indicated below when installing the socket head cap screws.

Piston Rod Diameter	Cap Screw Size	Torque
5/8"	10-32 x 3/8	76 in/lbs.
1" thru 3-1/2	1/4-28 x 5/8	180 in/lbs.
4" thru 10"	5/16-24 x 1	360 in/lbs.

D. If retainer held bushing is used, reinstall retainer and tie rod nuts. (retorque tie rod nuts to values shown in catalog.)

E. Install rod wiper in bushing.

FILE #4770
REVISED 6-24-70

ASSEMBLY INSTRUCTIONS

MILLER "BASE-LOK" PNEUMATIC CYLINDER PISTON ROD SEAL AND BUSHING ASSEMBLY

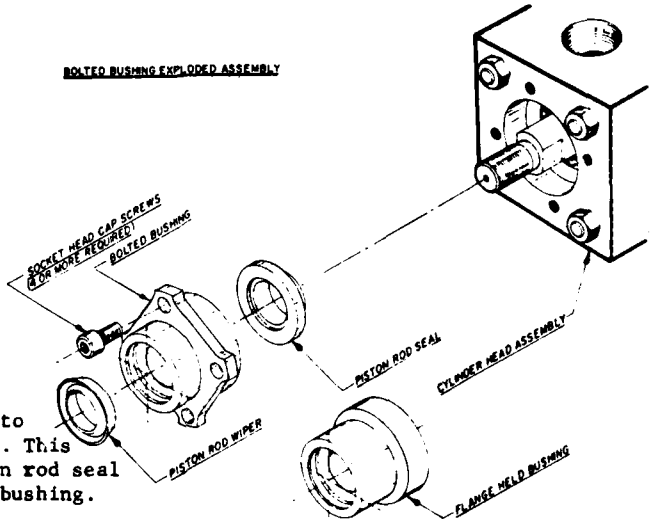
This kit contains Miller's new design rod seal assembly which includes either a bolted design bushing or a retainer held bushing, both of Base-Lok design. Please follow the assembly instructions carefully.

Step 1 If bushing is retainer held, remove tie rod nuts and retainer. Remove rod seal parts from cylinder and discard. Remove any dirt, chips, etc. from bushing cavity in head. Inspect piston rod and polish out any nicks or scratches in piston rod.

Step 2 For convenience, extend piston rod partially and install the rod seal assembly per assembly drawing and in sequence as follows:

A. Rod Seal

B. Bushing



Step 3 A. After bushing has been put on piston rod the flange of piston rod seal should be inserted into the counterbore of the bushing before inserting bushing into the counterbore of the head. This is to assure that the piston rod seal is properly mounted in the bushing.

B. The rod seal and bushing is then inserted into the bushing cavity of the cylinder head.

C. If the bolted bushing is used socket head cap screws are used to hold the bushing in the cylinder head. Use the torque figures indicated below when installing the socket head cap screws.

Piston Rod Diameter	Cap Screw Size	Torque
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D. If retainer held bushing is used, reinstall retainer and tie rod nuts. (retorque tie rod nuts to values shown in catalog.)

E. Install rod wiper in bushing.

Miller

MILLER FLUID POWER
A FLICK REEDY SUBSIDIARY CORPORATION
7N015 York Road, Bensenville, Illinois 60106
Power Cylinders • Pumps • Valves
Hand Presses • Compressed Air Dryers
Tie Seal Rings • Air Motors

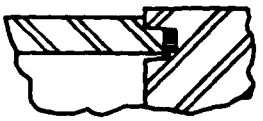
R

FILE #4770A 6-24-70

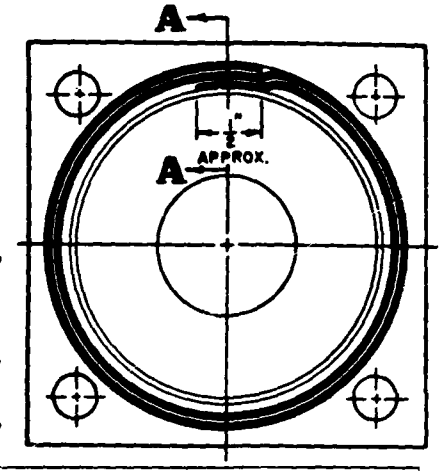
D-58

Field Installation of Latest Design MILLER "SHEF SEAL" Tubing End Seal

SHEF SEAL is a rectangular strip of Teflon sealing material supplied already cut to the proper lengths for the various bore sizes as shown in table below—or supplied in long lengths on convenient spools from which the Teflon strip is easily cut with knife or scissors to the required lengths (shown in table). Squareness of cut is not critical and length of cut need only approximate the lengths shown in table below. Installation of the Teflon strip is as follows:



SECTION A-A SHOWING "SHEF SEAL" TUBING END SEAL



Step #1. Apply grease to the tubing groove of cylinder head or cap.

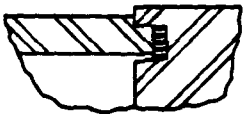
Step #2. Coil the Teflon strip on its narrow edge into the greased tubing groove. The strip should make two complete revolutions plus about ½" overlap.

For convenience of demonstration, the sketch at right exaggerates the space between the Shef Seal coils which actually hug each other closely when fitted into tubing groove.

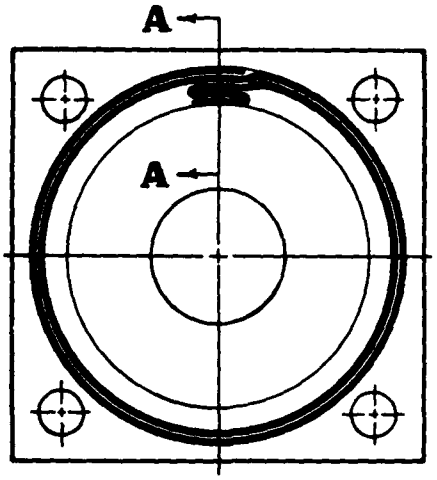
SUGGESTED "SHEF-SEAL" LENGTHS IN INCHES												
Bore	1-1/2	2	2-1/2	3-1/4	4	5	6	7	8	10	12	14
Model "A" or "J"	10-1/4	13-3/8	16-1/2	21-1/4	26	32-1/8	38-1/2	-	51	63-5/8	77	89½
Model "H"	10-3/4	14	18	22-3/4	28	34-1/2	40-3/4	47½	53½	67	79½	93

Field Installation of Previous Design MILLER "SHEF SEAL" Tubing End Seal

Some earlier Tubing End Seals utilized .070" square "SHEF SEAL" with the ends butted together. The new rectangular strip replaces and is completely interchangeable with this previous design. Also, some earlier designs had seal cavities wider than the groove now being used. SHEF SEAL is used in the wide groove cavities by spiraling in "SHEF SEAL", starting from the O. D. of the tubing groove, then making two complete revolutions and zig-zagging in accordance with the sketch at right. The sketch is exaggerated to more clearly illustrate how "SHEF SEAL" is installed. Also, if desired, Miller can furnish a metal ring, at extra charge, which reduces this wide cavity to the narrower dimensions of the new cavity of the latest design.



SECTION A-A SHOWING "SHEF SEAL" TUBING END SEAL



(The space between the coils does not actually exist as "SHEF SEAL" is coiled snugly against itself.)

If the "SHEF SEAL" material becomes twisted or deformed, we ordinarily recommend replacement with new "SHEF SEAL" sealing material when the cylinder is reassembled. However, if a cylinder is disassembled and there is no new "SHEF SEAL" material available and the "SHEF SEAL" which came out of the cylinder on disassembly is twisted or distorted, it can be made more satisfactory for use by simply submerging in boiling water for 5 to 10 minutes, remove from the water and stretch the material by hand, exercising care in not pulling too hard. Distorted "SHEF SEAL" has been successfully reused after reforming in the above described manner.

"SHEF SEAL" on original equipment is sometimes furnished in a continuous ring of .070" square material. For field service, it, too, would be replaced with the rectangular strip.

Advantages of Spooled Teflon Strip SHEF SEAL

By using Teflon strip "Shef Seal" from a spool, you avoid the stocking of the many different lengths required for the different bore sizes. You just cut the length you need from the spool. And only one cross section dimension of the spooled Teflon strip Shef Seal fits all bores of Miller Model "H" and Model "J" Hydraulic Cylinders and all Miller Model "A" Air Cylinders of Shef Seal design. Thus, the great expense and confusion of stocking an extensive range of seal sizes are completely eliminated. And the field installation from the spooled strip provides the quickest, easiest and most effective servicing of tubing end seals.

Miller

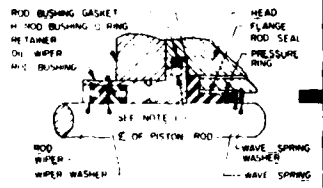
MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION
7N015 York Road • Bensenville, Illinois

File #2039, Issue 7
D-61

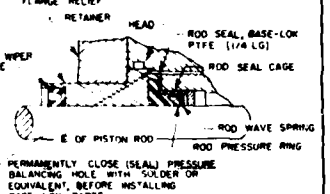
NOTES

1. ROD BUSHING O-RING IS LOCATED IN BUSHING FLANGE ON THE FOLLOWING BORE AND ROD SIZE COMBINATIONS
   - 1 1/2 H BORE WITH 1" DIA ROD
   - 2 H BORE WITH 1 3/8 DIA ROD
2. CIRCULAR RETAINERS WITH COUNTERSUNK CAP SCREWS FURNISHED BEFORE H-8-68 ARE NOT INTERCHANGABLE WITH LATER CIRCULAR RETAINERS OR CURRENT REPLACEMENT BOLTED BUSHING - ROD BUSHING & ROD SEAL PARTS ARE INTERCHANGABLE WITH CURRENT REPLACEMENT FOR RETAINER HELD BUSHINGS

SERIAL NOS W/o SUFFIX AND W/ SUFFIX A
WITH SMALL OR FULL SQ RETAINER

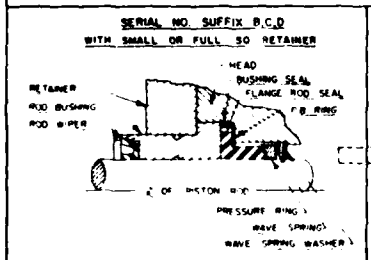


REPLACEMENT PARTS
WITH SMALL OR FULL SQ RETAINER

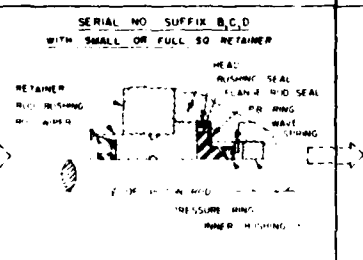


- PERMANENTLY CLOSE (SEAL) PRESSURE BALANCING HOLE WITH SOLDER OR EQUIVALENT, BEFORE INSTALLING BASE-LOK PARTS

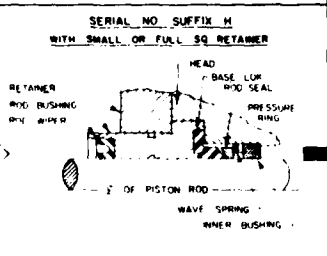
SERIAL NO SUFFIX B,C,D
WITH SMALL OR FULL SQ RETAINER



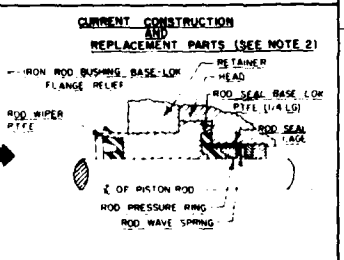
SERIAL NO SUFFIX B,C,D
WITH SMALL OR FULL SQ RETAINER



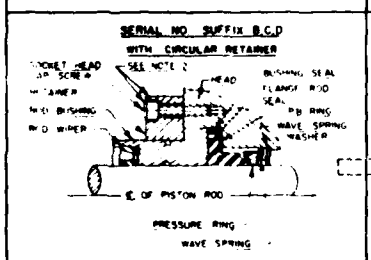
SERIAL NO SUFFIX H
WITH SMALL OR FULL SQ RETAINER



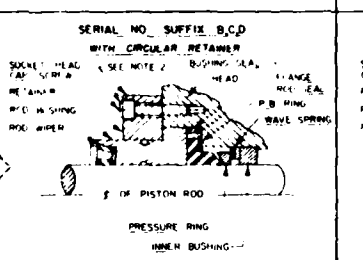
CURRENT CONSTRUCTION AND REPLACEMENT PARTS (SEE NOTE 2)



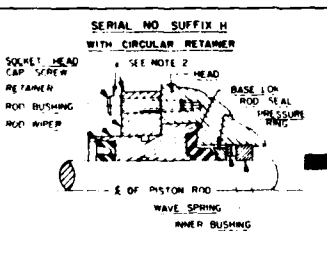
SERIAL NO SUFFIX B,C,D
WITH CIRCULAR RETAINER



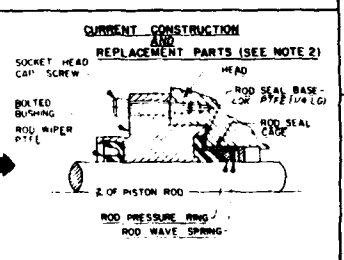
SERIAL NO SUFFIX B,C,D
WITH CIRCULAR RETAINER



SERIAL NO SUFFIX H
WITH CIRCULAR RETAINER



CURRENT CONSTRUCTION AND REPLACEMENT PARTS (SEE NOTE 2)



REVISIONS

MATERIAL

MILLER FLUID POWER DIVISION
FLICK-REEDY CORPORATION

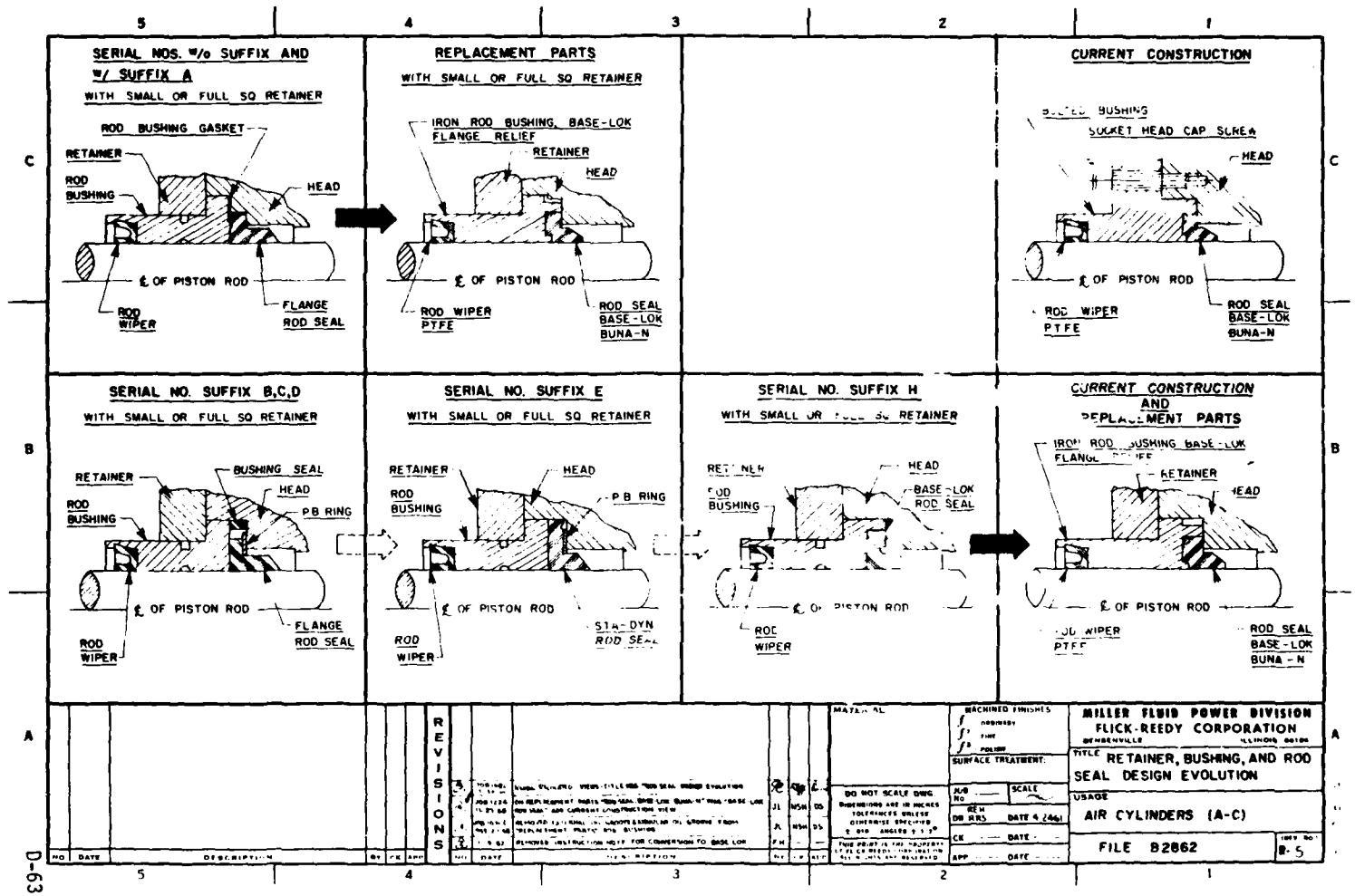
TITLE BUSHING, ROD PARTS, AND RETAINER DESIGN EVOLUTION

DRAWN HYDRAULIC CYLINDERS (LH-J-H)

FILE B2861

6-7

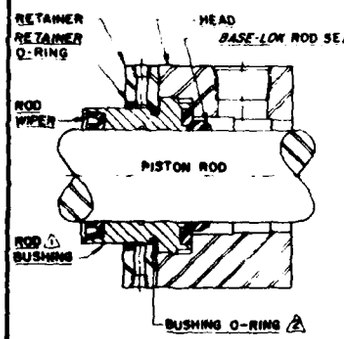
ASSEMBLY


SERIAL NOS. W/o SUFFIX AND W/ SUFFIX A
WITH SMALL OR FULL SQ RETAINER
ROD BUSHING GASKET
RETAINER
ROD BUSHING
HEAD
℄ OF PISTON ROD
ROD WIPER
FLANGE ROD SEAL
REPLACEMENT PARTS
WITH SMALL OR FULL SQ RETAINER
IRON ROD BUSHING, BASE-LOK FLANGE RELIEF
RETAINER
HEAD
℄ OF PISTON ROD
ROD WIPER PTFE
ROD SEAL BASE-LOK BUNA-N
CURRENT CONSTRUCTION
SOCKET HEAD CAP SCREW
HEAD
℄ OF PISTON ROD
ROD WIPER PTFE
ROD SEAL BASE-LOK BUNA-N
SERIAL NO. SUFFIX B,C,D
WITH SMALL OR FULL SQ RETAINER
RETAINER
BUSHING SEAL
HEAD
ROD BUSHING
P B RING
℄ OF PISTON ROD
FLANGE ROD SEAL
ROD WIPER
SERIAL NO. SUFFIX E
WITH SMALL OR FULL SQ RETAINER
RETAINER
HEAD
ROD BUSHING
P B RING
℄ OF PISTON ROD
STA-DYN ROD SEAL
ROD WIPER
SERIAL NO. SUFFIX H
WITH SMALL OR FULL SQ RETAINER
HEAD
BASE-LOK ROD SEAL
ROD BUSHING
℄ OF PISTON ROD
ROD WIPER
CURRENT CONSTRUCTION AND REPLACEMENT PARTS
IRON ROD BUSHING BASE-LOK FLANGE RELIEF
RETAINER
HEAD
℄ OF PISTON ROD
ROD WIPER PTFE
ROD SEAL BASE-LOK BUNA-N
REVISIONS
NO. DATE DESCRIPTION BY CK APP
MATERIAL
MACHINED FINISHES
SURFACE TREATMENT:
DO NOT SCALE DWG
SCALE
DR RMS DATE 4/24/61
CK DATE
APP DATE
MILLER FLUID POWER DIVISION
FLICK-REEDY CORPORATION
BENSENVILLE ILLINOIS
TITLE RETAINER, BUSHING, AND ROD SEAL DESIGN EVOLUTION
USAGE
AIR CYLINDERS (A-C)
FILE B2862
B-5
D-63

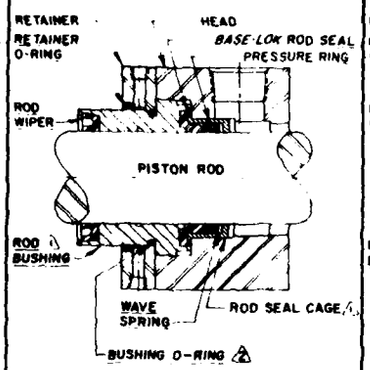
E-54

ROD SEAL & BUSHING CONSTRUCTION- WATER COOLED, LUBRICATED, DRAINBACK, & METALLIC SEAL APPLICATIONS

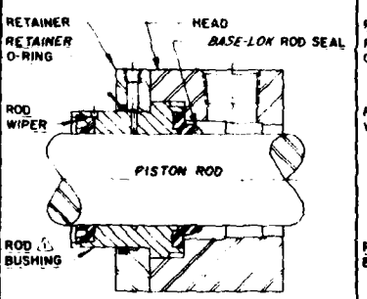
A-C WATER COOLED ROD BUSHING



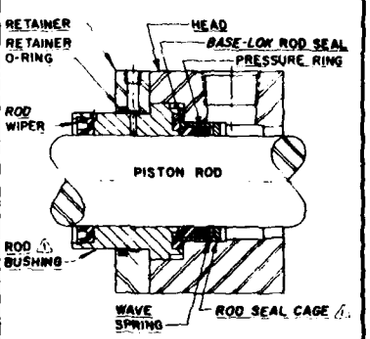
J-H WATER COOLED ROD BUSHING



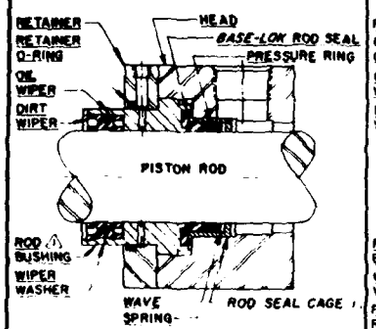
A-C LUBRICATED ROD BUSHING



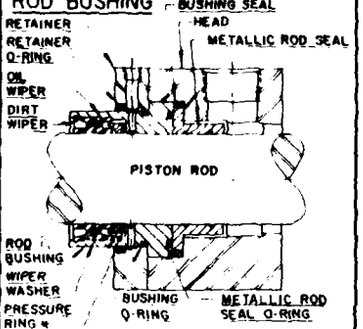
J-H LUBRICATED ROD BUSHING



J-H DRAINBACK ROD BUSHING



H METALLIC SEAL DRAINBACK ROD BUSHING



* WAVE SPRING AND PRESSURE RING ARE NOT PRESENT FOR "H" ROD SIZE.

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DECIMALS ANGLES	FINISH INFORMATION	FLICK-REEDY CORPORATION MILLER FLUID POWER DIVISION BENSENVILLE ILLINOIS
MATERIAL		TITLE ROD SEAL & BUSHING PARTS ARRANGEMENT
THIS PRINT IS THE PROPERTY OF FLICK REEDY CORPORATION THE SUBJECT MATTER MAY BE PATENTED. ONLY SUCH USE AS IS AUTHORIZED BY THE OWNER MAY BE MADE		USAGE A-C-J-H CYLINDERS
DR BY DATE CH BY DATE APP DATE		SCALE FILE B3083 B-1

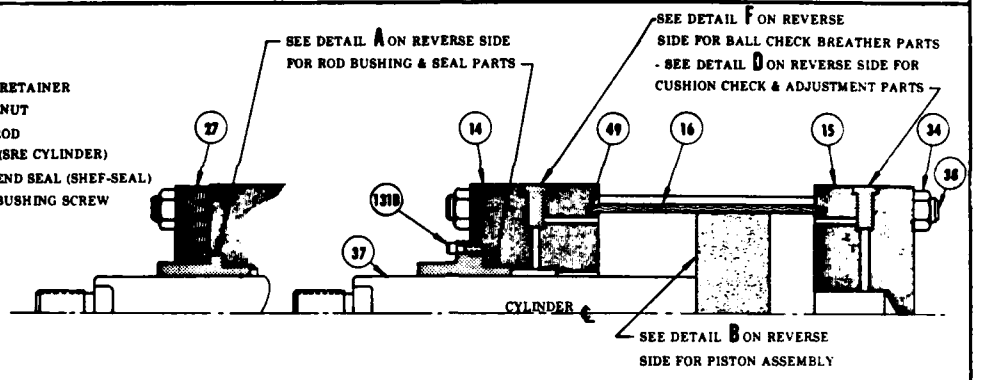
MILLER SINGLE ROD CYLINDER

DOUBLE ACTING — NON-ROTATING

WHEN ORDERING PARTS OR IN CORRESPONDENCE SPECIFY PART NAME AND SERIAL NO. _____

Serial No. is stamped on Nameplate and Port side of Head

14-HEAD
15-CAP
16-TUBE
27-SQUARE RETAINER
34-TIE ROD NUT
37-PISTON ROD
38-TIE ROD (SRE CYLINDER)
49-TUBING END SEAL (SHEF-SEAL)
131B-BOLTED BUSHING SCREW



PISTON ROD LENGTH_____ **TIE ROD LENGTH**_____ **TUBING LENGTH**_____

ADDITIONAL PARTS (NOT SHOWN) REQUIRED FOR CERTAIN MOUNTING MODELS

MODELS 62 & 66 - ADD FLANGE PLATE (28) CAP END TIE ROD NUTS ARE NOT REQUIRED. TIE RODS ARE THREADED INTO FLANGE PLATE

MODEL 86 - ADD CLEVIS BRACKET (88) AT CAP END. CAP END TIE ROD NUTS ARE NOT REQUIRED. TIE RODS ARE THREADED INTO BRACKET.

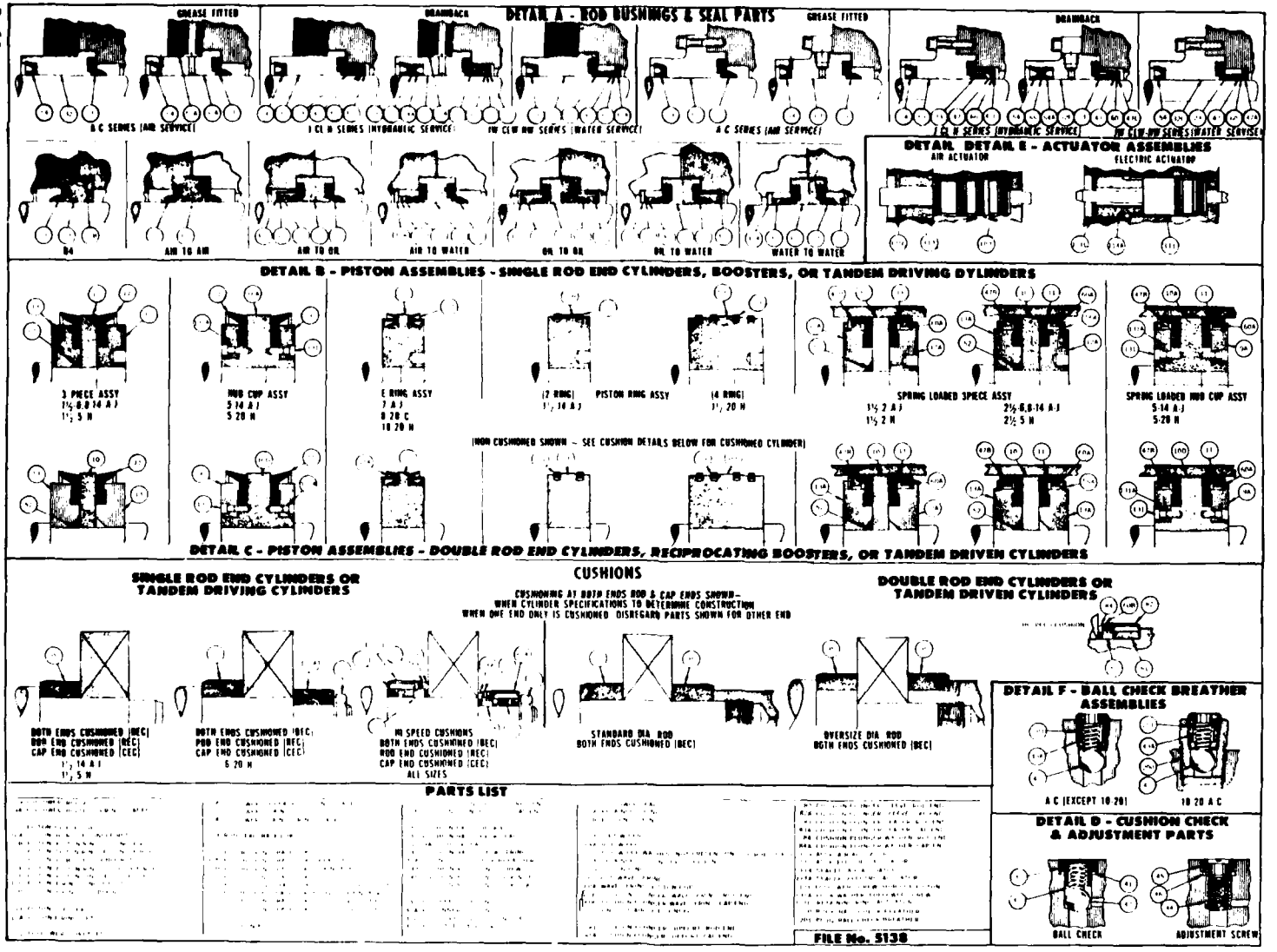
MODEL 77 - SUBSTITUTE MOUNTING LUGS (82) FOR 2 TIE ROD NUTS, EACH END

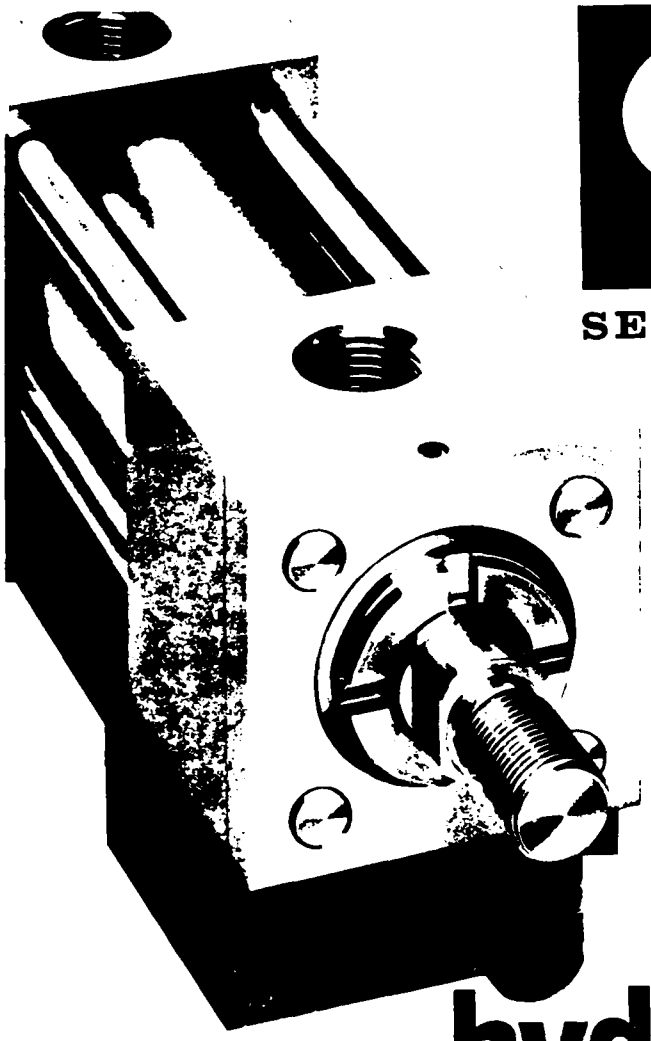
MODELS 61 & 65 - WHEN BOLTED BUSHING IS INDICATED, ADD FLANGE PLATE (28)

- WHEN FULL SQUARE RETAINER IS INDICATED SUBSTITUTE FLANGE PLATE (28) FOR RETAINER (27)
- OMIT ROD END TIE ROD NUTS. TIE RODS ARE THREADED INTO FLANGE PLATE.

12 69

FILE NO. 5138A


DETAIL A - ROD BUSHINGS & SEAL PARTS
GREASE FITTED
DRAINBACK
B C SERIES (AIR SERVICE)
J CL R SERIES (HYDRAULIC SERVICE)
JW CLW RW SERIES (WATER SERVICE)
A C SERIES (AIR SERVICE)
J CL R SERIES (HYDRAULIC SERVICE)
JW CLW RW SERIES (WATER SERVICE)
B4
AIR TO AIR
AIR TO OIL
AIR TO WATER
OIL TO OIL
OIL TO WATER
WATER TO WATER
DETAIL B - PISTON ASSEMBLIES - SINGLE ROD END CYLINDERS, BOOSTERS, OR TANDEM DRIVING CYLINDERS
3 PIECE ASSY
1½-8-8-14 A J
1½ 5 N
HUB CUP ASSY
5-14 A J
5-20 N
E RING ASSY
7 A J
8-20 C
10-20 N
(2 RING)
1½-14 A J
PISTON RING ASSY
(4 RING)
1½-20 N
SPRING LOADED 3PIECE ASSY
1½ 2 A J
1½ 2 N
2½-6-8-14 A J
2½ 5 N
SPRING LOADED HUB CUP ASSY
5-14 A J
5-20 N
(NON CUSHIONED SHOWN - SEE CUSHION DETAILS BELOW FOR CUSHIONED CYLINDER)
DETAIL C - PISTON ASSEMBLIES - DOUBLE ROD END CYLINDERS, RECIPROCATING BOOSTERS, OR TANDEM DRIVEN CYLINDERS
CUSHIONS
CUSHIONING AT BOTH ENDS ROD & CAP ENDS SHOWN-
WHEN CYLINDER SPECIFICATIONS TO DETERMINE CONSTRUCTION
WHEN ONE END ONLY IS CUSHIONED DISREGARD PARTS SHOWN FOR OTHER END
SINGLE ROD END CYLINDERS OR TANDEM DRIVING CYLINDERS
DOUBLE ROD END CYLINDERS OR TANDEM DRIVEN CYLINDERS
BOTH ENDS CUSHIONED (BEC)
ROD END CUSHIONED (REC)
CAP END CUSHIONED (CEC)
1½ 14 A J
1½ 5 N
BOTH ENDS CUSHIONED (BEC)
ROD END CUSHIONED (REC)
CAP END CUSHIONED (CEC)
6-20 N
HI SPEED CUSHIONS
BOTH ENDS CUSHIONED (BEC)
ROD END CUSHIONED (REC)
CAP END CUSHIONED (CEC)
ALL SIZES
STANDARD DIA ROD
BOTH ENDS CUSHIONED (BEC)
OVERSIZE DIA ROD
BOTH ENDS CUSHIONED (BEC)
DETAIL E - ACTUATOR ASSEMBLIES
AIR ACTUATOR
ELECTRIC ACTUATOR
DETAIL F - BALL CHECK BREATHER ASSEMBLIES
A C (EXCEPT 10-20)
10-20 A C
DETAIL D - CUSHION CHECK & ADJUSTMENT PARTS
BALL CHECK
ADJUSTMENT SCREW
PARTS LIST
FILE No. 5138



convert to ®

FORM 105-730286

SERIES "2TH"

GENERAL PARTS
BREAKDOWN
INSTALLATION AND
SERVICE INSTRUCTIONS

hydraulic cylinders

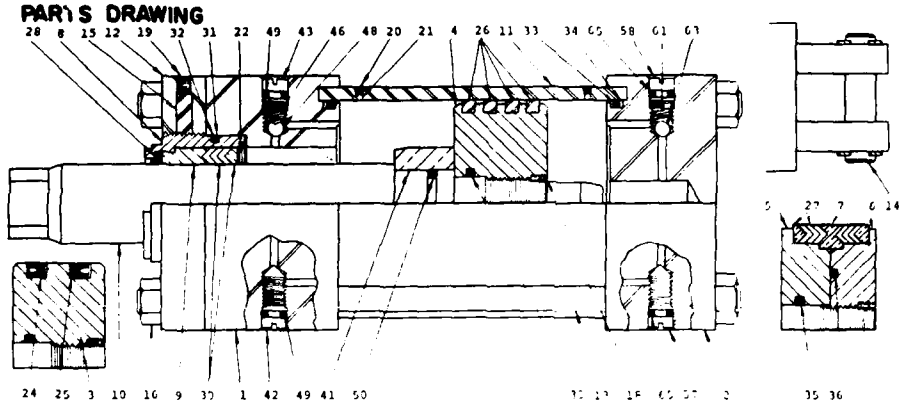
LITHO IN U.S.A.

ORTMAN-MILLER MACHINE CO. INC.
19 143RD ST. HAMMOND, IND. 46320

Garlock

GENERAL PARTS BREAKDOWN
INSTALLATION AND SERVICE INSTRUCTIONS
FOR SERIES 2TH CYLINDER

PARTS DRAWING



PARTS

ITEM	PART NAME	ITEM	PART NAME	ITEM	PART NAME	USE
1	HEAD END COVER	16	TIE ROD NUT	34	END COVER NON-EXT. RING	ITEMS CYLINDERS
2	CAP END COVER	18	PISTON LOCK SCREW	35	PISTON SEAL O-RING	1-30 - NON-CUSH.
3	BLOCK VEE PISTON	19	CART. LOCK SCREW	36	PISTON PLATE O-RING	1-50 - CUSH. H'D
4	SCR PISTON	20	BLEEDER SCREW	41	H'D END CUSH. NOSE	END
5	VEE PISTON PLATE-FWD.	21	BLEEDER BALL	42	H'D CUSH. ADJ. N'DLE	1-364
6	VEE PISTON PLATE-REAR	22	ROD PKG. RET. RING	43	H'D BALL CH'K SCREW	57-65- CUSH. CAP
7	PISTON SUPPORT BRG.	24	BLOCK VEE PISTON PKG.	46	H'D BALL CH'K SPRING	END
8	CARTRIDGE	25	PISTON PKG. NON-EXT. RING	48	H'D BALL CH'K BALL	1-65 - CUSH. BOTH
9	ROD BEARING	26	SCR PISTON PKG.	49	H'D N'DLE & CH'K O-RING	ENDS
10	PISTON ROD	27	VEE PISTON PKG. ASS'Y.	50	CUSH. NOSE O-RING	
11	TUBE	28	ROD WIPER	57	CAP CUSH. ADJ. N'DLE	
12	CART. RET. PLATE	30	VEE ROD PKG. ASS'Y.	58	CAP BALL CH'K SCREW	
13	TIE ROD	31	CART. O-RING	61	CAP BALL CH'K SPRING	
14	CLEVIS PIN ASS'Y.	32	CART. NON-EXT. RING	63	CAP BALL CH'K BALL	
15	CARTRIDGE SLUG	33	END COVER O-RING	65	CAP N'DLE & CH'K O-RING	

KITS

SEAL KITS (KIT NAME)	(KIT TYPE)	(ITEM NUMBERS)
SCR PISTON SEAL KIT	510	26, 33(2), 34(2)
S-V PISTON SEAL KIT	519	24(2), 25(2), 33(2), 34(2), 35
VEE PISTON SEAL KIT	520	27(2), 33(2), 34(2), 35, 36
ROD GLAND CART ASSY	530	8, 9, 22, 28, 30, 31, 32
ROD GLAND SEAL KIT	540	28, 30, 31, 32
ROD GLAND REPAIR KIT	550	9, 28, 30, 31, 32
NC COMPLETE REPAIR KIT (SCR)	531	9, 28, 30, 31, 32, 33(2), 34(2), 35
CUSH COMPLETE REPAIR KIT (SCR)	584	9, 28, 30, 31, 32, 33(2), 34(2), 35, 49(2), 50, 65(2)
NC COMPLETE REPAIR KIT (S-V)	565	9, 24(2), 25(2), 28, 30, 31, 32, 33(2), 34(2), 35
CUSH COMPLETE REPAIR KIT (S-V)	560	9, 24(2), 25(2), 28, 30, 31, 32, 33(2), 34(2), 35, 49(2), 50, 65(2)
NC COMPLETE REPAIR KIT (VEES)	561	9, 27(2), 28, 30, 31, 32, 33(2), 34(2), 35, 36
CUSH COMPLETE REPAIR KIT (VEES)	564	9, 27(2), 28, 30, 31, 32, 33(2), 34(2), 35, 36, 49(2), 50, 65(2)
NC COMPLETE SEAL KIT (SCR)	571	28, 30, 31, 32, 33(2), 34(2), 35
CUSH COMPLETE SEAL KIT (SCR)	574	28, 30, 31, 32, 33(2), 34(2), 35, 49(2), 50, 65(2)
NC COMPLETE SEAL KIT (S-V)	575	24(2), 25(2), 28, 30, 31, 32, 33(2), 34(2), 35
CUSH COMPLETE SEAL KIT (S-V)	578	24(2), 25(2), 28, 30, 31, 32, 33(2), 34(2), 35, 49(2), 50, 65(2)
NC COMPLETE SEAL KIT (VEES)	571	28, 30, 31, 32, 33(2), 34(2), 35, 36, 27(2)
CUSH COMPLETE SEAL KIT (VEES)	574	27(2), 28, 30, 31, 32, 33(2), 34(2), 35, 36, 49(2), 50, 65(2)
SERVICE ASSEMBLY KITS		
SCR PISTON ASSY KIT	610	4, 18, 26, 33(2), 34(2), 35
S-V PISTON ASSY KIT	619	3, 18, 24(2), 25(2), 33(2), 34(2), 35
VEE PISTON ASSY KIT	620	5, 6, 7, 18, 27(2), 33(2), 34(2), 35, 36
NC HEAD ASSY KIT	611	1, 33, 34
CUSH HEAD ASSY KIT	612	1, 33, 34, 42, 43, 46, 48, 49(2)
NC CAP ASSY KIT	641	2, 33, 34, ALSO 14 FOR CLEVIS MOUNTED CYLINDERS ONLY
CUSH CAP ASSY KIT	643	2, 33, 34, 57, 58, 61, 63, 65(2), ALSO 14 FOR CLEVIS MOUNTED CYLS ONLY
HEAD END CUSH NOSE	650	41, 50

INSTALLATION AND SERVICE INSTRUCTIONS

2TH CYLINDERS

1. GENERAL: The parts drawing on Page 2 shows a complete listing of parts and is applicable to all standard Series 2TH hydraulic cylinders. This parts drawing, when used in conjunction with the listed parts and kits, should facilitate the ordering of any replacement parts or kits by specifying: (1) cylinder serial number, as it appears on the name plate; and (2) item number and part name or kit type and name.

2. INSTALLATION OF CYLINDER: Standard cylinders are furnished with seals compatible with petroleum base fluids. These seals work best within the temperature range of 0° F. to 175° F. For fluids other than petroleum base, different seal material may have to be used.

   For the cylinder to perform well, it must be properly installed. Alignment of the cylinder with load is most important. Forcing rod, clevis pins, or mounting bolts into position indicates that the cylinder is not properly aligned, and permanent damage may result from such installation.

   Protective port covers should not be removed before installing piping, as dirt or other foreign particles may enter the cylinder. All pipe and fittings must be clean before making final connections.

3. PROCEDURE FOR REPLACEMENT OF ROD SEALS AND CARTRIDGE:

   A. Disconnect cylinder and drain oil from head end port.
   B. Loosen cartridge lock screw (19).
   C. Remove rod cartridge (8) from the retainer (12) and slip off the piston rod (10).
   D. Remove retaining ring (22), rod packing assembly (30), rod bearing (9), and rod wiper (28). (The wave spring and any shims are considered part of the rod packing assembly.)
   E. Remove cartridge O-ring (31) and cartridge non-extrusion ring (32).
   F. Reassemble the cartridge with corresponding replacement parts, cleaning all parts thoroughly. Swelling, shrinking, wear, nicks, cuts, and indentations are all signs of defective seals. Such seals should be replaced.
   G. Prior to installation, all rubber parts must be well coated with lubricant.
   H. Carefully guide cartridge assembly over the end of the piston rod (10) and into the retaining plate (12); tighten in place with a wrench.

4. PROCEDURE FOR REPACKING CYLINDERS:

   A. Disconnect cylinder and drain oil from head and cap end ports.
   B. Remove the tie rod nuts (16).
   C. Remove cap end (2) and then head end (1). Cartridge retainer plate (12) and cartridge (8) will come off with head end.
   D. Remove piston and rod assembly from tube (11).
   E. Remove retainer plate (12) and rod cartridge (8) from head end (1). Removal is simplified by rotating retaining plate (12) 45° with respect to head end (1).
   F. Remove or loosen cartridge lock screw (19). Cartridge, if desired, may now be removed from retainer plate.
   G. Clamp piston rod (10) in soft jaws and proceed as follows:

   (1) SCR Type Piston

      a. Remove piston lock screw (18).
      b. The piston (4) is threaded onto the piston rod (10) and can be backed off once the piston lock screw (18) has been removed. Use the pin spanner holes provided in rear face of piston.
      c. Remove head end cushion nose (41).
      d. Remove piston packing rings (26).

   (2) Block Vee Type Piston

      a. Remove piston lock screw (18).
      b. Turn threaded piston (3) from piston rod. Use the pin spanner holes provided in rear face of piston.
      c. Remove head end cushion nose (41).
      d. Remove block vee packing (24) and back-up (non-extrusion) ring (25).

   (3) Vee Type Piston

      a. Remove piston plate lock screw (18) and turn threaded rear piston plate (6) from piston rod. Use pin spanner holes provided in rear piston plate.
      b. Remove piston support bearing (7), forward piston plate (5), and head end cushion nose (41).
      c. Remove vee piston packing assemblies (27) from forward and rear piston plates.

5. CLEANING: Clean all parts thoroughly. The packings and seals in this cylinder are compatible with hydraulic oils, air, water, and neutral fluids. The cleaning agent must also be compatible to avoid damage to packings and seals. Whenever a particular lubricant is specified for an installation, do not deviate from this specification without checking for compatibility.

6. INSPECTION:

   A. Inspect all packings, seals, and non-extrusion rings for swelling, shrinking, wear, nicks, cuts, and indentations. Discard all damaged packings, seals, and non-extrusion rings.
   B. Check and inspect bore of tube for scratches, excessive wear, and any other defect that might damage piston packing or cause piston bypass.
   C. Inspect piston rod for signs of wear, nicks, dents, scratches, or anything that may damage rod packing or rod bearing. Excessive wear on one side of piston rod or rod bearing usually indicates misalignment in installation and should be corrected.
   D. Inspect all remaining items for evidence of damage or wear. In most cases, a little polishing of the various parts will restore them to like-new condition.

7. REPLACEMENT: Replace all damaged packings, seals, rod wipers, and non-extrusion rings.

8. REASSEMBLY: The procedure for reassembly is essentially the reverse of disassembly. However, the following exceptions and considerations should be noted:

   A. All O-rings and non-extrusion rings should be well coated with lubricant after they are installed in their respective grooves and prior to reassembly with the mating part. Care must be taken when assembling O-rings and packings that they are not damaged, as this will cause leakage.

      (1) It is sometimes difficult to install assembled vee type pistons into a tube. If this should happen, it may be necessary to assemble the piston within the tube.

      (2) Care must be taken to be sure the rear plate (6) is tight against the forward plate (5). Any gap between these plates may permit the piston plate O-ring (36) to extrude. This can lead to piston bypass.

   B. Tie rod threads and nut bearing faces should be well lubricated to allow tightening the nuts evenly for proper pre-stressing. To avoid twisting of the tie rods during tightening, hold with vise grip or clamp. To assure equal pre-stressing of the tie rods, first turn on nuts even and snug to align assembly; then the nuts are to be tightened alternately. For proper tie rod pre-stressing, they should be torqued as recommended:

CYLINDER BORE	1½	2-2½	3½-4	5	6	7	8
TORQUE FT. LB.	26	56	148	282	374	560	690

9. TESTING:

   A. After the cylinder has been completely reassembled, it should be tested, either on a test bench or in the regular installation. Watch for the following as the cylinder is cycled at pressures ranging from normal operating pressure to 50 percent over, depending on the availability of the higher pressures:

      (1) Rod gland leakage.

      (2) Leakage at end cover O-rings.

      (3) Leakage at cushion adjusting needle.

      (4) Leakage at ball check plug.

   B. Final adjustment of cushion adjusting needle must be made after cylinder is installed in system.

YOUNG RADIATOR COMPANY

RACINE, WISCONSIN 53404

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR YOUNG HEAT EXCHANGERS

INSTALLATION INSTRUCTIONS

Young Radiator Company Heat Exchangers are designed to give the optimum heat transfer rate for given flow conditions. Ordinarily the most viscous fluid is piped to the shell side while the least viscous is piped to the tube side. The shell side of the Exchanger is baffled and therefore the shell fluid is required to make many changes of direction in its travel through the Exchanger. This breaks up the surface film which would otherwise prevent the transfer of heat. The next important consideration in the piping of the fluids to the Exchanger pertains to temperature. A single pass Exchanger should be piped counter flow for greatest heat transfer as this will give the greatest mean temperature difference over the entire length of the Exchanger. True counter flow exists where the two fluids flow in opposite directions in the Exchanger and is possible in the single pass Exchanger only.

In connecting a multi-pass Exchanger, the shell fluid should enter the Exchanger at the same end at which the tube fluid enters.

Strainers

In making up the pipe on the lube oil side of a Heat Exchanger for lubricating oil cooling it is essential to install a strainer on the outlet side of the Heat Exchanger. This is to collect foreign matter which may have entered the Exchanger in shipping and piping, preventing its entry into the engine. Consult your Young Radiator Company representative or write the factory directly for strainer recommendations.

Water Regulating Valves

In the interest of conserving water, a water regulating valve should be installed ahead of the Heat Exchangers in which water is used for cooling another fluid. Normally the regulating valve is temperature controlled and the control bulb for the valve is placed in the stream of fluid being cooled. Consult Young Radiator Company or a reputable manufacturer of this equipment for recommendations.

Pressure Relief Valve

When there is a possibility of surge pressures, above the design pressure of the Heat Exchanger a pressure relief or regulating valve should be installed to protect the Exchanger from bursting pressures. Consult Young Radiator Company factory or a reliable manufacturer of such equipment for recommendations.

SERVICE RECOMMENDATIONS

The Heat Exchanger, when shipped from the factory, is clean and should require no on-the-job cleaning. It is recommended that the Exchanger be inspected thoroughly on both the shell and tube side making sure that no foreign matter entered while in shipment. This inspection can be made without removing the end bonnets of the Exchanger. It is also recommended that the bolts holding the end bonnet to the end casting be checked and pulled down so as to insure tightness. The Exchanger should be mounted solidly in place and the pipe connections made up, being sure that all connections are tight. If the Exchanger is to be stored for any length of time before use, shell and bonnet openings should be kept sealed to prevent the entry of dirt or other foreign matter.

When the Exchanger is first installed, sufficient data should be taken to establish the temperature and pressure drops. Similar data recorded at regular intervals by the operator will serve to detect any accumulation of sediment or scale, and from such data the proper interval between cleanings can be established.

When an Exchanger is disassembled for cleaning, new gaskets should be used upon reassembly. This is important in both the Fixed and Removable Tube Bundle Exchangers.

Care should be taken when removing or handling the tube bundle of a Removable Tube Bundle Exchanger to protect the baffle plates and tubes from being bent or damaged. The result of bent baffle plates is bypassing of fluid with an accompanying decrease in heat transfer rate.

Corrosive and Scale Forming Fluids

In many sections of the country raw water is extremely corrosive or scale forming and should be treated to prevent damage to the Heat Exchanger and to prolong periods between cleanings. Before piping fluids to a Heat Exchanger, they should be analyzed as to what action they will have on the metals in the Exchanger.

If salt water is used as a cooling medium, zinc pencils should be used in the Heat Exchanger on the salt water side to prevent corrosion of the Exchanger. Parts in contact with the salt water should be of Admiralty metal, cast iron, or copper-nickel alloys.

Water Treatment - Closed System

In a closed water system, such as an engine jacket system, Young Cooling System Treatment No. 3-1-2 should be added to prevent corrosion and control scale deposits. This treatment is effective under normal operating conditions for a period of six months, after which the system should be drained and refilled with a new solution of Young No. 3-1-2.

Draining

A Heat Exchanger mounted horizontally will not completely drain until it is tipped at a slight angle.

Therefore, in draining, it is important to purge or blow out the tubes with compressed air.

If the Heat Exchanger is installed where there is chance of freezing on shutdown, the water circuit should be completely drained or an antifreeze should be added.

Cleaning Engine Jacket Water or Raw Water Circuit

Young "Cooling System Cleaner" No. 585, in the proportion of one pound to six gallons of water, should be used to remove oil, grease, rust, and scale. The solution should be circulated at normal rate and at a temperature between 180 to 200 F for a period of from one to three hours. (Do not allow solution to boil). After this has been done, open drain cocks in the water system and flush thoroughly with clean water. The Exchanger water connections should then be reversed and fresh water-cleaner solution circulated, again for one to three hours. After draining, the unit should be thoroughly flushed with fresh water and then reconnected for service.

Severely fouled tubes can also be cleaned by use of a rotary brush, similar to a shotgun cleaner, in conjunction with an air or electric rotating tool. This type of equipment is available commercially.

Cleaning Lube Oil Passages

Formation of oil sludge and other deposits about the tubes decreases the efficiency of the Exchanger and it is important that a cleaning medium be used which is suitable for removing such sludge.

Benzol, trichlorethylene and various commercial solvents are suitable for this operation. Benzol, and the hydrocarbon derivatives, are inflammable and should be used with due regard for open flames and the "sparking" of tools.

Benzol and trichlorethylene vapors are also toxic in "harmful" concentrations. Ample ventilation must be provided in the working area, supplying fresh air and exhausting all fumes to an outdoor location.

The solvent should be circulated through the Exchanger in the reverse direction to the normal flow for approximately fifteen minutes, after first soaking for about ten minutes. The length of time of circulation depends on the degree of dirt deposit.

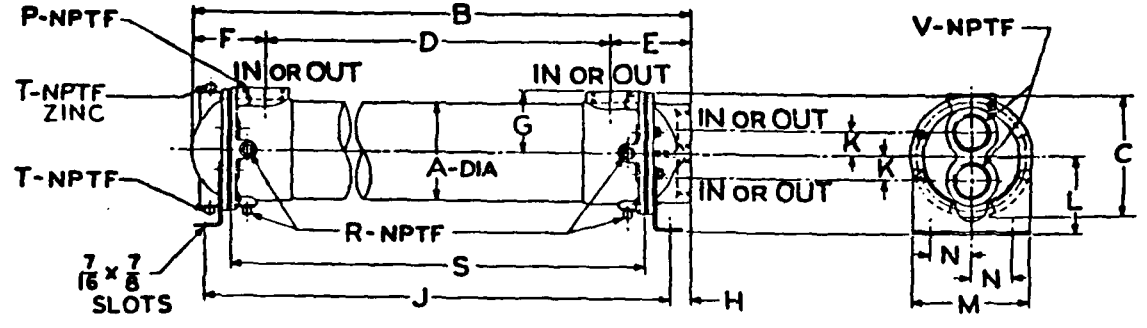
YOUNG RADIATOR COMPANY
2825 Four Mile Road Racine, Wisconsin 53404
Plants at: Racine, WI, Mattoon, IL and Centerville, IA

PARTS LIST

Young Radiator Company -- Heat Exchanger Assembly
Model F-503-EY-2P-CNT-B
Part Number 264444
Drawing C260499 and Form 3000

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	NSS ***	Tube Bundle & Shell Assembly
2	1	269473	Bonnet Kit, Inlet & Outlet
	1	120015	Bonnet, Brass
	1	67443 **	Gasket
3	1	269472	Bonnet Kit, Return
	1	120016	Bonnet, Brass
	1	67442 **	Gasket
	1		Pipe Plug, Brass
4	1	269428 *	Anode, Zinc
5	8	5/16-18 x 1-1/4"	Capscrew
6	8	5/16-18 x 15/16"	Capscrew
7	8		Washer
8	2	67489	Bracket, mounting
*		269441	Anode Kit, box of 12
**		269448	Gasket Kit, box of 5 each
***	Not Serviced Separately		

Recommended spare parts include one or more anode kits and one or more gasket sets.



PAINT – ONE COAT PRIMER GRAY ENAMEL

DIMENSION DRAWING
Customer
Address
Cust. Order No.
Y. R. Co. Order No.
Y. R. Co. Part No.
Y. R. Co. Model No.
Per
Date

DM-8844
SHT. 5 of 11

	SHELL	TUBE
OPERATING PRESSURE	150 psi	150 psi
TEST PRESSURE	250 psi	250 psi
MAXIMUM OPERATING TEMPERATURE	350F	350F

MODEL	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	V
F-502	5.12	23.12	6.50	15.50	4.06	3.56	3.31	1.06	21.62	1.18	4.00	6.25	2.00	1.50	.38	18.50	.38	1.50
F-503	5.12	32.12	6.50	24.50	4.06	3.56	3.31	1.06	30.62	1.18	4.00	6.25	2.00	1.50	.38	27.50	.38	1.50
F-504	5.12	41.12	6.50	33.50	4.06	3.56	3.31	1.06	39.62	1.18	4.00	6.25	2.00	1.50	.38	36.50	.38	1.50

YOUNG RADIATOR COMPANY, RACINE, WISCONSIN 53404 | F-500 2 PASS | FORM 3000

APPENDIX E

VENDOR DATA FOR ELECTRICAL EQUIPMENT

TECHNICAL MANUAL

WATERTIGHT A.C. MAGNETIC CONTROLLER SIZE "3"

30H.P. 440V. 3PH. 60CY.

CUTLER-HAMMER, INC.
MILWAUKEE, WISCONSIN

C-H TECHNICAL MANUAL 6862SP1104

CONTROLLER SECTION
INDEX

CUTLER-HAMMER, INC.

MILWAUKEE, WISCONSIN

6862SP1104

SHEET 1 OF 1 SHEETS

6862SP1104

LIST OF MATERIAL & RECOMMENDED REPAIR PARTS

ITEM NO.	DEVICE QUAN.	SPARE QUAN.	NAME OF PART	PART NO.	REPAIR PART DWG. OR PUB. NO.	ITEM
1	1	0	SIZE "3" CONTACTOR(C10EN3)(M)		C10E-1	-
1A		6	CONTACT STATIONARY	23-4028		
1B		3	CONTACT, MOVABLE	23-4029		
1C		3	SPRING, CONTACT	69-2908		
1D		3	RETAINER, SPRING	19-1736-2		
1E		2	SPRING, ARM. FRAME	69-2554		
1F		1	INTER., N.O.-N.C. BASE MTD.	C320KB8		
1G		1	COIL, SHUNT (110 VOLT)	9-1891-23		
2	1	0	SIZE "3" OVLD.RELAY(C300ENA3)(OL)		C300E-1	-
2A		2	HEATER COIL	* (LATER)		
3			CONTROL DISCONNECT SW. (CDS)	--	--	-
3A	3	0	CONTACT BLOCK 2N.O.	10250T2		

CHGS. 1 6 | 2 7 | 3 8 | 4 9 | 5 10

ENGR. A. A. Rice

DATE 8-19-69

A. C. MAGNETIC CONTROLLER SIZE "3"

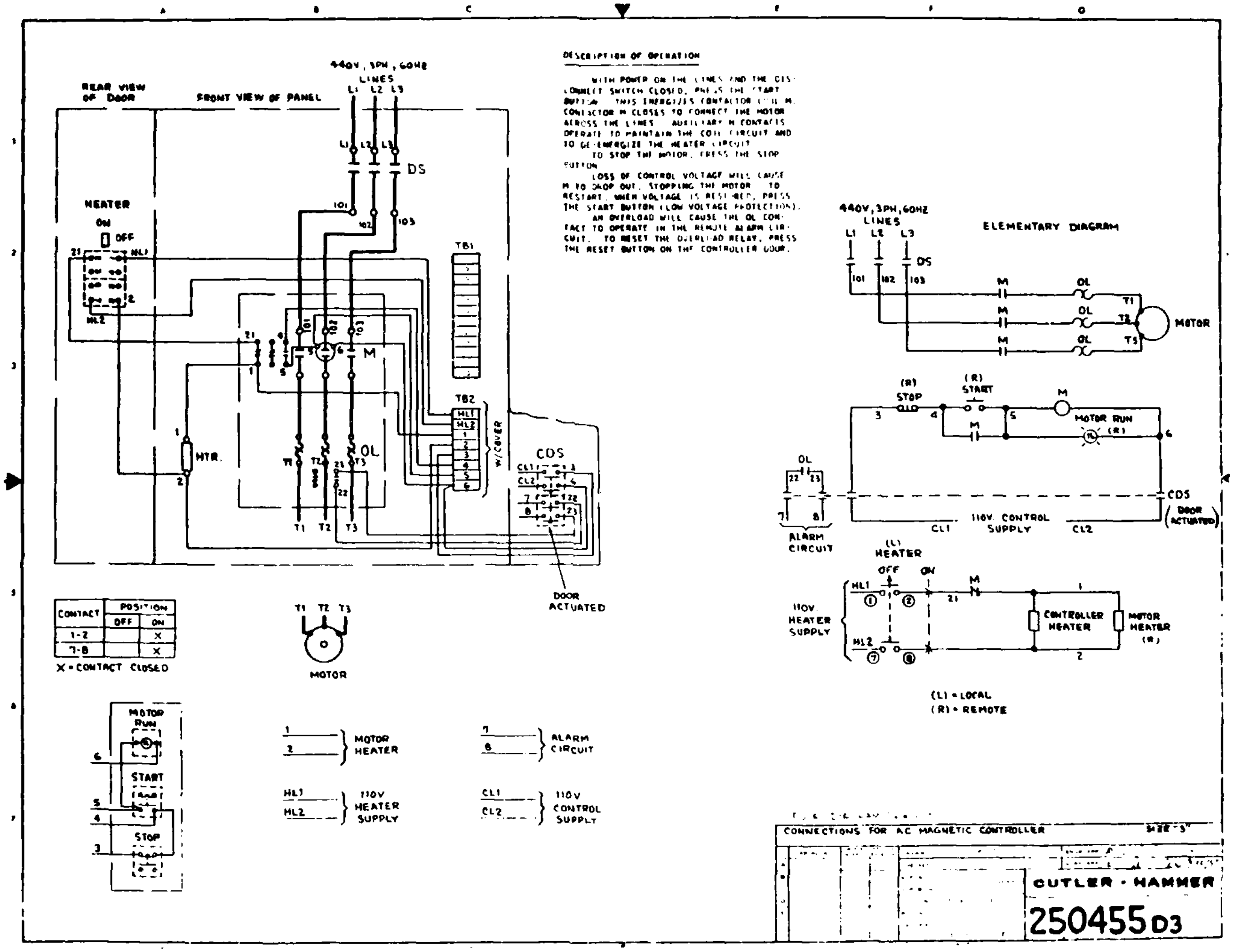
WHEN RE-ORDERING, ALWAYS SPECIFY COMPLETE NAMEPLATE READING ON APPLIANCE, PART NO. AND DWG. NO. BELOW

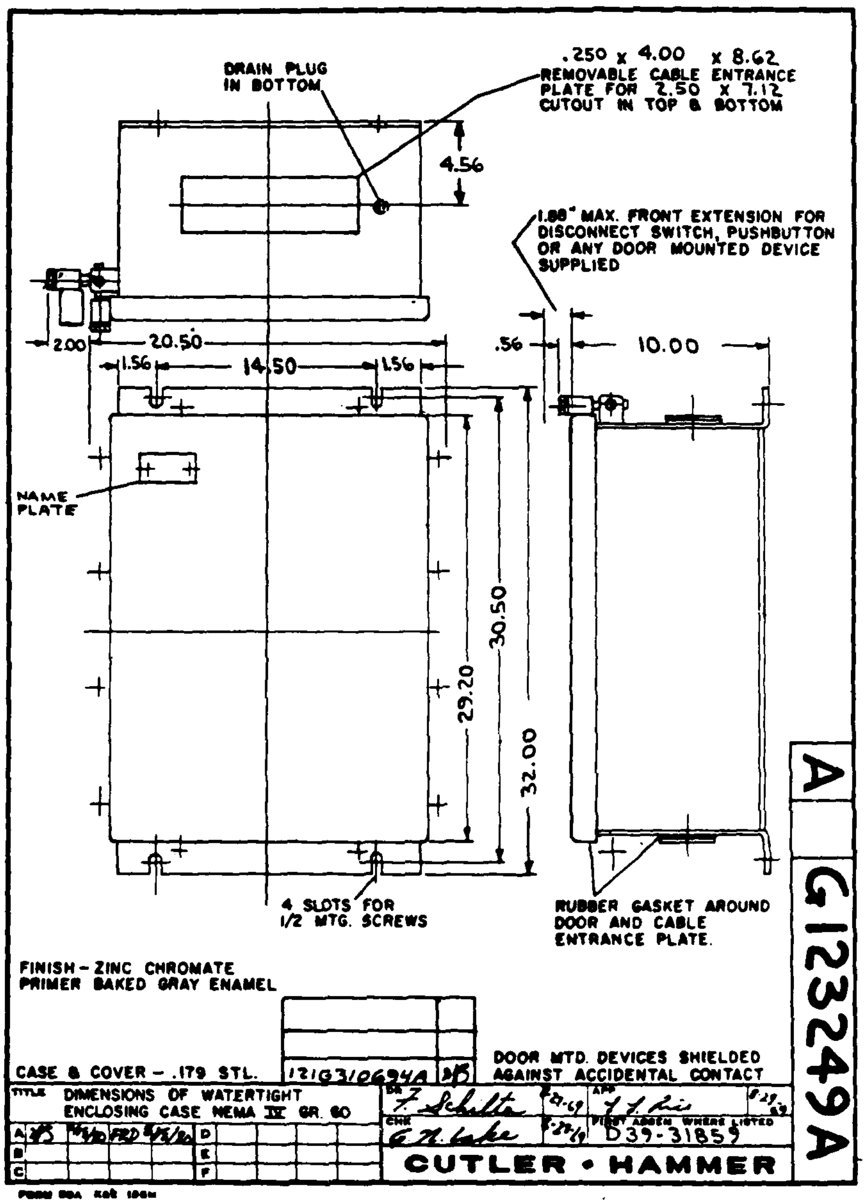
C-H ORDER NO. G123991B

C-H DWG. NO. 6862SP1104 REV

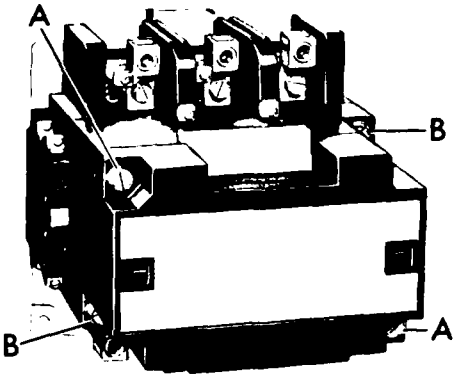
CUTLER-HAMMER INC. MILWAUKEE, WIS.

SHEET 1 OF 1 SHEETS


DESCRIPTION OF OPERATION
WITH POWER ON THE LINES AND THE DISCONNECT SWITCH CLOSED, PRESS THE START BUTTON. THIS ENERGIZES CONTACTOR COIL M. CONTACTOR M CLOSES TO CONNECT THE MOTOR ACROSS THE LINES. AUXILIARY M CONTACTS OPERATE TO MAINTAIN THE COIL CIRCUIT AND TO DE-ENERGIZE THE HEATER CIRCUIT.
TO STOP THE MOTOR, PRESS THE STOP BUTTON.
LOSS OF CONTROL VOLTAGE WILL CAUSE M TO DROP OUT, STOPPING THE MOTOR. TO RESTART, WHEN VOLTAGE IS RESTORED, PRESS THE START BUTTON (LOW VOLTAGE PROTECTION).
AN OVERLOAD WILL CAUSE THE OL CONTACT TO OPERATE IN THE REMOTE ALARM CIRCUIT. TO RESET THE OVERLOAD RELAY, PRESS THE RESET BUTTON ON THE CONTROLLER DOOR.
REAR VIEW OF DOOR
FRONT VIEW OF PANEL
440V, 3PH, 60HZ LINES
L1 L2 L3
DS
HEATER
ON
OFF
HL1
HL2
M
OL
MTR.
TB1
TB2
W/COVER
CDS
DOOR ACTUATED
T1 T2 T3
MOTOR
CONTACT
POSITION
OFF
ON
1-2
7-8
X
X = CONTACT CLOSED
MOTOR RUN
START
STOP
MOTOR HEATER
110V HEATER SUPPLY
ALARM CIRCUIT
110V CONTROL SUPPLY
ELEMENTARY DIAGRAM
(R) STOP
(R) START
MOTOR RUN (R)
(DOOR ACTUATED)
CL1
CL2
(L) HEATER
CONTROLLER HEATER
MOTOR HEATER (R)
(L) = LOCAL
(R) = REMOTE
CONNECTIONS FOR AC MAGNETIC CONTROLLER
CUTLER - HAMMER
250455 D3


DRAIN PLUG
IN BOTTOM
.250 x 4.00 x 8.62
REMOVABLE CABLE ENTRANCE
PLATE FOR 2.50 x 7.12
CUTOUT IN TOP & BOTTOM
4.56
1.88" MAX. FRONT EXTENSION FOR
DISCONNECT SWITCH, PUSHBUTTON
OR ANY DOOR MOUNTED DEVICE
SUPPLIED
2.00
20.50
1.56
14.50
1.56
.56
10.00
NAME
PLATE
30.50
29.20
32.00
4 SLOTS FOR
1/2 MTG. SCREWS
RUBBER GASKET AROUND
DOOR AND CABLE
ENTRANCE PLATE.
FINISH - ZINC CHROMATE
PRIMER BAKED GRAY ENAMEL
CASE & COVER - .179 STL.
DOOR MTD. DEVICES SHIELDED
AGAINST ACCIDENTAL CONTACT
TITLE DIMENSIONS OF WATERTIGHT
ENCLOSING CASE NEMA IV GR. 60
D39-31859
CUTLER • HAMMER
A
G123249A

RENEWAL PARTS AND INSTRUCTION PUBLICATION FOR NEMA SIZE "3" 2 AND 3 POLE AC CONTACTORS



TYPICAL CONTACTOR THREE POLE
WITH TWO CIRCUIT ELECTRICAL INTERLOCK

INTRODUCTION

This publication is designed to simplify inspection and maintenance. It features . . .

1. A publication number keyed to the ordering number of the device . . . to simplify filing and fact finding.
2. A nameplate inscription keyed to the specific renewal parts publication . . . to eliminate cross referencing.
3. An exploded view for easy, positive identification of parts with illustrated steps on "how to assemble and disassemble" . . . to conserve time and eliminate guesswork.
4. Comprehensive maintenance information to provide maximum performance. This information should be read carefully.

DESCRIPTION

These are 2 and 3 pole A-c contactors for across the line applications within the ratings shown on the nameplate of the equipment.

CARE

These A-c contactors require no mechanical maintenance. Any maintenance required can be performed with an electrician's screwdriver. For continued uninterrupted performance, renew all of the power contacts and springs at the same time before the contact tip material has worn away.

When renewing the contacts check all terminal screws to insure they are tight and secure.

Suggestion — refer to publication 14183 for helpful information on inspecting and determining when to replace contacts.

RENEWAL OF OPERATING COIL

The operating coil is epoxy encapsulated and so constructed to provide long service life. Should the coil require changing, the entire operation can be performed in a few minutes.

1. Unfasten the two pan head cover screws "A" and remove the cover item 28 page 2.
2. Unfasten the four pan head screws item 27 securing the clamp item 25 and the armature item 22. Remove the clamp and the armature.
3. Pull the coil straight out.
4. Install the new coil with the coil terminal blades engaging the coil terminal clips.
5. Install the armature (narrow end to the left) into its seated operating position.
6. Install the clamp and secure the screws.
7. Install the cover.

RENEWAL OF POWER UNIT

NOTE • The power unit item 1 consists of a factory assembly of all the magnetic parts, movable contacts, and their carrier assembly. This unit usually permits immediate restoration to service of a device which may have become inoperative.

Unfasten the two gold colored Hex. Head screws "B", pull out the power unit, plug-in the new and retighten the screws "B". A set of stationary contacts is included with the power unit. It is advisable to install these stationary contacts at the same time, particularly if visual inspection indicates that both the movable and stationary contacts need replacement. Specify coil by suffix letter selected from the coil table on page 4.

RENEWAL OF POWER CONTACTS

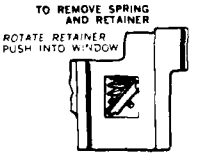
The power contacts when used within their rating will provide long trouble free life. They should not be filed or dressed.

1. Remove the power unit assembly by loosening the two gold colored slotted hex. head screws "B" and pull the power unit straight out.

MOVABLE CONTACTS

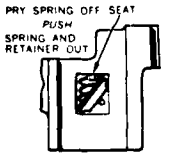
2. Remove the contact bar item 34 by removing the two screws and washers items 35 and 36.
3. Refer to sketch "A". Raise the retainer item 12 against the spring to free the contact so it can drop out.

SKETCH "A"

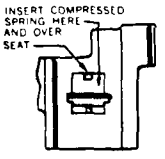


SKETCH "B"

4. Refer to sketch "B" and "C". Rotate the retainer into the position shown and push it into the window to hold it. Lift the spring off the seat with a small screwdriver. Push the spring and retainer through the window.



SKETCH "C"

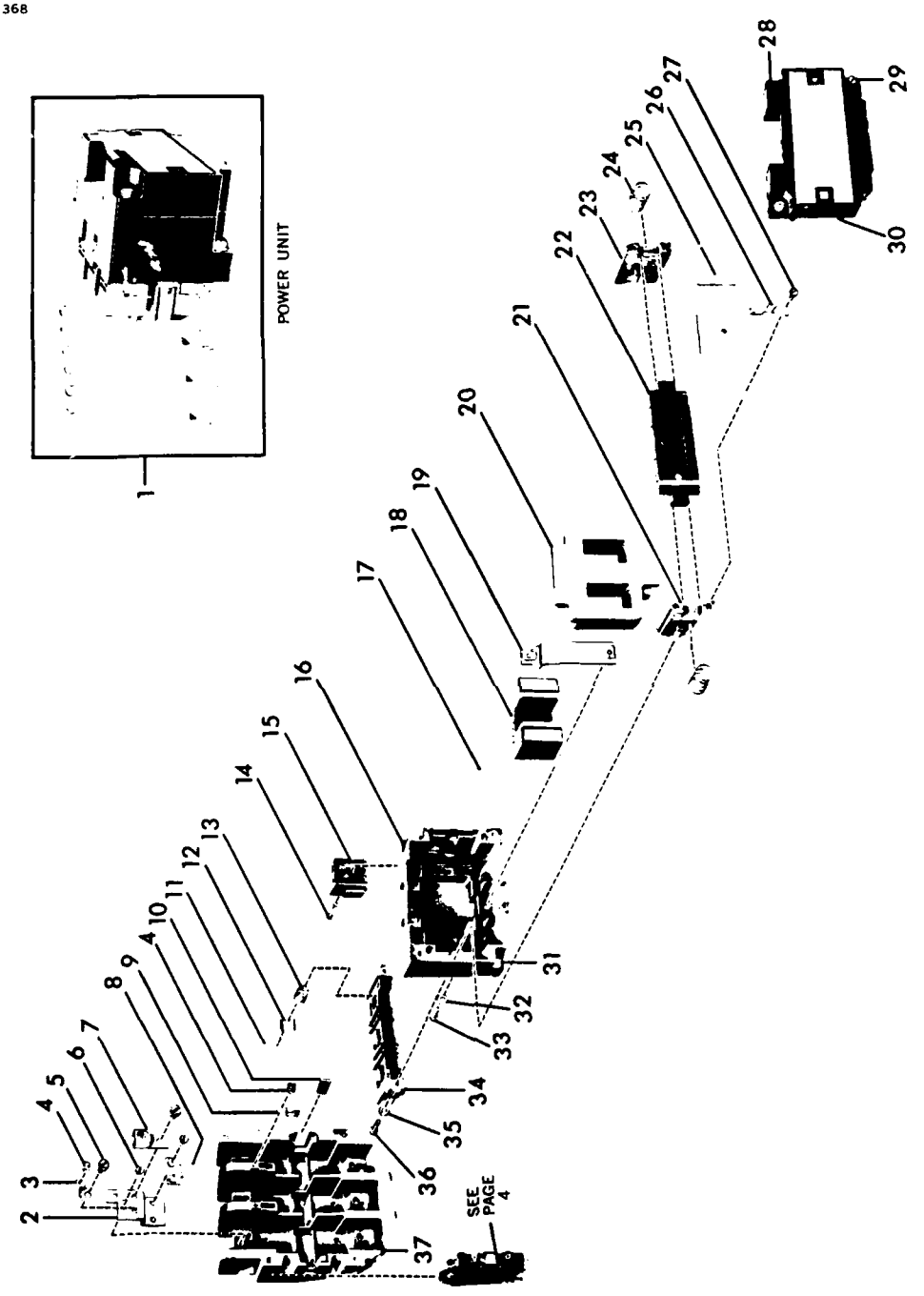


SKETCH "D"

5. Refer to sketch "D". Place and hold the retainer in the position as shown.
6. Compress the spring with the thumb and index finger and insert and seat in the cavity above the retainer.
7. Raise the retainer against the spring, insert and position the contact. Contact tips must face away from the retainer.
8. Install the contact bar to the push bars items 21 and 23 with screws and washers items 35 and 36.

Note: The contact bar is not reversible. Match the ends of the contact bar to fit inside the raised projections on the push-bars.

(Continued on Page 4)


POWER UNIT
1
2
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34
35
36
37
SEE PAGE 4

RENEWAL PARTS — Information Required

To insure prompt handling of renewal parts orders, please include the following: **DESCRIPTION, PART NO., AND QUANTITY REQUIRED.**

▲Recommended Spare Parts:

A Renewal Set of Contacts for 2 Poles, Part No. 6-25 (includes items 6, 8, 11, 12 and 13).

A Renewal Set of Contacts for 3 Poles, Part No. 6-25-2 (includes items 6, 8, 11, 12 and 13).

PARTS LIST

Item No.	Description of Part	2 Pole Contactor No. Req.	2 Pole Contactor Part No.	3 Pole Contactor No. Req.	3 Pole Contactor Part No.
• 1	Power unit (includes items 6, 8, 11 *thru 36*)	1	C10EX	1	C10EX
2	Terminal Plate	4	80-2807	6	80-2807
3	Control Terminal	2	80-2824	2	80-2824
4	Auxiliary Terminal Clamp	*	55-1743	*	55-1743
5	1/4-20 x .625 Slotted Hex Sems Screw	*	11-2682	*	11-2682
6	10-32 x .438 Flathead Sems Screw	12	11-2390	18	11-2390
7	Lug				
	Copper (Furnished with Open Contactor)	4	80-2801	6	80-2801
	Aluminum (Furnished with Enclosed Contactor)	4	80-3307	6	80-3307
▲ 8	Stationary Contact	4	23-4028	6	23-4028
9	Coil Terminal Clip	2	80-2747	2	80-2747
10	Insulator	1	56-3494	1	56-3494
▲11	Movable Contact	2	23-4029	3	23-4029
12	Retainer	2	19-1736-2	3	19-1736-2
13	Spring	2	69-2908	3	69-2908
14	8-32 x .50 Round Head Screw	4	911-416Z	6	911-416Z
	No. 8 Lockwasher	4	16-42	6	16-42
15	Arc Chute	4	62-531	6	62-531
16	Magnet Housing (see Item 31)	1	49-3626	1	49-3626
17	Spring	1	69-2770	1	69-2770
★18	Magnet Frame	1	48-1030	11	48-1030
19	Clamp	1	19-1570	1	19-1570
20	Coil (see Coil Table on page 4)	1	.....	1	.....
21	Push Bar (Left Hand)	1	61-1612	1	61-1612
★22	Armature	1	48-1029	1	48-1029
23	Push Bar (Right Hand)	1	61-1606	1	61-1606
24	Spring	2	69-2554	2	69-2554
25	Clamp Plate	1	79-8622	1	79-8622
26	Indicating Plate	2	30-4864	2	30-4864
27	10-32 x .62 Pan Head Sems Screw	4	11-2523	4	11-2523
28	Cover (includes items 29 and 30) (without nameplate) (give complete nameplate data for cover with nameplate)	1	49-4152	1	49-4152
29	1/4-20 x 1.04 Pan Head Sems Screw	2	11-2313	2	11-2313
30	Spring	4	69-2552	4	69-2552
31	1/4-20 x 1.45 Slotted Hex Head Sems Screw	2	11-2522	2	11-2522
32	No. 10 Washer	2	916-521Z	2	916-521Z
33	10-32 x 1.00 Pan Head Sems Screw	2	11-2765	2	11-2765
34	Contact Bar	1	23-4030-3	1	23-4030-3
35	No. 10 Washer	2	916-166	2	916-166
36	10-32 x .875 Pan Head Sems Screw	2	11-2521	2	11-2521
37	Molded Base	1	17-9043	1	17-9043

•Coil must be specified by suffix letter selected from coil table on page 4.
The power units are supplied only with 3 power poles.

*As required.

★It is recommended that items 18 and 22 be replaced together.

(Continued from Page 1)

STATIONARY CONTACTS

Note: It is not necessary to disconnect any wiring.

9. Remove the screws securing the stationary contacts.
10. Install the new contacts and screws.

ELECTRICAL INTERLOCKS

The electrical interlocks are renewable as a complete assembly. See illustrations and tables below for the various electrical interlocks.

ARC CHUTES

These seldom require renewal. Some burning and discoloration are normal. When the contacts are renewed, brush out any loose accumulations.

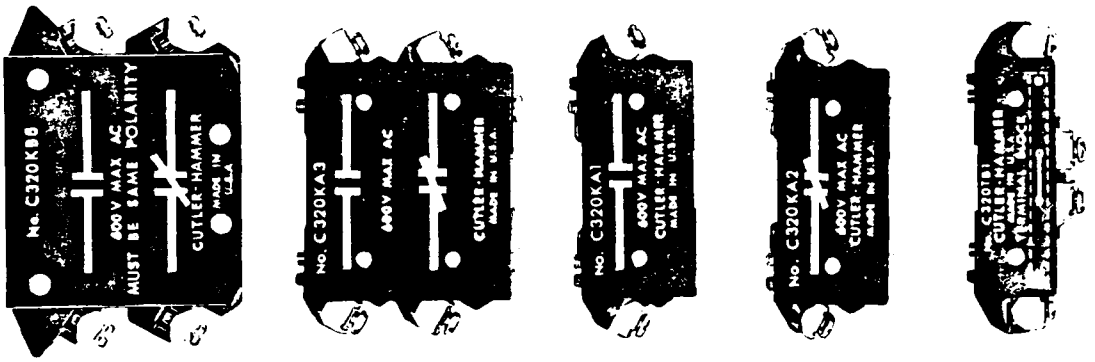
MAGNET

The magnet clamp screws item 33 are accessible when the two center arc chutes are removed.

LUBRICATION

Do not lubricate any part of this equipment.

ACCESSORIES
ELECTRICAL INTERLOCKS, TERMINAL BLOCK AND COIL TABLE



ADD ON TYPE

BASE MOUNTED

Circuit	Catalog No.
1 N.O.	C320KB7
1 N.O.-1 N.C.	C320KB8

FOR MOUNTING ABOVE BASE MOUNTED INTERLOCK

Circuit	Catalog Number
1 N.O.	C320KA1
1 N.C.	C320KA2
1 N.O.-1 N.C.	C320KA3

TERMINAL BLOCK

Cat. No.
C320TB1

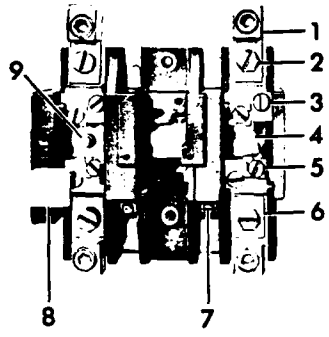
Operating Coils Selection Table

Volts	Cycles	Part Number	*Suffix Letter	Volts	Cycles	Part Number	*Suffix Letter
120 110	60 50	9-1891-1	A	600 550	60 50	9-1891-4	D
240 220	60 50	9-1891-2	B	208	60	9-1891-13	E
480 440	60 50	9-1891-3	C	380	50	9-1891-14	L

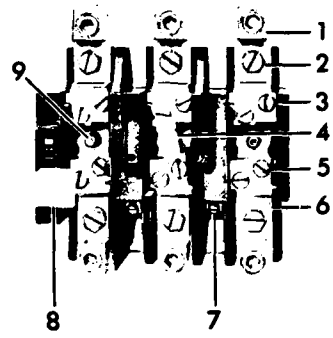
*Suffix letter required only when power unit is ordered.

RENEWAL PARTS AND INSTRUCTIONS FOR 100 AMPERES STANDARD TRIP EUTECTIC OVERLOAD RELAY

(WHITE BUTTON)



1 Element Overload Relay



2 or 3 Element Overload Relay

RENEWAL PARTS — *Information Required*

To insure prompt handling of renewal parts orders, please include the following: **DESCRIPTION, PART NO., AND QUANTITY REQUIRED.**

PARTS LIST

Item No.	Description of Part	No. Req.	1 Element Part No.	No. Req.	*3 Element* Part No.
1	Lug (Copper)	4	80-2801	6	80-2801
2	¼-20 x .75 Slotted Hex Head Sems Screw	4	11-2683	6	11-2683
3	10-32 x .50 Pan Head Sems Screw	4	11-2537	6	11-2537
4	Connector	1	25-2217-2	1	25-2217-2
5	Screw	4	11-2581	6	11-2581
6	Terminal Plate	4	80-3321	6	80-3321
7	Auxiliary Terminal Clamp				
	Silver (Color)	2	55-1743	2	55-1743
	Gold (Color)	2	55-1743-2	2	55-1743-2
8	Button (White)	1	53-1346-6	1	53-1346-6
9	Thermal Element	1	10-4057	3	10-4057
	6-32 x .312 Round Head Sems Screw	3	11-1525	3	11-1525

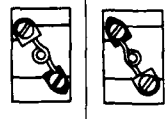
NOTE: The parts listed and illustrated are available for repairs. Should other parts be required order a complete overload relay by referring to the identifying number on the mounting plate.

INSTRUCTIONS

This overload relay has two steps of adjustment (low or high) obtained by POSITIONING THE HEATER COILS as shown in the adjacent illustrations. Note the location of the pointed terminal on the heater coil.

The heater coil selection table furnished with the starter illustrates the proper mounting position.

HEATER COIL POSITION



All coils must be mounted in the same position for a given overload relay.

Reset and tripped indication —

A transparent rectangular window above the reset button provides visual indication.

Relay Reset — Dark Window.

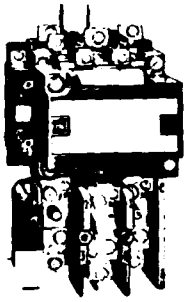
Relay Tripped — Light (silver) Window.

Do not disassemble this relay.

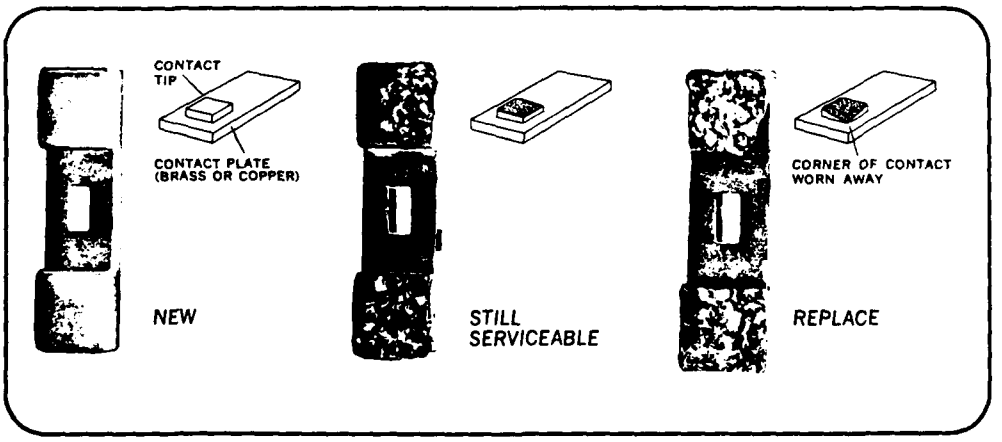
PUBLICATION NO. 14183
867

TO ELECTRICAL MAINTENANCE MEN

ARE YOU GETTING **FULL SERVICE** FROM THE CONTACTS IN YOUR **CUTLER-HAMMER CONTROLS**



Here's a hint that may be HELPFUL...



Are you throwing away contacts before they are worn out? Have you wondered when contacts do need replacing? Are you making the decision to replace contacts based on your experience with old forged copper contacts?

Cutler-Hammer's introduction of the cadmium silver oxide contacts, over a decade ago, heralded a new era of longer contact life. But with longer contact life came new visual contact inspection means of judging when contacts need replacement.

This brochure is designed to help you get maximum life from your contacts, yet replace them before a costly shutdown occurs.

WHAT CAUSES A CONTACT TO WEAR OUT

In establishing and interrupting motor currents, contacts are subjected to both electrical and mechanical wear. Normally mechanical wear is insignificant. Electrical wear, caused by arcing, erodes the contacts; and during arcing a small part of each contact is vaporized and blown away.

Accurate determination of the time to replace contacts should actually combine measurement of wear allowance and judgment regarding the appearance of the contacts.

VISUAL INSPECTION

CAUTION: Contacts should never be inspected without first disconnecting the power at the branch circuit disconnecting device. In starters provided with a separate low voltage power supply, the separate control source should also be disconnected.

As contacts continually make and interrupt a current, the surface of the contact will change in color, contour, in smoothness, resulting in discolorations, irregularity of surface, and pitting. Normally a new contact has a uniform silver color. As electrical wear occurs, the silver color may change to blue, brown, or black. The black color is primarily a result of silver oxidation which is beneficial to contact operation. The presence of small black embedded granules in the contacts indicates the presence of cadmium oxide which is also an excellent electrical conductor.

Irregularity of contour is caused by uneven electrical wear. Such wear does not necessarily indicate that a contact is worn out. Considerable silver is built into the contact to provide for wear allowance.

Irregularity of contour usually involves a slantwise type of wear. As an example, one corner of a contact may wear more quickly than the other three corners wear away. This type of wear is normal. Even though the wear allowance of the contact may not be exceeded, contacts should be replaced if it is noted that one contact is nearing the condition in which it will be making direct contact with the plate. The plate is the material on which the contact tips are fastened. If the plate material is contacted, welding of the contacts may occur.

Pitting is caused by melting and vaporization of the material. The pitted surface has high spots and low spots, and tests indicate that such a surface provides a better contact than a smooth surface. The size of a pit mark, or crater, is proportional to the amperes of the arcing current. On a high amperage contact, then, the pit marks will be larger than on a low amperage contact. Pitting of a contact that is wearing well will show a uniform texture. When it appears that chunks are being torn away from the arcing surface, it is advisable to replace the contact.

Curling of a contact is a condition in which the corners of the contact separate from the plate to which the contact is fastened. If such separation is occurring, the contact should be replaced. Curling is usually a result of service that produces very high heat. An example of such service is severe inching or jogging of the contactor, or when the device is subjected to fault conditions that occur from short circuits or grounds in the system. If the condition continues to exist with each replacement of contacts, the application should be carefully checked to determine if the contactor is properly rated for the application, and whether other associated equipment is operating properly.

Inspection of contacts is a simple maintenance operation. Merely remove the contact block cover and slide out the movable contact bar. Where periodic maintenance is performed regularly, inspection of the movable contacts alone will tell the story. If the movable contacts are in reasonably good condition, chances are that the stationary contacts are also in good condition. If the contacts appear to be questionable, check the stationary contacts also, and the wear allowance as described in the next paragraphs. With a little experience, you will soon become an expert in judging contacts by their appearance and **YOU WILL AVOID THE NEEDLESS WASTE OF THROWING AWAY GOOD USABLE CONTACTS.**

MEASUREMENT OF WEAR ALLOWANCE

Wear allowance of a contact is defined as the total thickness of contact material which may be worn away before the contact becomes inadequate to carry the rated current. Generally, a contact is serviceable as long as the remaining wear allowanace is not less than a specified minimum value. Usually this minimum value is in the order of 0.015 inch.

On a contactor, the means of determining how much wear allowance an arrangement of contacts has remaining is to insert a 1/32" feeler gage between the armature and the magnet frame, and move the armature toward the sealed position until it comes to rest against the feeler gage. At this point, if the contacts are touching, the wear allowance has not been exceeded, and the contacts are still usable.

In many instances, visual observation of the contacts during measurement of wear allowance, may be difficult. A more reliable method of determining whether the contacts are or are not touching is to use a continuity checker. There should be continuity with the armature closed against the 1/32" feeler gage. It is advisable to use a wide feeler gage to avoid the possibility of tilting the armature while holding it closed.

If the continuity checker indicates continuity, the contacts have sufficient wear allowance to still be usable. If there is no continuity, the contacts should be replaced. Be sure to check the continuity checker to make sure that it is working properly.

WHEN TO REPLACE CONTACTS

Determination of when to replace contacts should combine both visual inspection and measurement of wear allowance. If there is extreme pitting and curling of the corners, or if the contact has eroded at the corners to a point where the contact bridge is beginning to show, the contacts should be replaced. Even with contacts whose appearance is good, however, they should be replaced if they do not check out satisfactorily on measurement of wear allowance.

DO NOT FILE silver contacts, as all you are doing is removing useful life. Filing of the contacts will neither improve the performance, nor extend the life of the contact.

REPLACEMENT OF CONTACTS

CAUTION: Contacts should never be inspected or replaced without first disconnecting the power at the motor branch circuit disconnecting device. In starters provided with a separate low voltage supply, the separate control source should also be disconnected.

When you have determined that the contacts should be replaced, it is advisable to replace the STATIONARY CONTACT, MOVABLE CONTACT, AND THE MOVABLE CONTACT SPRING. Also, if a device is used to control a three-phase motor, it is advisable to replace all of the power pole contacts whenever any one pole needs replacement. Contact kits are readily available containing all of the necessary contacts and springs to make this replacement readily. The contact kit part number providing all the necessary parts for replacement of the contacts is included on the nameplate of the contactor.

Remember, **DO NOT REPLACE CONTACTS UNNECESSARILY;** but when it is necessary, replace all of the power contacts in that device.

CUTLER-HAMMER, Milwaukee, Wis.

Made in U. S. A.

Chromalox®

Installation, Operation and RENEWAL PARTS IDENTIFICATION

SERVICE REFERENCE			
DIV. 4	SEC. ARMTO	NUMBER	3001E
SALES REFERENCE	(Supersedes PD406-4)		PD406-5
			161-048231-001

Chromalox Screw Plug Oil Immersion Heaters – Type ARMTO

Constructed of Steel Sheathed Elements with Steel Screw Plugs

Catalog Numbers as Listed on Page 4

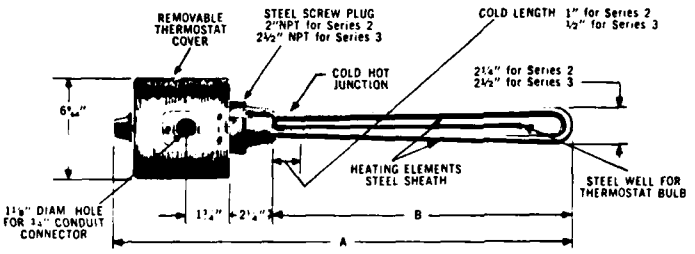


FIGURE A

NOTE: Series 2 Heaters — All Cat. Nos. starting with 2; Series 3 Heaters — All Cat. Nos. starting with 3 See Page 4 for Specifications.

CONTROL CHARACTERISTICS OF BUILT-IN THERMOSTATS USED IN STANDARD HEATERS

Contacts — Double pole, single throw, snap action break on temperature rise

Contact Maximum A.C. Rating

35 amps. 4.375 KW at 125 volts
25 amps. 6.25 KW at 250 volts

Note: a. Connect thermostat directly to any heater rated within electrical capacities shown above. See Fig. 6.

b. Wire thermostat into holding coil circuit of suitable contactor (See Figs. 7 thru 11) for:

1. Heater electrical capacities greater than shown.
2. Three phase heaters (Check factory for 3 - Thermostats.
3. Heaters connected to D.C. systems. Pilot service only with D.C. magnetic contactor. 250 max. voltage.

INSTALLATION CAUTIONS –

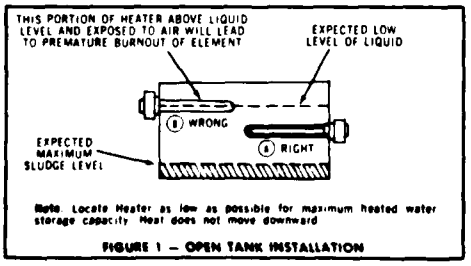
1. Be sure *Line Voltage* is the *same* as that stamped on *heater nameplate*.

2. Do not *connect* heaters in series whose element *wattages* are uneven.

Note: Heaters of same *voltage* and *wattage* can be connected two or more in series across a supply voltage equal in value to the sum of the heater voltages.

3. Install heaters above maximum expected sludge level. See Fig. 1.

4. Do not bend the heating elements. If bending is necessary, check the factory.



Note: Locate Heater as low as possible for maximum heated water storage capacity. Heat does not move downward.

FIGURE 1 – OPEN TANK INSTALLATION

5. Protect terminal end of heaters from drippings, condensation, spray, or direct spillover.

6. Install heater below expected low liquid level in open tank installations. (See (A), Fig. 1). Entire heated length of heater must be immersed at all times.

7. When used in a *closed tank* as a *circulation heater*:

a. Place heater at an elevation so that natural circulation can take place.

b. Important: Heat should never be located at the highest point in the water system. Provide expansion tank, if necessary.

c. Install heater in side wall of tank (customer furnished). Install in a vertical position (See Fig. 2).

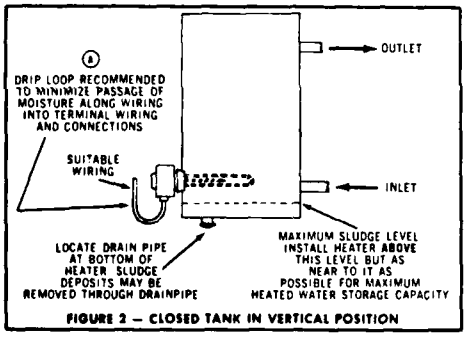


FIGURE 2 – CLOSED TANK IN VERTICAL POSITION

d. If application requires heater be installed thru top of vertical tank, it is IMPORTANT to locate tank outlet pipe location higher than hot-cold junction of heater (See Fig. A).

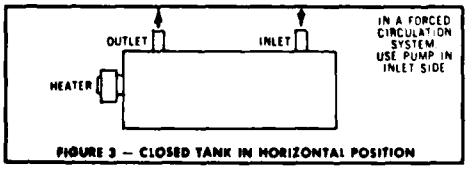


FIGURE 3 – CLOSED TANK IN HORIZONTAL POSITION

e. When installed in a horizontal plane (See Fig. 3), position outlet and inlet in a vertical plane, facing upward to prevent air pockets in the heater.

f. Keep the heater housing filled with liquid at all times.

g. Use only in solutions which will not corrode copper.

9. Insulated copper wire may be used where temperatures will not exceed 500°F.

10. Use explosion resistant terminal housings in hazardous locations.

OPERATION CAUTIONS —

1. Be sure all trapped air is removed from the closed tank. Bleed the air out of the liquid piping system and heater housing prior to operation.

a. The *heater housing* in closed tank systems must be kept *filled* with liquid at all times.

2. Do not operate any section of the heating element in air in open tank installations (See B, Fig. 1). Never allow the liquid level to fall below the heating elements or any part of same.

3. Disconnect power to the heater before removing heater from the tank.

4. Disconnect the power to the heater in case of tank drainage or failure of water supply.

a. Do not operate heater if dry.

5. Keep heating elements above sludge deposits.

6. Do not allow excessive coatings to form on heating elements or heater burnouts will occur.

INSTALLATION INSTRUCTIONS —

1. Pull off thermostat knob (on some knobs, first loosen set screw).

2. Remove thermostat cover.

3. Screw heater directly through threaded opening in the tank wall. (See Fig. 4).

a. Use a standard high quality pipe sealing compound on the threads (available locally).

b. Screw heater into threaded opening—tighten sufficiently with proper wrench applied on *hex portion of screw plug.*

4. Rough-in suitable wiring (BX, flexible or rigid conduit) thru knockout on thermostat housing. Rigid conduit is normally used with heaters equipped with moisture-resistant or explosion-resistant terminal housings. (See ①, Fig. 2). See appropriate wiring diagram and also Renewal Parts Table, Line Current Data as a guide in determining branch circuit wiring and control equipment requirements.

Note: All wiring should be done in accordance with local and/or national electric codes.

5. Wire as per proper wiring diagrams (Page 3).

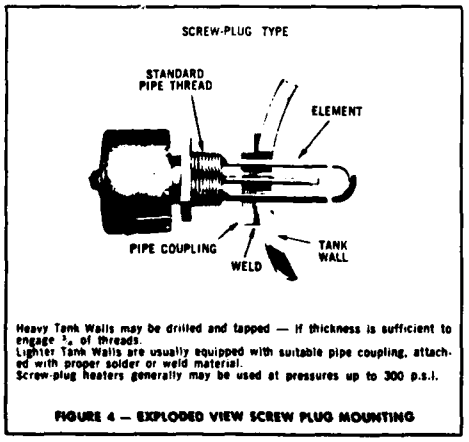


FIGURE 4 — EXPLODED VIEW SCREW PLUG MOUNTING

6. Replace thermostat cover.

7. Replace thermostat knob.

8. Set thermostat knob to the desired liquid temperature setting.

MAINTENANCE INSTRUCTIONS —

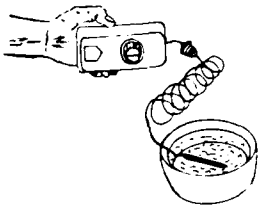
1. Remove heating elements periodically (disconnect power supply) to inspect and remove scale deposits.

2. Remove sludge deposits from heater tank, drain thru drain pipe, if available.

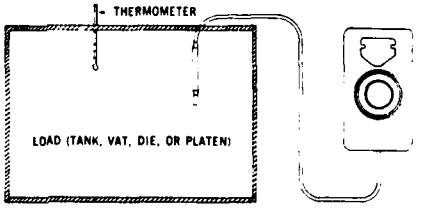
3. Clean terminal end (disconnect power supply) of all contamination.

FIELD CALIBRATION OF THERMOSTAT —

Thermostats are carefully calibrated to the temperature of the sensing bulb at the factory. However, they should be recalibrated to the actual working temperature of the load for the most satisfactory operation.



A. Allow bulb to adjust to known temperature (boiling water 212°F.) or place bulb in material to be heated and measure temperature with thermometer reading when control "clicks" off.



B. 1. Calibrate to correspond with thermometer.
2. Recalibrate to "load" characteristics if necessary.

C. To set Calibration adjustment screw:

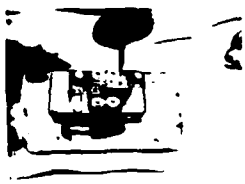
❶ Remove knob.

❷ Remove cover.

❸ Loosen outer shaft set screw — Use ¾" Allen wrench.

❸ Loosen stop set screw. Use 5/64" Allen wrench.

❺ Pull off outer shaft.



❻ Turn adjusting screw until contacts click open.

❼ Replace knob and without turning shaft set knob at same temperature reading as thermometer or known value. Tighten stop set screw and outer shaft screw. See ③ and ④. If necessary, to reach shaft set screw, rotate shaft slightly. *Be sure* stop set screw is tight.

❽ Move knob to the "OFF" position.

❾ Loosen knob screw and remove knob.

❿ Replace cover.

⓫ Replace knob. Tighten knob screw.

⓬ Recheck calibration and repeat process if closer calibration is required.

WIRING DIAGRAMS –

Broken line indicates customer-furnished equipment and field wiring by User or Contractor.

WIRING DIAGRAMS

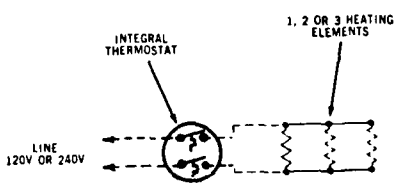


FIGURE A

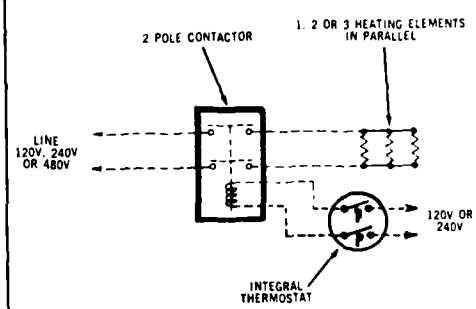


FIGURE B

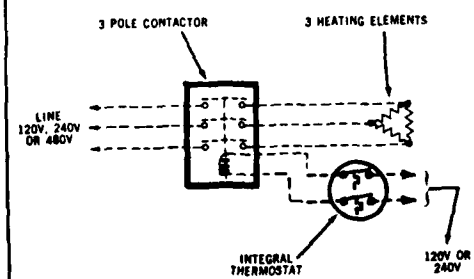


FIGURE C

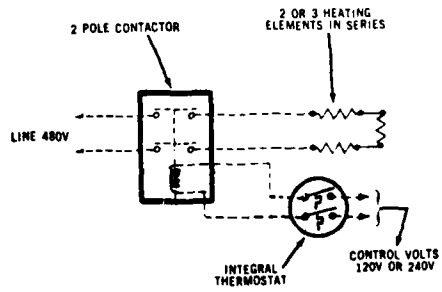


FIGURE D

E-17

RENEWAL PARTS IDENTIFICATION

Volts	KW	Phase	Catalog Number	Thermostat Range 150° - 550°F (standard)	Catalog Number	SPECIAL THERMOSTATS 0 - 100°F. Range	50° - 250°F Range	Heating Element Sub-Assembly	DIMENSIONS (Inches) A	B	Max. Amps Per Line	Wire Per Wiring Dia.
120	1.5	1	ARMTO-2155	300-017108-027	ARMTO-2155T	300-017108-025	300-017108-028	156-050507-001	18¾₁₆	11¾	12.5	A
240			ARMTO-2155	300-017108-027	ARMTO-2155T	300-017108-025	300-017108-028	156-050507-002			6.25	A
480			ARMTO-2155	300-017108-027	ARMTO-2155T	300-017108-025	300-017108-028	156-050507-002			3.13	D
550			ARMTO-2155	300-017108-027	ARMTO-2155T	300-017108-025	300-017108-028	156-050507-003			2.72	D
120	2	1	ARMTO-2205	300-017108-027	ARMTO-2205T	300-017108-025	300-017108-028	156-050507-004	24¾₁₆	17¾	16.67	A
240			ARMTO-2205	300-017108-027	ARMTO-2205T	300-017108-025	300-017108-028	156-050507-005			8.35	A
480			ARMTO-2205	300-017108-027	ARMTO-2205T	300-017108-025	300-017108-028	156-050507-006			4.17	D
550			ARMTO-2205	300-017108-027	ARMTO-2205T	300-017108-025	300-017108-028	156-050507-007			3.63	D
120	2.5	1	ARMTO-2255	300-017108-027	ARMTO-2255T	300-017108-025	300-017108-028	156-050507-008	26¾₁₆	19⅛	20.8	A
240			*ARMTO-2255*	*300-017108-027*	*ARMTO-2255T*	*300-017108-025*	*300-017108-028*	*156-050507-009*			10.4	A
480			ARMTO-2255	300-017108-027	ARMTO-2255T	300-017108-025	300-017108-028	156-050507-010			5.2	B
550			ARMTO-2255	300-017108-027	ARMTO-2255T	300-017108-025	300-017108-028	156-050507-011			4.54	D
120	3	1	ARMTO-2305	300-017108-027	ARMTO-2305T	300-017108-025	300-017108-028	156-050507-012	31¾₁₆	24⅞	25.0	B
240			ARMTO-2305	300-017108-027	ARMTO-2305T	300-017108-025	300-017108-028	156-050507-013			12.5	A
480			ARMTO-2305	300-017108-027	ARMTO-2305T	300-017108-025	300-017108-028	156-050507-014			6.25	B
550			ARMTO-2305	300-017108-027	ARMTO-2305T	300-017108-025	300-017108-028	156-050507-015			5.45	D
120	4	1	ARMTO-2405	300-017108-027	ARMTO-2405T	300-017108-025	300-017108-028	156-050507-016	39¾₁₆	32¾	33.33	B
240			ARMTO-2405	300-017108-027	ARMTO-2405T	300-017108-025	300-017108-028	156-050507-017			16.67	A
480			ARMTO-2405	300-017108-027	ARMTO-2405T	300-017108-025	300-017108-028	156-050507-018			8.34	B
550			ARMTO-2405	300-017108-027	ARMTO-2405T	300-017108-025	300-017108-028	156-050507-019			7.27	D
120	5	1	ARMTO-2505	300-017108-027	ARMTO-2505T	300-017108-025	300-017108-028	156-050507-020	46⅜₁₆	40¼	41.6	B
240			ARMTO-2505	300-017108-027	ARMTO-2505T	300-017108-025	300-017108-028	156-050507-021			20.8	A
480			ARMTO-2505	300-017108-027	ARMTO-2505T	300-017108-025	300-017108-028	156-050507-022			10.4	B
550			ARMTO-2505	300-017108-027	ARMTO-2505T	300-017108-025	300-017108-028	156-050507-023			9.1	D
240	6	1	ARMTO-2605	300-017108-027	ARMTO-2605T	300-017108-025	300-017108-028	156-050507-024	54⅜₁₆	47¹¹⁄₁₆	25.0	B
480			ARMTO-2605	300-017108-027	ARMTO-2605T	300-017108-025	300-017108-028	156-050507-025			12.5	B
550			ARMTO-2605	300-017108-027	ARMTO-2605T	300-017108-025	300-017108-028	156-050507-026			10.9	D
240	7	1	ARMTO-2705	300-017108-027	ARMTO-2705T	300-017108-025	300-017108-028	156-050507-027	65⅜₁₆	53⅜	29.16	B
480			ARMTO-2705	300-017108-027	ARMTO-2705T	300-017108-025	300-017108-028	156-050507-028			14.58	B
550			ARMTO-2705	300-017108-027	ARMTO-2705T	300-017108-025	300-017108-028	156-050507-029			12.7	D
120	3	1	ARMTO-3305	300-017108-027	ARMTO-3305T	300-017108-025	300-017108-028	156-050506-001	24¾₁₆	17½	25.0	A
		3Δ	ARMTO-3305	300-017108-027	ARMTO-3305T	300-017108-025	300-017108-028	156-050506-001			14.5	C
240		1	ARMTO-3305	300-017108-027	ARMTO-3305T	300-017108-025	300-017108-028	156-050506-002			12.5	A
		3Δ	ARMTO-3305	300-017108-027	ARMTO-3305T	300-017108-025	300-017108-028	156-050506-002			7.22	C
480		1	ARMTO-3305	300-017108-027	ARMTO-3305T	300-017108-025	300-017108-028	156-050506-011			6.25	B
		3Δ	ARMTO-3305	300-017108-027	ARMTO-3305T	300-017108-025	300-017108-028	156-050506-011			3.61	C
120	3.75	1	ARMTO-3375	300-017108-027	ARMTO-3375T	300-017108-025	300-017108-028	156-050506-003	26⅜₁₆	19¾₁₆	31.2	A
		3Δ	ARMTO-3375	300-017108-027	ARMTO-3375T	300-017108-025	300-017108-028	156-050506-003			18.1	C
240		1	ARMTO-3375	300-017108-027	*ARMTO-3375T*	*300-017108-025*	300-017108-028	156-050506-004			15.6	A
		3Δ	ARMTO-3375	300-017108-027	ARMTO-3375T	300-017108-025	300-017108-028	156-050506-004			9.05	C
480		1	ARMTO-3375	300-017108-027	ARMTO-3375T	300-017108-025	300-017108-028	156-050506-012			7.8	B
		3Δ	ARMTO-3375	300-017108-027	ARMTO-3375T	300-017108-025	300-017108-028	156-050506-012			4.51	C
120	4.5	1	ARMTO-3455	300-017108-027	ARMTO-3455T	300-017108-025	300-017108-028	156-050506-005	31⅞₁₆	24⅝	37.5	B
		3Δ	ARMTO-3455	300-017108-027	ARMTO-3455T	300-017108-025	300-017108-028	156-050506-005			21.7	C
240		1	ARMTO-3455	300-017108-027	ARMTO-3455T	300-017108-025	300-017108-028	156-050506-006			18.75	A
		3Δ	ARMTO-3455	300-017108-027	ARMTO-3455T	300-017108-025	300-017108-028	156-050506-006			10.85	C
480		1	ARMTO-3455	300-017108-027	ARMTO-3455T	300-017108-025	300-017108-028	156-050506-013			9.38	B
		3Δ	ARMTO-3455	300-017108-027	ARMTO-3455T	300-017108-025	300-017108-028	156-050506-013			5.43	C
120	6	1	ARMTO-3605	300-017108-027	ARMTO-3605T	300-017108-025	300-017108-028	156-050506-007	39¾₁₆	32¹¹⁄₁₆	50.0	B
		3Δ	ARMTO-3605	300-017108-027	ARMTO-3605T	300-017108-025	300-017108-028	156-050506-007			29.1	C
240		1	ARMTO-3605	300-017108-027	ARMTO-3605T	300-017108-025	300-017108-028	156-050506-008			25.0	A
		3Δ	ARMTO-3605	300-017108-027	ARMTO-3605T	300-017108-025	300-017108-028	156-050506-008			14.45	C
480		1	ARMTO-3605	300-017108-027	ARMTO-3605T	300-017108-025	300-017108-028	156-050506-014			12.5	B
		3Δ	ARMTO-3605	300-017108-027	ARMTO-3605T	300-017108-025	300-017108-028	156-050506-014			7.23	C
240	7.5	1	ARMTO-3755	300-017108-027	ARMTO-3755T	300-017108-025	300-017108-028	156-050506-009	47¼	40⅜₁₆	31.2	B
		3Δ	ARMTO-3755	300-017108-027	ARMTO-3755T	300-017108-025	300-017108-028	156-050506-009			18.05	C
480		1	ARMTO-3755	300-017108-027	ARMTO-3755T	300-017108-025	300-017108-028	156-050506-015			15.6	B
		3Δ	ARMTO-3755	300-017108-027	ARMTO-3755T	300-017108-025	300-017108-028	156-050506-015			9.03	C
240	9	1	ARMTO-3905	300-017108-027	ARMTO-3905T	300-017108-025	300-017108-028	156-050506-010	54¾	47⅞₁₆	37.5	B
		3Δ	ARMTO-3905	300-017108-027	ARMTO-3905T	300-017108-025	300-017108-028	156-050506-010			21.7	C
480		1	ARMTO-3905	300-017108-027	ARMTO-3905T	300-017108-025	300-017108-028	156-050506-016			18.75	B
		3Δ	ARMTO-3905	300-017108-027	ARMTO-3905T	300-017108-025	300-017108-028	156-050506-016			10.85	C

THERMOSTAT KNOBS

Thermostat Part Number	Thermostat Knob
300-017108-025	169-017963-001
300-017108-027	169-017110-001
300-017108-028	169-017109-001

EMERSON

CHROMALOX SERVICE ADMINISTRATION
EMERSON ELECTRIC CO.
1740 GOLDEN MILE HIGHWAY — MONROEVILLE, PENN. 15146 • PHONE: (412) 327-6074 • TELEX: 86-872

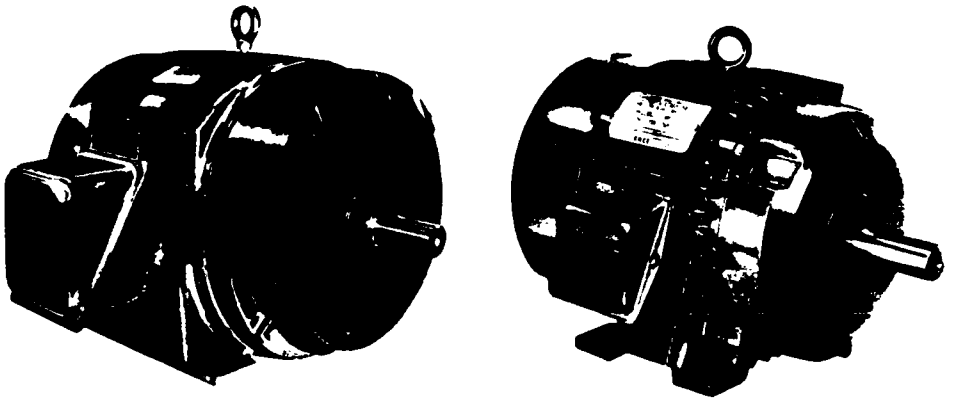
NOVEMBER, 1967

INSTRUCTION MANUAL B-3620-3

INSTALLATION, OPERATION AND CARE OF

RELIANCE

STANDARD INTEGRAL HORSEPOWER INDUCTION MOTORS



IMPORTANT: It is important that these instructions be studied by the men installing and operating this equipment. Read thoroughly before starting. Keep these instructions for future reference.

RELIANCE ELECTRIC COMPANY

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RECEIVING AND HANDLING

ACCEPTANCE

Thoroughly inspect this equipment before accepting shipment from the transportation company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept them until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage in shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the Reliance invoice, nor should payment of the Reliance invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest Reliance District Office for assistance. Please keep a written record of all communications.

STORAGE

Equipment which is not going to be used immediately, should not be unpacked until ready for use. If this equipment is to be stored for any period of time prior to installation, the area storage should be clean and dry, protected from low temperature, rapid or extreme changes in humidity, oil, dirt and similar adverse conditions. Equipment storage should be inspected periodically and the shaft rotated approximately every six months.

UNPACKING

After unpacking and inspection to see that all parts are in good condition, turn the shaft by hand to be sure there are no obstructions to free rotation. Equipment which has been in storage for some time should be tested and relubricated prior to being put into service. Refer to "Test for General Condition" and "Lubrication" for procedure to be performed after extended storage.

Equipment with roller bearings is shipped with a shaft block at the opposite pulley end. In removing the shaft block, be sure to replace the bolts which are used to hold the shaft block in place during shipment.

WARRANTY

The Reliance Electric Company warrants workmanship and materials on this motor for a period of one year from date of shipment from the Reliance factory. In every case concerning warranty, contact the nearest Reliance Sales Office or authorized Reliance Service Shop.

INSTALLATION

INSPECTION

After the motor is unpacked, examine the nameplate data to see that it agrees with the power circuit to which it is to be connected. The motor is guaranteed to operate successfully with frequency not more than 5% and voltage not more than 10% above or below the nameplate data, or combined variation of voltage and frequency of not more than 10% above or below nameplate data. Efficiency, power factor and current may vary from nameplate data.

LOCATION

The motor should be installed in a location compatible with the motor enclosure and specified ambient.

MOUNTING

Mount the motor on a foundation sufficiently rigid to prevent excessive vibration. Ball-bearing motors may be mounted with the feet at any angle. After carefully aligning the motor with the driven unit, bolt securely in place.

DRIVE

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Heat to install. Driving a unit on the shaft will damage the bearings.

Belt Drive: Align the pulleys so that the belt will run true; tighten the belt just enough to prevent slippage, any tighter will cause premature bearing failure. If possible, the lower side of the belt should be the driving side.

Chain Drive: Mount the sprocket on the shaft as close to the bracket as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

Gear Drive and Direct Connection: Accurate alignment is very essential. Secure the motor and driven unit rigidly to the base.

INSTALLATION (Cont'd)

WIRING

Connect the motor to the power supply according to the diagram on the motor nameplate. For most 230 and 460 volt motors, nine leads are brought out from the stator windings so that the motor may be connected for either 230 or 460 volts.

STARTING

When starting the motor, check the following items:

1. The rotor should turn freely when disconnected from the load.
2. Driven machine should be unloaded when first starting the motor.

The motor should run smoothly with little noise. If the motor should fail to start and produces a decided hum, it may be that the load is too great for the motor or that it has been connected improperly. Shut down immediately and investigate for trouble.

DRAIN PLUGS

If motor is totally enclosed fan-cooled or non-ventilated it is recommended that condensation drain plugs be removed. These are located in the lower portion of the end shields.

ROTATION

To reverse the direction of rotation, interchange any two of the three line leads for three phase motors, for two phase four wire, interchange the line leads on any one phase. For two phase three wire, interchange phase one and phase two line leads.

TEMPERATURE RISE

Under normal operating conditions, with the motor applied in accordance with the nameplate rating, the temperature rise will not exceed the proper limits. Always use a thermometer to determine the heating of a motor. The hand is not reliable in determining whether or not the motor is too hot.

TEST FOR GENERAL CONDITION

If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmeter.

If the resistance is lower than one megohm the windings should be dried in one of the two following ways:

1. Bake in oven at temperatures not exceeding 90°C. until insulation resistance becomes constant.
2. With rotor locked, apply low voltage and gradually increase current through windings until temperature measured with thermometer reaches 194°F. Do not exceed this temperature.

INITIAL LUBRICATION

"Reliance motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be relubricated prior to starting."

OPERATION

Due to the inherent characteristics of insulating materials, abnormally high temperatures shorten the operating life of electrical apparatus. The total temperature, not the temperature rise, should be the measure of safe operation. The class of insulation determines the maximum safe operating temperature. Aging of insulation occurs at an accelerated rate at abnormally high temperatures. A general rule for gauging the effect of excessive heat is that for each 10°C. rise in temperature above the maximum limit for the insulation, the life of the insulation is halved.

Unbalanced voltage or single-phase operation of polyphase machines may cause excessive heating and ultimate failure. It requires only a slight unbalance of voltage applied to a polyphase motor to cause large unbalanced currents and resultant overheating.

Periodic checks of phase voltage, frequency and power consumption of a motor while in operation are recommended; such checks assure the correctness of frequency and voltage applied to the motor and yield an indication of the load offered by the apparatus which the motor drives. Comparisons of this data with previous no-load and full-load power demands will give an indication of the performance of the complete machine. Any serious deviations should be investigated and corrected.

OPERATION (Cont'd)

Stator troubles can usually be traced to one of the following causes:

Worn bearings	Operating single phase
Moisture	Poor insulation
Overloading	Oil and dirt

Dust and dirt are usually contributing factors. Some forms of dust are highly conductive and contribute materially to insulation breakdown. The effect of dust on the motor temperature through restriction of ventilation is a principal reason for keeping the windings clean.

Squirrel-cage rotors are rugged and, in general, give little trouble. The first symptom of a defective rotor is lack of torque. This may cause a slowing down in speed accompanied by a growling noise or perhaps failure to start the load.

This is caused by an open or high resistance joint in the rotor bar circuit. Such a condition can generally be detected by looking for evidence of localized heating.

MAINTENANCE

The fundamental principle of electrical maintenance is - KEEP THE APPARATUS CLEAN AND DRY. This requires periodic inspection of the motor, the frequency depending upon the type of motor and the service.

The following should be checked at regular intervals.

1. Windings should be dry and free of dust, grease, oil, and dirt. Windings may be cleaned by suction cleaners or by wiping. Nozzles on suction type cleaners should be non-metallic. Gummy deposits of dirt and grease may be removed by using a commercially available low volatile solvent. Do not use gasoline or other inflammable solvents.
2. Terminal connections, assembly screws, bolts and nuts should be tight. They may loosen if motor is not securely bolted and tends to vibrate.
3. Insulation resistance of motors in service should be checked periodically at approximately the same temperature and humidity conditions to determine possible deterioration of the insulation. When such measurements at regular intervals indicate a wide variation, the cause should be determined. Motor should be reconditioned if the motor has been subjected to excessive moisture, or by re-winding or re-insulating if necessary. Enclosed motors require very little attention. Be sure that external air chamber of fan-cooled motors does not become clogged with foreign material which will restrict passage of air.

DISASSEMBLY

If it becomes necessary to disassemble the motor, care should be taken not to damage the stator windings as the insulation may be injured by improper or rough handling. Precautions to keep bearings clean should be exercised.

Before removing either end shield:

1. Disconnect motor from power source. Tag the leads to insure proper reconnection.
2. Remove motor from mounting base.
3. Mark end brackets relative to position on frame so they can be easily replaced.

REMOVING BRACKETS AND ROTOR -

4. Remove bearing cartridge nuts or screws.
5. Remove front end bracket bolts.
6. Pull bracket.
7. Remove back end bracket in same manner.
8. Remove rotor.

REMOVING AND REPLACING BALL BEARINGS-

Bearings should not be removed unless they are to be replaced. When removal is necessary, use a bearing puller if possible. If a puller is not accessible and a hammer must be used, the blows should be transmitted through a hard wood or fibre block. A bearing puller may be rigged by using a metal plate, with holes drilled to match the tapped holes in the inner cap. Use care to keep the pressure equal to prevent breaking the cap.

To install a bearing, use a steady pressure on the inner race. One method is to use a piece of pipe of the correct size to slip over the shaft. If a

MAINTENANCE (Cont'd)

hammer is used, the blows should be transmitted through a block of wood or fibre. All bearings must be replaced with the identical part used by Reliance. In many cases special bearings are used which cannot be identified by markings on bearing.

For precautions in handling ball bearings, refer to Instruction Manual A-3611.

REASSEMBLY

Follow reverse procedure as outlined for Disassembly. Having marked the brackets in the original position, replace as marked.

LUBRICATION

INITIAL LUBRICATION

Grease lubricated motors are properly lubricated at the time of manufacture and it is not necessary to lubricate at time of installation. If the motor has been in storage for a period of six months or greater, lubricate before starting. Below is a list of recommended types of grease. These have all been tested and should be used whenever possible.

RELUBRICATION

To lubricate, remove filler plug and with motor running or at rest grease with clean lubricant until grease appears at drain hole or along shaft. 1/2 to 1 cu. inch of grease is sufficient in small sizes, proportionatly more in large HP motors.

RELUBRICATION PERIOD

For relubrication period, follow instruction plate on motor. If no plate is provided, relubricate per the following table:

HP at 1800 RPM or Less	Standard Conditions	Severe Conditions	Extreme Conditions
1/8 - 7-1/2	3 years	1 year	6 months
10 - 40	1-3 years	6mo.-1year	3 months
50 - 150	1 year	6 months	3 months
200 & Up	1 year	6 months	3 months
All Motors Over 1800 RPM	6 months	3 months	3 months

Standard Conditions: Eight hours per day, normal or light loading, clean 100°F. maximum ambient.

Severe Conditions: Twenty-four hours per day, shock loading, vibration, dirt or dust 100-150° F, ambient.

Extreme Conditions: Heavy shock or vibration, dirt or dust.

For motors operating in ambients between 0°F. and 120°F., use the following lubricants or their equal:

Standard Oil Co. of Indiana - Stanobar No. 2
Standard Oil Co. of New Jersey - Andok C* and B
Master Lubricants Co. - Lubriko M-6, M-21, and M-32
New York and New Jersey Lubricant Co. - F-925, S-58, and S-58-M
Gulf Refining Co. - Precision No. 2 and No. 3
The Texas Co. - Starfak H, M, and No. 2
Sinclair Refining Co. - A.F. No. 2
Tidewater Associated Oil Co. - Tycol Armitage 0
Union Oil Co. of California - Strona HT-1
Shell Oil Co. - Alvania No. 2
Standard Oil Co. of California - Chevron O. H. T.
Socony Mobil Oil Co. - Mobilux Grease No. 2

*Not recommended for roller bearings.

For operation in other ambient temperatures, refer to motor tag 162214 or nearest Reliance Sales Office.

SLEEVE BEARINGS (FRAMES D-5000)

Motors with sleeve bearings are shipped from the factory without oil. Fill the reservoirs to the center of the oil level gauge (minimum) to 3/8 above center (maximum) with a good grade of turbine oil as recommended for electric motor and generator use by a reputable oil manufacturer.

THESE OILS MAY BE USED

Mobil DTE Light or Heavy Medium
Texaco Regal A or PC

Use Oil of the viscosity range indicated in the following table:

Speed Range RMP	Recommended Viscosity Range SSU @ 100°F.
1500 and below	250-350
1800 and over	100-200

LUBRICATION (Cont'd)

Watch oil rings when first starting to see that they revolve.

Change oil every six months or more often under severe operation conditions.

CONSTANT LEVEL OILER

When supplied, refer to instructions accompanying the constant level oiler.

RECOMMENDED WIRE SIZE

Motor Horsepower

Volts	1-3	5	7-1/2	10	15	20	25	30	40	50	60	75
230	14	12	10	8	6	4	3	1	0	000	0000	300
460	14	14	14	12	10	8	6	6	4	3	2	0
575	14	14	14	14	12	10	8	6	6	4	3	2

Volts	100	125	150	200	250	300	350	400	450	500	600	700
230	500											
460	000	0000	300	500	700	900	1500	600*	750*	900*	1750*	--
575	0	000	0000	250	500	600	800	1000	1500	600*	900*	1500*
**2300					6	4	3	2	1	1	0	00

* Parallel
**Use high voltage cable.

GENERAL

For special motors for use by United States Government including special specifications, master plans, etc., refer to the applicable master plans and specifications involved.