TECHNICAL MANUAL

OPERATOR, UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR

WATER PURIFICATION BARGES (NSN 1930-01-234-2165) VOLUME 6 SHORE DISCHARGE SYSTEM

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content requirements normally ,associated with the Army technical manuals. This technical manual does, however, contain all essential information required to operate and maintain the equipment.

Approved for public release; distribution is unlimited

***This manual supersedes TM 55-1930-209-14&P-6, 30 January 1989.**

HEADQUARTERS, DEPARTMENT OF THE ARMY
15 OCTOBER 1992

WARNINGS AND SAFETY NOTICES

WARNING

**DANGEROUS VOLTAGES AND HAZARDOUS MATERIALS
ARE USED IN THIS EQUIPMENT.
DO NOT TAKE CHANCES!**

GENERAL WARNINGS

- Always redtag electrical equipment, control, circuits, and switches before beginning repairs.
- Do not service or adjust high voltage electrical equipment when alone.
- Do not overload circuits.
- Always use authorized, insulated tools and test equipment when working on electrical equipment.
- Remove all jewelry before working on or around electrical equipment with exposed current carrying areas.
- Do not wear clothing with exposed metal fasteners when working on electrical equipment.
- Always use approved breathing apparatus when working with chemicals.
- Avoid chemical contact with eyes, skin, and clothing.
- Always wear safety glasses, gloves, and rubber aprons when handling chemicals..
- Wear protective clothing and safety glasses as required when working on barge equipment.
- Always wear approved ear protection in noise hazard areas.

SPECIFIC WARNINGS

- Do not connect any new circuit to an existing circuit.
- Do not energize circuits if water condensation is present.
- If any sparks are seen, stop operation immediately. Determine cause and take corrective action.
- Never touch radio antennas of fixed-base radio transmitters. When transmitting, antennas contain high voltage.
- Always use approved breathing apparatus when handling material in multimedia filters and chlorination unit descaling acid crystals. Do not breathe dust from these materials.
- Avoid breathing vapors from coagulant aid chemicals. Use in a well-ventilated area. In case of chemical contact with skin, wash with water. For eyes, immediately flush at eyewash station and obtain medical help as soon as possible.
- Always wear work gives and shirts with full length buttoned sleeves when handling fuel oil and gasoline.

- Do not smoke or have open flames within 10 feet when handling fuel oil or gas. Only minimum number of personnel necessary to conduct fueling operation is permitted in area.
- Before starting any repairs on compressed air system, always release pressure from air receiver and compressor and open and redtag circuit breakers.
- On air compressor, do not adjust automatic regulator switch (pressure switch) and pilot valve setting.
- To avoid flying partials lodging in eyes, do not use compressed air to dust-off clothing or wok
- Stay dear of anchor cables when operating anchor winches.
- Always wear safety gloves or face shield when using power tools.
- Always wear lifevests when on weatherdeck and throughout the barge during storm conditions
- Lifevests are to be worn at all times aboard workboat.
- Only qualified persons will operate and maintain arc and fuel gas welders.
- When welding, always make sure those working with or near the welder wear proper clothing: heavy, hole-free gloves, heavy shirt, cuffless trousers, high shoes, and cap. Keep clothing dry and free of oil and other flammable substances
- Use dry heavy canvas drop cloth to cover work area and adjacent deck when arc welding.
- Before welding on bulkheads, deck plating and similar surfaces, always check carefully to make sure that the other side of the surface to be welded does not hide fuel or compressed gas tanks, flammable or hazardous materials, or electrical equipment or wiring.
- When welding, keep your head out of the fumes and make sure area is well ventilated.
- Before welding on surfaces which have been cleaned with cleaning solutions containing chlorinated hydrocarbons, always wash with water, dry and ventilate area thoroughly.
- Use shield with proper filter lens when welding. Do not allow others near welding operations to assist or observe without proper eye protection. This must include side shields during slag chipping operations.
- Warn personnel in area during welding operations not to look at arc or expose themselves to hot spatter or metal.
- In an extreme emergency, when welding is required in void 2 port, shut down chlorination system. Close all valves. Cover the parts of chlorination system not being welded with a heavy canvas drop cloth. Turn on vent 8 and, if available, provide additional forced air ventilation.

- Before welding on fuel oil or sludge tank, make sure tank is gas-free by: 1) removing all liquid from tank, 2) cleaning tank thoroughly, 3) seeing that tank is thoroughly dry, and 4) force ventilating tank.
- Connect arc welding work cable as dose to welding area as possible. Work cables connected to barge framework or other locations far from welding site increase the possibility of the welding current passing through lifting chains, crane cables or other possible circuit paths. This can create fire hazards or weaken lifting chains or crane cables until they break or fall.
- Always weld with all doors, portholes, and hatches propped open and necessary ventilation systems operating.
- Take frequent breaks away from the area where you are welding.
- Do not take oxygen and acetylene tanks into confined areas when welding.
- Always use a friction lighter to start oxyacetylene torch.
- Always maintain all welding equipment in proper working condition. If you have any doubts about the safety of any welding equipment, do not use the welder.

ELECTRICAL SHOCK SAFETY STEPS

Five safety steps to follow if someone is the victim of electrical shock

1. Do not try to pull or grab individual.
2. Turn off electrical power when possible.
3. If you can not turn off electrical power, pull, push, or lift person to safety using a wooden pole, rope or some other insulating material.
4. Get medical help as soon as possible.
5. After the injured person is free of contact with the source of electrical shock, move the person a short distance away and, if needed, start CPR immediately.

INTRODUCTION TO

TM 55-1930-209-14&P-6

You can help improve .this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Troop Support Command, ATTN: AMSTR-MMTS, 4300 Goodfellow Blvd., St Louis, MO 63120-1796. A reply will be furnished directly to you.

1. SCOPE

TM 55-1930-209-14&P covers the Reverse Osmosis Water Purification Barges, Models 300-WPB-1, 300-WPB-2 and 300-WPB-3, NSN 1930-01-234-2165. This manual consist of twenty-one volumes.

2. REVERSE OSMOSIS WATER PURIFICATION BARGES

The Reverse Osmosis Water Purification Barges provide up to 300,000 gallons of drinking water per 24 hour period. The drinking water, converted from seawater or brackish water, is for use by a Rapid Deployment Force in a forward area. When needed, the drinking water can be pumped to a shore facility onto another vessel. This manual provides operation and maintenance procedures for all the component systems on the barges.

3. VOLUME 1 -- NORMAL OPERATIONS

This volume provides information and procedures on normal Reverse Osmosis Water Purification Barge operations, including barge movement and deployment, communications and electrical power systems, drinking water production, shutdown, and required operational maintenance. Emergency shutdown procedures are also provided.

4. VOLUME 2 -- SEAWATER SYSTEM

This volume describes operation and maintenance of the seawater system which supplies seawater to the Reverse Osmosis Water Purification Units (ROWPUs) for processing to the air conditioning unit for cooling to the ballast tank for barge trimming to the chlorination unit for priming and cooling, and to the diesel generators for cooling.

5. VOLUME 3 -- REVERSE OSMOSIS WATER PURIFICATION UNIT (ROWPU) SYSTEM

Volume 3 provides operation and maintenance procedures for the ROWPU System which processes seawater or brackish water to produce drinking water. Normally, this system processes seawater supplied by the seawater system (TM 55-1930-209-14&P-2) to create product water. Chlorine is then added to this product water by the chlorination system (TM 55-1930-209-14&P-4). The resultant drinking water is discharged into four storage tanks that are part of the drinking water system (TM 55-1930-209-14&P-5).

6. VOLUME 4 -- CHLORINATION SYSTEM

Operation and maintenance procedures for the chlorination system onboard the Water Purification Barges are contained in this volume. This system produces chlorine in a sodium hypochlorite solution, upon demand, to water processed by the ROWPU system just before the water enters the four drinking water storage tanks.

7. VOLUME 5 -- DRINKING WATER SYSTEM

The drinking water system provides storage for water produced by the ROWPUs and includes pumps and valves to move this water from onboard storage tanks to the shore discharge system, to another vessel, or overboard. The drinking water system also provides a pressurized water supply for drinking and washing onboard the barges.

8. VOLUME 6 -- SHORE DISCHARGE SYSTEM

This volume provides operation and maintenance procedures for the shore discharge system which transfers drinking water from barge storage tanks to hold/storage facilities ashore.

9. VOLUME 7 -- COMPRESSED AIR SYSTEM

Volume 7 describes the operation and maintenance of the compressed air system which provides compressed air to five air stations in the ROWPU space, one in the workshop, and one on stem weatherdeck This system also provides compressed air to two air stations for blowdown of seachests in void 2 starboard and void 4 port. Compressed air is used on the barges to operate air-powered impact tools, to propel air through the shore discharge hose, to blowdown seachest, and for general cleaning blowdown.

10. VOLUME 8 -- FUEL OIL SYSTEM

This volume provides operation and maintenance procedures for the fuel oil system which functions as a centralized receiving storage and distribution system for diesel fuel used for barge operations. This onboard fuel system provides fuel for two 155 kW diesel ship service generators, a 20 kW ship auxiliary generator, two ROWPU high-pressure pump diesel engines, and a fueling station for the barge workboat.

11. VOLUME 9 -- ELECTRICAL POWER SYSTEMS

Operation and maintenance procedures for the two electrical power systems installed aboard the Water Purification Barges are contained in Volume 9. The normal electrical power system generates, controls and distributes all electrical power for operating the water purification system and its auxiliary systems. The emergency electrical system supplies 24 Vdc from a battery bank to 24 Vdc equipment and converts to 24 Vdc through an inverter to 120 Vac to power emergency lighting and equipment.

12. VOLUME 10 -- LIGHTING SYSTEM

Volume 10 contains operation and maintenance procedures for the onboard lighting systems for the Water Purification Barges. This system supplies interior and exterior lighting. Normal and emergency interior lighting is provided in the deckhouse ROWPU space, dayroom, workshop, and voids. Exterior lighting consist of searchlights and floodlights for use at night or during reduced visibility. Lights on the weatherdeck and standard navigation and status lights are for use during operation and towing.

13. VOLUME 11 -- EQUIPMENT MONITORING SYSTEM

This volume provides operation and maintenance procedures for the equipment monitoring system which monitors the operation of several equipment components onboard the Water Purification Barges. This system monitors operating conditions such as amount of drinking water in storage tanks and temperature of diesel engine cooling water. Sensors detect unacceptable operating conditions, the main processor flashes at double intensity and remote alarms (horns, strobe lights and buzzer alert crewmembers that corrective action is necessary.

14. VOLUME 12 -- COMMUNICATIONS SYSTEM

Operation and maintenance procedures for the communications system are provided in Volume 12. This system consists of three separate communications methods, radio communications, foghorn and intercom telephones.

15. VOLUME 13 -- HANDLING EQUIPMENT

This volume contains operation and maintenance procedures for handling equipment used for lifting, transporting and repositioning equipment and materials onboard the barges. The system includes a bridge crane, bow crane and a void 4 trolley hoist.

16. VOLUME 14 -- ANCHOR, MOORING, AND TOWING EQUIPMENT

Volume 14 describes the operation and maintenance procedures for the anchor mooring, and towing equipment on the Water Purification Barges. This equipment provides a method to hold (anchor) the barges in a fixed position offshore, at dockside, or next to another vessel and a method to move the barges from one location to another.

17. VOLUME 15 -- MISCELLANEOUS EQUIPMENT (DAYROOM, WORKSHOP, ACCESSES, AND SANITATION SYSTEMS)

Volume 15 addresses operation and maintenance procedures for miscellaneous equipment installed on the Water Purification Barges. This equipment includes the dayroom on the forward starboard side of deckhouse, the workshop on the forward portside of deckhouse, accesses such as deckhouse doors and portholes and various accesses to and from the voids, and two separate sanitation systems (toilets and bilge). Additional equipment addressed in this volume includes: guard rails, rubber fendering, removable rubber floor mats, eyewash stations, component labels, caution, warning and danger signs, and storage areas.

18. VOLUME 16 -- VENTILATION, HEATING, AND AIR CONDITIONING SYSTEMS

This volume contains operation and maintenance procedures for the deckhouse and voids ventilation systems and the heating and air conditioning (HAC) system installed on the Water Purification Barges. The ventilation system provides fresh air circulation in the deckhouse and voids with 17 hatches and 10 ventilation fans. The HAC controls the temperature in the dayroom and deckhouse.

19. VOLUME 17 -- WORKBOAT, LIFESAVING, AND FIREFIGHTING EQUIPMENT

Volume 17 includes procedures for the operation and maintenance of:

a. Workboat -- provides water transportation for crew members and visitors, small cargo items, transportation of the messenger line for the shore discharge hose and similar work-related tasks associated with operating the Water Purification Barges.
b. Lifesaving Equipment -- installed on the barges and consisting of 2 liferafts, 15 Type II and 24 Type V lifevests and 4 lifesaving rings.
c. Firefighting Equipment -- installed on the barges and consisting of Halon 1301 system, 2 C02 hose reel units, a smoke detector system, 17 portable C2 fire extinguishers, 5 dry chemical fire extinguishers, 5 self-contained breathing apparatuses, and a portable, engine driven firefighting pump. The workboat also has a 10-pound, portable, dry chemical tire extinguisher.

20. VOLUME 18 -- SUPPORTING APPENDICES FOR VOLUMES 1-17.

Volume 18 contains the Maintenance Allocation Chart. Components of End Item List, Tools and Test Equipment List, Expendable/Durable Supplies and Materials List and the Repair Parts and Special

All of the information contained in this volume is common to volumes 1-17 and does not appear in individual volume.

Appendix A in volumes 1-17 provides information unique to each volume. Appendix B in volumes 1-17 provides manufacturers manuals and instructions unique to the system described in each volume. Appendixes C-G are located in Volume 18.

21. VOLUME 19 -- PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

Volume 19 contains PMCS pertinent to all onboard systems for the Reverse Osmosis Water Purification Barges.

22. VOLUME 20 - SUPPLEMENTAL DATA

Volume 20 contains the Basic Issue Items List, and additional Authorization List for all onboard systems for the Reverse Osmosis Water Purification Barges.

23. VOLUME 21 -- WINCH, DOUBLE DRUM, DIESEL

This volume contains operation and maintenance procedures for the 20-ton double drum diesel engine winch used on the Water Purification Barges. Appendix B of Volume 21 contains the Maintenance Allocation Chart end the Repair Parts and Special Tools List for the winch.

TECHNICAL MANUAL
NO. 55-1930-209-14&P-6

HEADQUARTERS
DEPARTMENT OF THE ARMY,
WASHINGTON D.C., 15 OCTOBER 1992

TECHNICAL MANUAL

OPERATORS', UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)

FOR
WATER PURIFICATION BARGES
(NSN 1930-01-234-2165)
VOLUME 6
SHORE DISCHARGE SYSTEM

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Troop Support Command, ATTN: AMSTR-MMTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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*** Supersedes TM 55-1930-209-14&P-6, 30 January 1989**

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LIST OF APPENDICES

NOTE

The following appendices, common to all TM's in this series, are in TM-55-1930-209-14&P-18.

MAINTENANCE ALLOCATION CHART (MAC)
TOOLS AND TEST EQUIPMENT LIST (TTEL)
EXPENDABLE /DURABLE SUPPLIES AND MATERIALS UST (ESML)
REPAIR PARTS AND SPECIAL TOOLS LIST (RPSTL)
REPAIR PARTS LIST TO FIGURE NUMBER CROSS-REFERENCE UST

NOTE

The following appendices, common to all TM's in this series, are in TM 55-1930-209-14&P-20.

COMPONENTS OF END ITEM LIST (COEIL) AND BASIC ISSUE ITEMS LIST (BIILL)
ADDITIONAL AUTHORIZED ITEMS LIST (AAL)

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LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1 INTRODUCTION

Section I. General

1-1 Purpose. This Technical Manual (TM) describes the operation and maintenance of the shore discharge system on Water Purification Barges. Differences between Barge 1 and other barges are noted in appropriate paragraphs and figures. Otherwise, information pertains to all barges. Information on other systems installed onboard is in TM 551930-209-14 & P-1 thru P-5 and P-7 thru P-17. TM 55-1930-209-14 & P-18 and TM 55-1930-209-14&P-20 contain appendices common to all TM's. Location of major barge components is shown in Figure 1-1.

1-2 Scope. This system discharges drinking water produced by the Reverse Osmosis Water Purification unit (ROWPU's) from barge drinking water storage tanks via a flexible steel and rubber-coated hose to a storage area ashore, as shown in Figure 1-2.

1-3 Warranties and guarantees. Warranty/guarantee information is contained in Chapter 7.

1-4 Maintenance form and records. Required maintenance forms and records are explained in DA PAM-738-750, The Army Maintenance Management System (TAMMS).

1-5 Destruction of Army materiel to prevent enemy use. This shall be as directed in TM 750-244-3.

1-6 Storage. For storage of this system, refer to Chapter 5.

Section II. Description and data

1-7 Description. This shore discharge system transfers drinking water from barge storage tanks to holding/storage facilities ashore. Major system components are listed in Table 1-1. Shore discharge system installation and its electrical hookup are shown in Appendix B.

1-8 Capabilities. This system, under optimum conditions, moves 300,000 gallons of drinking water per day from barge drinking water storage tanks to shore storage facilities.

1-9 Special limitations. The shore discharge system has been designed to operate in conditions not exceeding Sea State 3.

1-10 Performance characteristics

Maximum operating pressure	150 psi
Flow rate capacity	300,000 gal/day
Flexible hose length	2500 ft
Ambient operating temperature	32° to 120° F
Electrical power requirement	440 Vac, 3 ph, 60 Hz

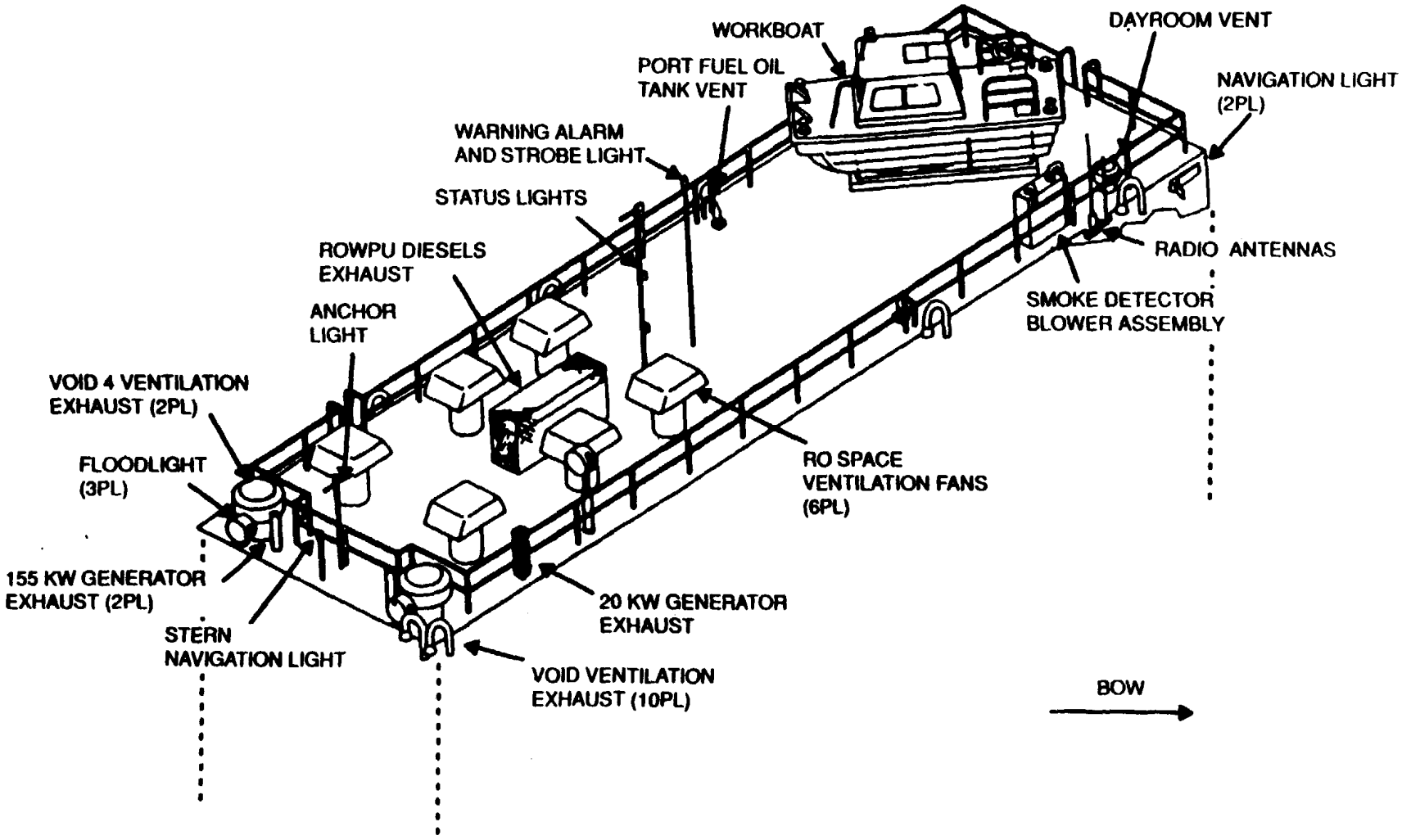


Figure 1-1. Major Components of ROWPU Barge Systems and Equipment - Deckhouse Roof (Sheet 1 of 3)

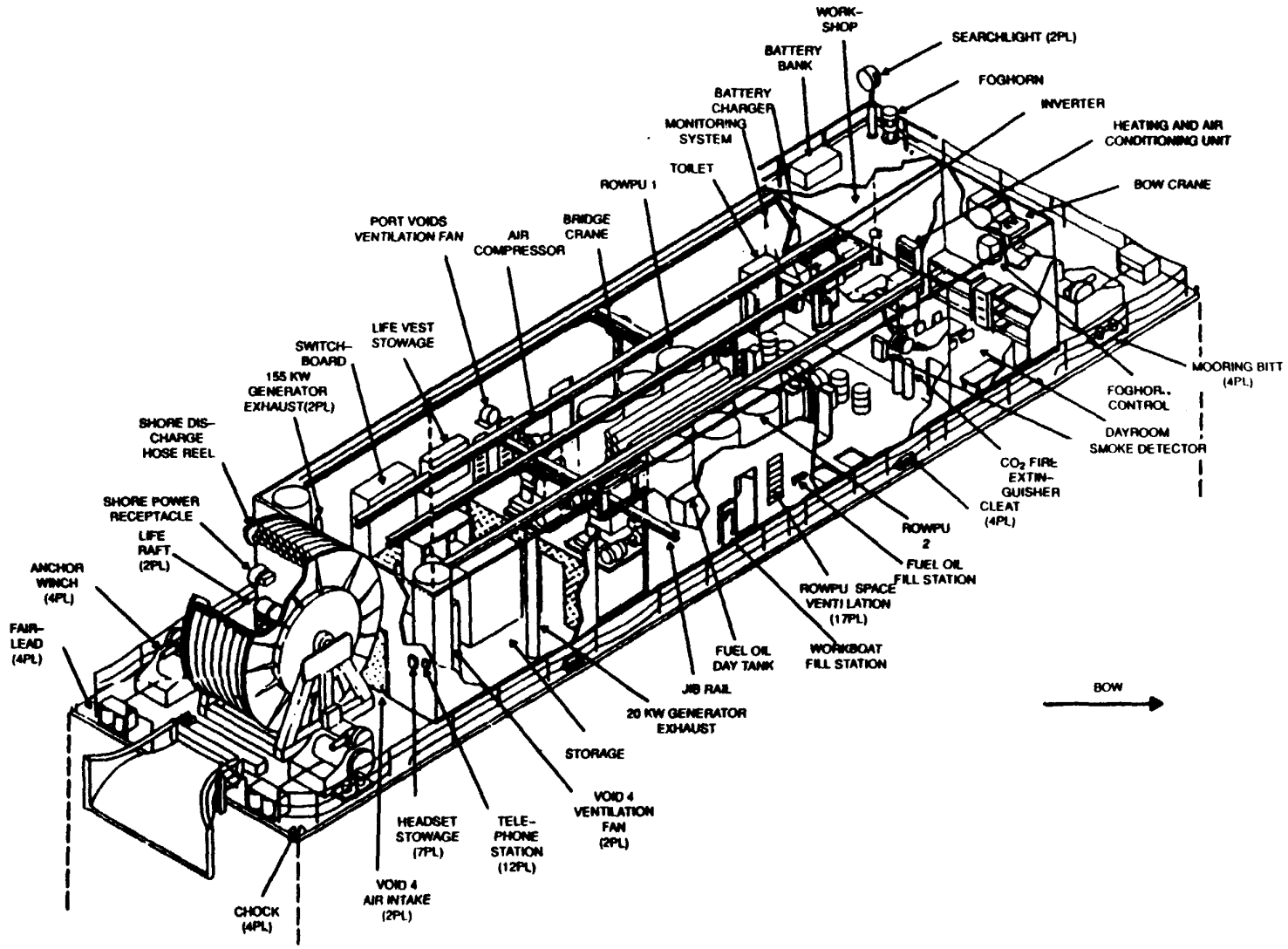


Figure 1-1. Major Components of ROWPU Barge Systems and Equipment - Deckhouse Roof (Sheet 2 of 3)

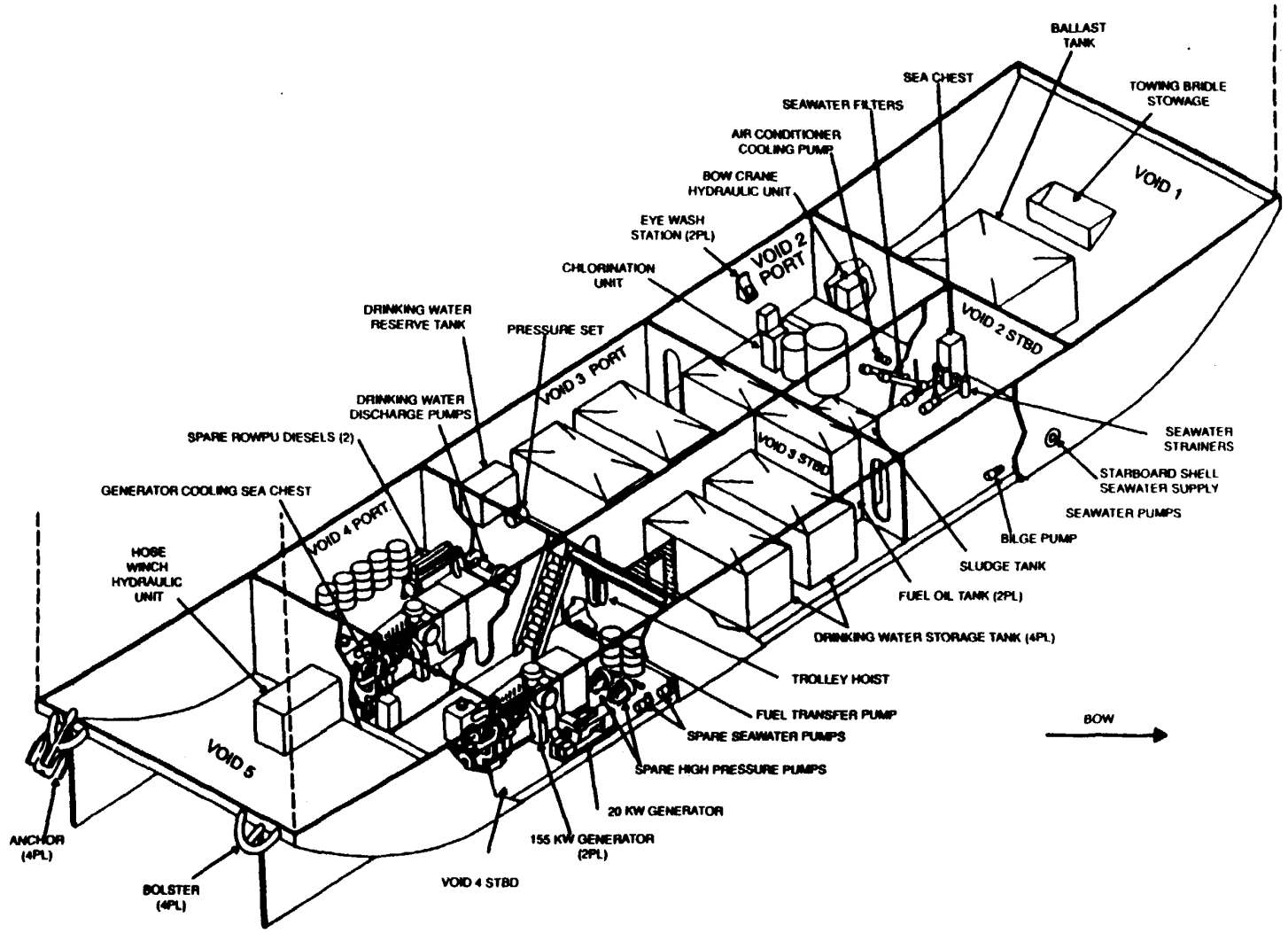


Figure 1-1. Major Components of ROWPU Barge Systems and Equipment - Deckhouse Roof (Sheet 3 of 3)

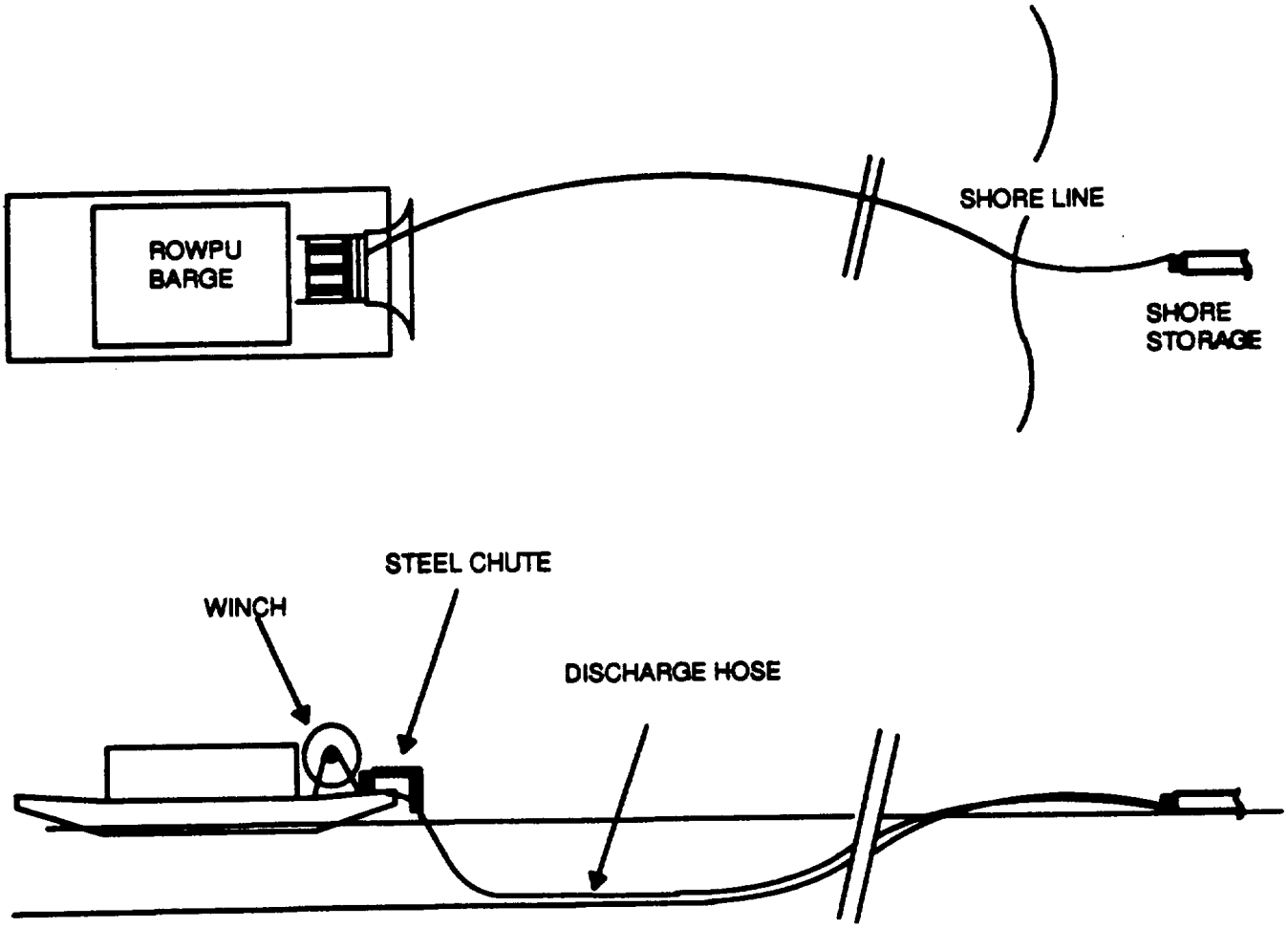


Figure 1-2. Shore Discharge System Installation

Table 1-1. Components of Shore Discharge System

Component	Function	Location
Hose reel winch	Deploys and retrieves hose	Centerline of barge at stern
Hydraulic power unit	Provides power to winch and levelwind	Void 5
Levelwind	Guides hose onto reel during hose retrieval	Aft of winch
Chute	Supports hose when deployed	Aft of levelwind
PIG	Forces water out of hose	Stored when not in use
PIG insertion point	Inserts PIG into flexible hose	Stem portside in shore discharge water pipe connection to hose
PIG receiver	Catches PIG on shore	On shore end of discharge hose
Flexible discharge hose	Carries water from barge to shore when deployed	On winch when retrieved
Hose reel winch hydraulic unit START/STOP switch	Starts and stops hydraulic power unit	Aft deckhouse bulkhead control panel portside on weatherdeck
Hose end cap	Attachment point for messenger line when pulling flexible hose ashore with shore winch	Screws on end of hose or stored in workshop stowage area
Floating buoys	Keeps hose end cap from catching on sea bottom	Attached to hose end cap during deployment. Stored in ROWPU space aft stowage area
Messenger line	Attaches to hose end cap on end of hose to allow shore winch to pull hose to shore	On dispensing reel on aft of workboat
Shore winch	Pulls discharge hose to shore	Stored on bow forward of bow crane. Remains on shore when barge is deployed

1-11 Equipment specifications

a. Winch with flexible pipe

Supplier	Coflexip and Services, Inc.
Part no.	830426-1 (Barge 1) 840464-A1 (Barge 2) 840464-B1 (Barge 3)
CAGEC	Not available
Manufacturer	Deckmaster
Model no.	WHR-102-12525
Type	Hydraulic driven W/2500 ft of 4 3/8in. I.D. Coflexip pipe and control panel
Capacity	2500 ft of 6 in. O.D. flexible pipe (5 wraps on drum)
Weight	
Winch empty	24.581 lb
Winch full	74,000 lb
Coflex pipe	49,419 lb
Size	
Overall	164 in. L x 144 in. W x 176 in. H
Base	144 in. X 144 in.
Drum flange	164 in.
Rating	10,000 lb at midlayer at 25 fpm, brake (disc and band) rated 18,000 lb at midlayer at 25 fpm

Winch hydraulic motor	
Manufacturer	TRW Ross Gear Division
Part no.	MAB-10-D-02-A1
Quantity	1
b. Hydraulic power unit	
Supplier	Coflexip and Services, Inc.
Part no.	830426-3 (Barge 1) 840464-A3 (Barge 2) 840464-83 (Barge 3)
CAGEC	Not available
Manufacturer	Deckmaster
Model no.	HPP-30EC-50
Type	Hydraulic
Weight	1850 lb
Size	60 in. L x 36 in. W x 47 in. H
Motor	
Manufacturer	Toshiba/Houston
Model no.	B0304FLB1UC
Horsepower	30
Power	440 Vac, 3 ph, 60 Hz
Type	TEFC, double-ended w/Internal heater
Quantity	1
c. Levelwind	
Supplier	Coflexip and Services. Inc.
Part no.	830426-1-6
CAGEC	Not available
Rating	1000 lb lateral at 6 in/min.
Weight	2250 lb
Size	172 1ri. L x 21 in. W x 45 in. H
Quantity	1
d. Chute (gutter)	
Supplier	Coflexip and Services. Inc.
Part no.	830426-4 (Barge 1) 840464 A4 (Barge 2) 840464-4 (Barge 3)
CAGEC	Not available
Weight	8000 lb
Material	Steel
Quantity	1
e. PIG	
Supplier	Coflexip and Services, Inc.
Part no.	830426-3
CAGEC	Not available
Size	4 in. O.D. x 8 in. L
Material	Poly-Foam
Quantity	1
f. PIG launch	
Supplier	Coflexip and Services, Inc.
Part no.	830426-3-1
CAGEC	Not available
Quality	1
g. PIG receiver	
Supplier	Coflexip and Service, Inc.
Part no.	830426-3-2
CAGEC	Not available
Quantity	1

h. Gate valve

Manufacturer	The William Powell Co.
CAGEC	48422
Part no.	Not available
Size	4 in. nominal
Type	Full bore
Rating	150 lb
Connection	Flanged
Material	Corrosion resistant steel
Quantity	2

i. Control station (winch hydraulic power unit remote control switch)

Manufacturer	Square D Co. Bell Electrical Products Div.
CAGEC	81487
Part no.	BW 240
Type	NEMA 4
Class	9001
Quantity.	1

j. Shore winch

Manufacturer	Conmaco, Inc.
CAGEC	62303
Supplier	Government furnished equipment
NSN	3950-01-1 40-6773
Capacity	20 tons
Dry weight	5.5 tons
Quantity	1

1-12 Items furnished

1-12.1 Components installed as part of the drinking water shore discharge system are listed on the parts list of the drawings in Appendix B and in the Components of End Item List in TM 55-1930-209-14&P-20.

1-12.2 Common and bulk items onboard are listed in the Expendable Supplies and- Materials List in TM 55-1930-209-14& P-20.

1-12.3 Repair parts and special tools onboard are listed in the Repair Parts and Special Tools List in TM 55-1930-209-14& P-18.

1-13 Items required but not furnished. During barge deployment, an LCM-8, or similar type vessel with equal capability, is required to transport the shore winch (weighing 5.5 tons) from barge to shore facility. This type vessel or one of equal capability is required again to retrieve the winch from shore and load it on the barge for transport to the next site. A 50K (RTFL) Rough Terrain Forklift is also required for loading and unloading the winch from the LCM-8.

1-14 Tools and test equipment. A repair kit, Coflexip part No. 830426-4, is provided for repairing the discharge hose. This kit contains the following:

Amount	Item
1	Hot air gun w/air supply unit
3	Air nozzles
6 lb	Rilsan wire
1	Toolbox

1-14.1.Consumable 1/2 inch plus stainless steel bands with clamps and wrench are also included in the kit.

1-14.2 For other maintenance, use existing tools and equipment onboard. A complete list of tools and test equipment onboard is in the Tools and Test Equipment List in TM 55-1930-209-14&P-18.

CHAPTER 2 DESCRIPTION OF OPERATION

Section I. Description and data

2-1 Shore winch installation. To set up the shore discharge system to pump drinking water ashore, an LCM-8 or vessel with same capability, is positioned across the bow of the ROWPU barge. When the 20-ton capacity shore winch (weighing 5.5 tons) has been readied for deployment (TM 55-1930-209-14 & P-21), the bow crane lifts it off the barge and sets it in the LCM-8. When the LCM-8 has run ashore and lowered its ramp, the shore unit uses a forklift to unload the winch. The winch is then positioned on the beach and stabilized by stakes driven in by an air compressor-powered jackhammer. The free end of the messenger line, which has been brought ashore, is then fastened to the winch drum. At the barge, the bitter end of the messenger line and lines from floating buoys are tied to the hose end cap. See TM 55-1930-209-14 & P-21 for details about installation, operation and maintenance of the shore winch.

2-2 Hose deployment. A supervisor coordinates hose deployment from the hose reel to the shore winch takeup. Operator uses winch control lever and levelwind control lever to match barge reel winch deployment speed with shore winch retrieval speed. As the hose is deployed, marker buoys are attached to the hose. These buoys, along with status lights (nighttime) or status markers on the deckhouse top, warn vessels that an underwater hose is deployed.

2-3 Pumping water to shore. When hose is connected to shore connection, flexible discharge hose deployment is complete. Drinking water is then pumped ashore until water-making operations at this location are stopped and discharge hose is retrieved.

2-4 Hose retrieval. Retrieval begins when the flexible hose is disconnected from the water connection ashore and the PIG catcher is attached to the hose end. The PIG, propelled by compressed air, travels from the barge end of the discharge hose to the shore, and pushes the water out of the hose to make it easier to retrieve. When this procedure is complete, the PIG catcher on the end of the discharge hose is replaced with the hose end cap and floating buoys. The barge winch operator then operates both the hose reel winch control lever and levelwind control lever to rewind the hose on the winch reel.

CHAPTER 3 OPERATING INSTRUCTIONS

Section I. Operating controls and indicators

3-1 Operating controls and Indicators. Information about shore discharge system operating controls and indicators is contained in Table 3-1 and shown in Figures 3-1 thru 3-9. Operating valves are shown in Figures 3-6 thru 3-9 and are listed in Table 3-2.

Section II. Prestart procedures

3-2 Prestart procedures. Before operating shore discharge system, be sure to check system for damage and perform before operation checks and services in Appendix C.
Section III. Operating procedures

NOTE

During operating procedures, perform during operation checks and services In Appendix C.

3-3 Discharge hose deployment

WARNING

Make sure good communications between barge and shore facility have been established to coordinate discharge hose deployment.

3-3.1 Predeployment procedures. Before deploying the discharge hose, make sure the predeployment operations in paragraphs 3-3.1.1 thru 3-3.1.3 have been performed.

NOTE

Shore winch must be positioned and securely anchored before i pulls discharge hose to shore.

3-3.1.1 Shore winch installation. Make sure the shore winch (20-ton capacity) has been properly positioned and secured according to procedures in TM 55-1930-209-14&P-21.

3-3.1.2 Preparation of discharge hose

a. Free pulling head tiedown. Check that pulling head is secured to coupling.
b. Attach three 500-pound buoyancy floats to pulling head. This prevents hose end from getting stuck in seabottom.

3-3.1.3 Preparation of shore discharge hose reel winch and hydraulic power system

a. Make sure that hydraulic lines are properly connected to hydraulic power package and to winch and levelwind. Make sure that electrical connections are tight and in order.
b. Check sight gauge on hydraulic reservoir to ensure proper level of hydraulic oil (Figure 3-4).
c. If temperature gauge reads 45 degrees F or less, turn heater ON/OFF switch to ON (Figure 3-3).

NOTE

Hose reel winch has two braking systems: 1) a hand-pumped band brake located on starboard side of winch and 2) a spring-loaded, normally-on hydraulic disc brake located on the winch port side.

On Barge 1, during operation, disc brake is released (OFF) when the winch control lever (Figure 3-1) is in the DEPLOY or RETRIEVE position and set (ON) when in the NEUTRAL position.

On Barges 2 and 3, disc brake is set or released when disc brake winch lever (Figure 3-2) Is positioned ON (set) or OFF (released). Manual release is accomplished by using the hose reel winch hydraulic brake releases hand pump.

Table 3-1. Operating Controls and Indicators

Control/Indicator	Figure	Location
Winch hose control lever	3-1 (Barge 1) 3-2 (Barges 2 and 3)	Portside of winch
Winch pressure gauge	3-1 (Barge 1) 3-2 (Barges 2 and 3)	Portside of winch near winch control lever
Winch disc brake lever	3-2 (Barges 2 and 3)	Portside of winch near winch control lever
Levelwind control lever	3-1 (Barge 1) 3-2 (Barges 2 and 3)	Portside of winch
Levelwind pressure gauge	3-1 (Barge 1) 3-2 (Barges 2 and 3)	Portside of winch near levelwind control lever
Hydraulic power unit control panel	3-3	Void 5 or hydraulic power unit
Hydraulic unit remote control switch	3-3	On deckhouse aft bulkhead portside on stem
Zero adjustment screw	3-4	old 5 on hydraulic power unit
Piston pump high (supply) pressure gauge	3-4 (Barge 1) 3-5 (Barges 2 and 3 -A PRESSURE)	Void 5 on hydraulic power unit
Piston pump low (return) pressure gauge	3-4 (Barge 1) 3-5 (Barges 2 and 3 -B PRESSURE)	Void 5 on hydraulic power unit
Charge pressure gauge	3-4 (Barge 1) 3-5 (Barges 2 and 3 -CHARGE PRESSURE)	Void 5 on hydraulic power unit
Levelwind pump pressure gauge	3-4 (Barge 1) 3-5 (Barges 2 and 3 -LEVELWIND PRESSURE)	Void 5 on hydraulic power unit
Supply filter pressure gauge	3-4 (Barge 1) 3-5 (Barges 2 and 3 -SUCTION FILTER)	Void 5 on hydraulic power unit
Return filter pressure gauge	3-4 (Barge 1) 3-5 (Barges 2 and 3 -RETURN FILTER)	Void 5 on hydraulic power unit
Level gauge	3-4	Void 5 on hydraulic power unit
Temperature gauge	3-4	Void 5 on hydraulic unit
PIG launcher controls		
PIG insertion point	3-6	Portside of winch
Compressed air hose connection	3-6	Portside of winch
Valve SD1	3-6	Portside of winch
Valve SD2	3-6	Portside of winch
Winch hydraulic disc brake release controls		
Disc brake release pump handle	3-7	Portside of winch
Hose reel winch disc brake	3-7	Portside of winch
Hose reel winch disc valve SD4	3-7	Portside of winch
Hose winch band brake		
Band brake pump handle	3-8	Starboardside of winch
Band brake valve SD3	3-8	Starboardside of winch
Levelwind valve SD5 (Barges 2 and 3)	3-9	Portside of winch

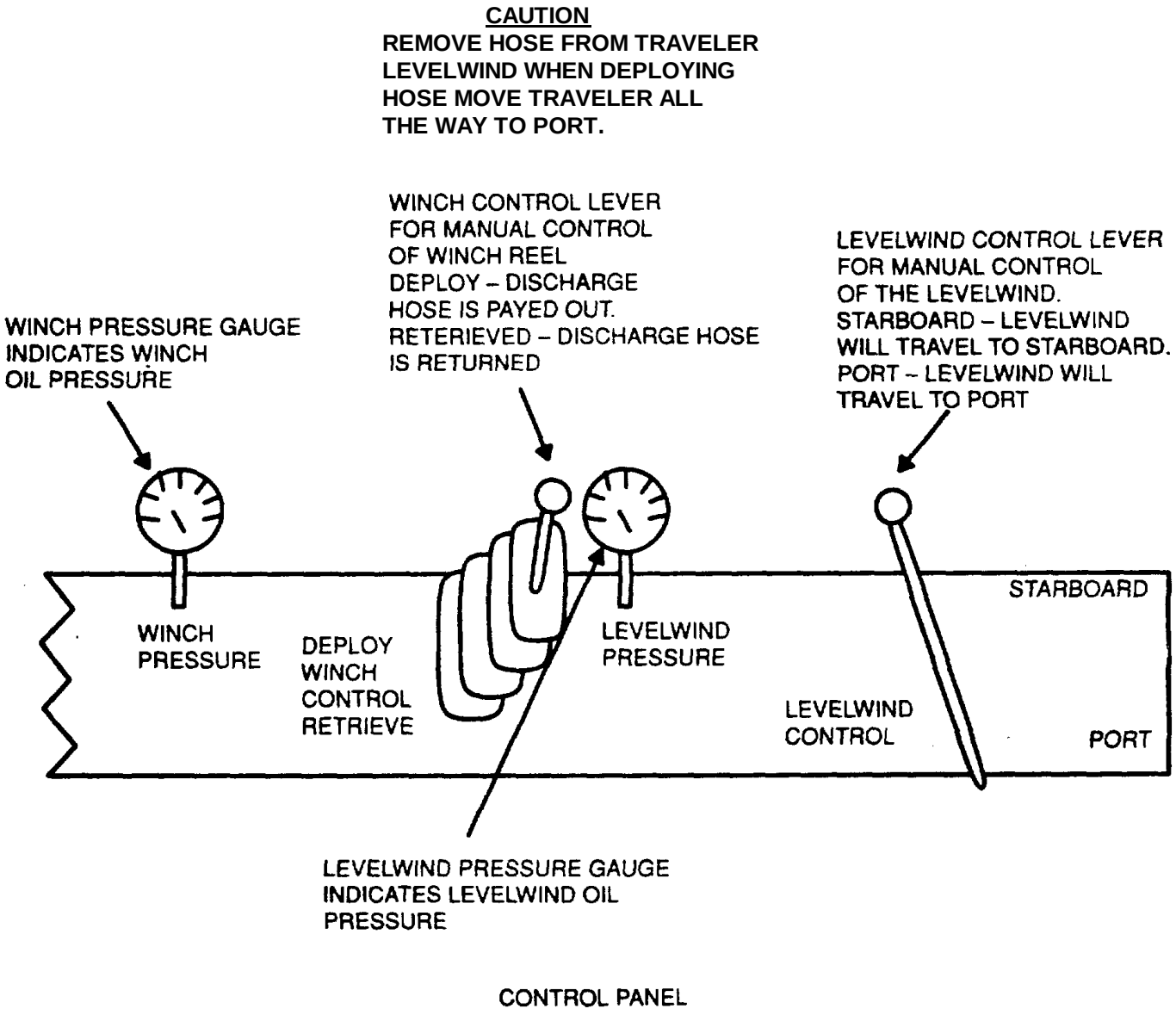


Figure 3-1. Shore Discharge System Winch Controls and Indicators (Barge 1)

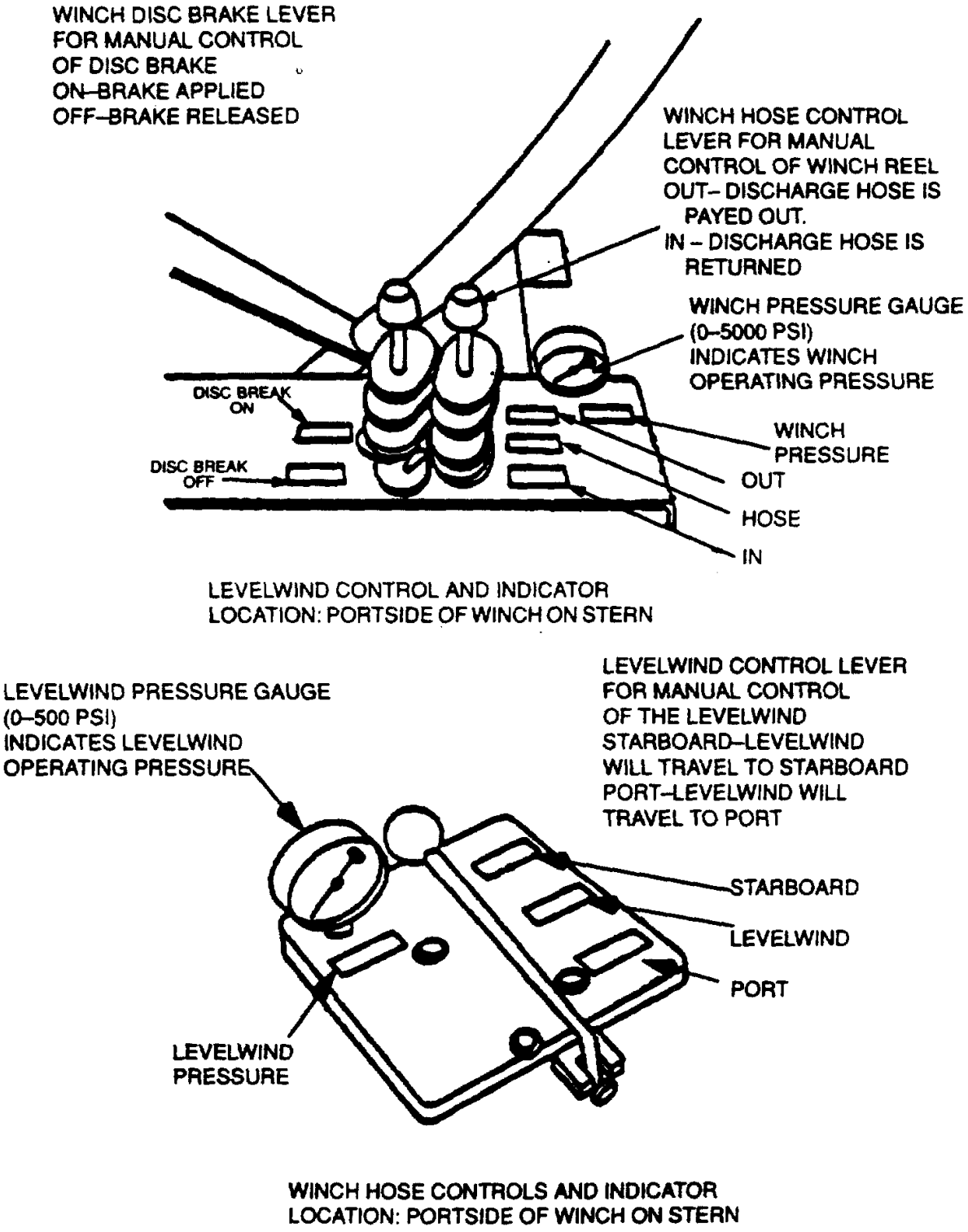


Figure 3-2. Shore Discharge System Winch Controls and Indicators (Barges 2 and 3)

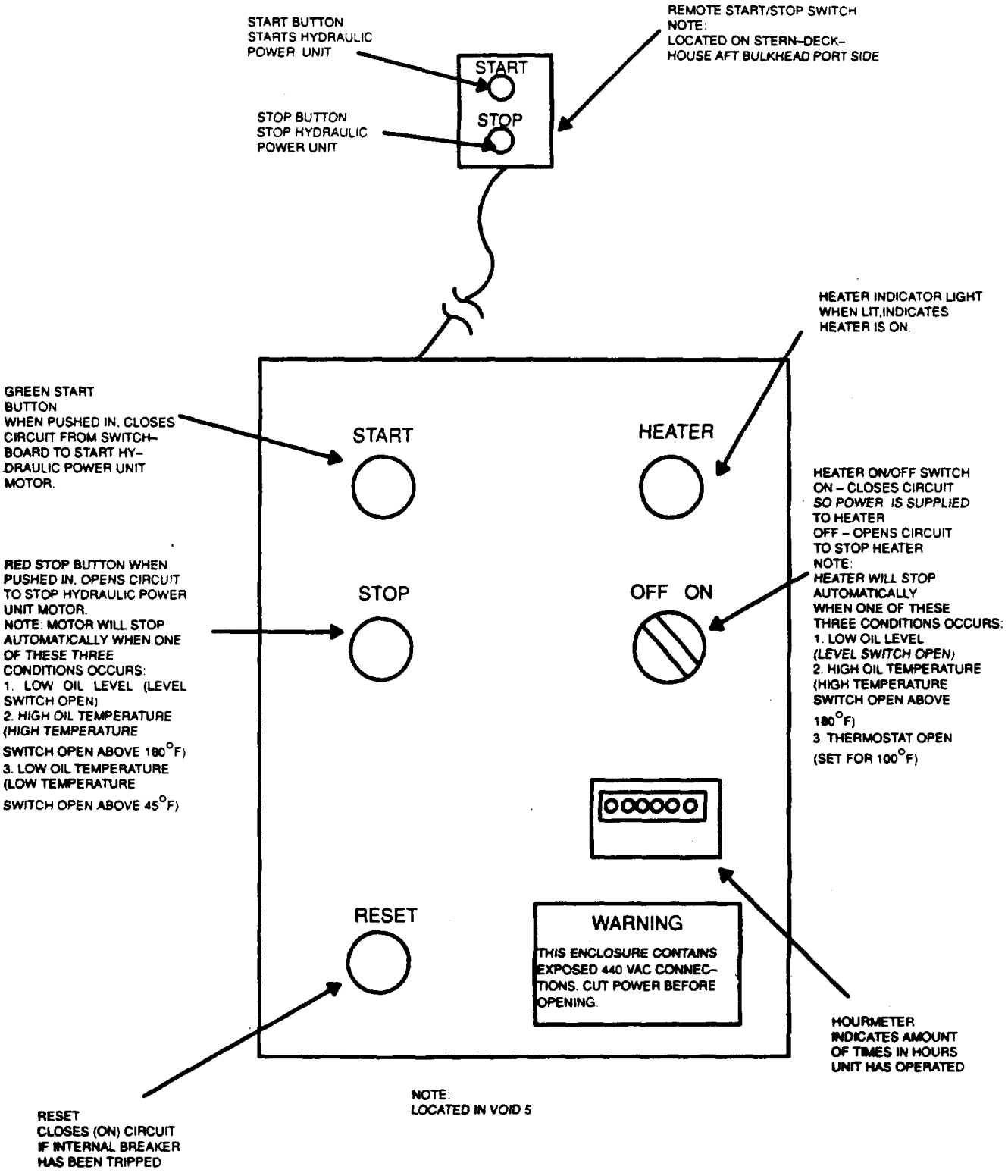
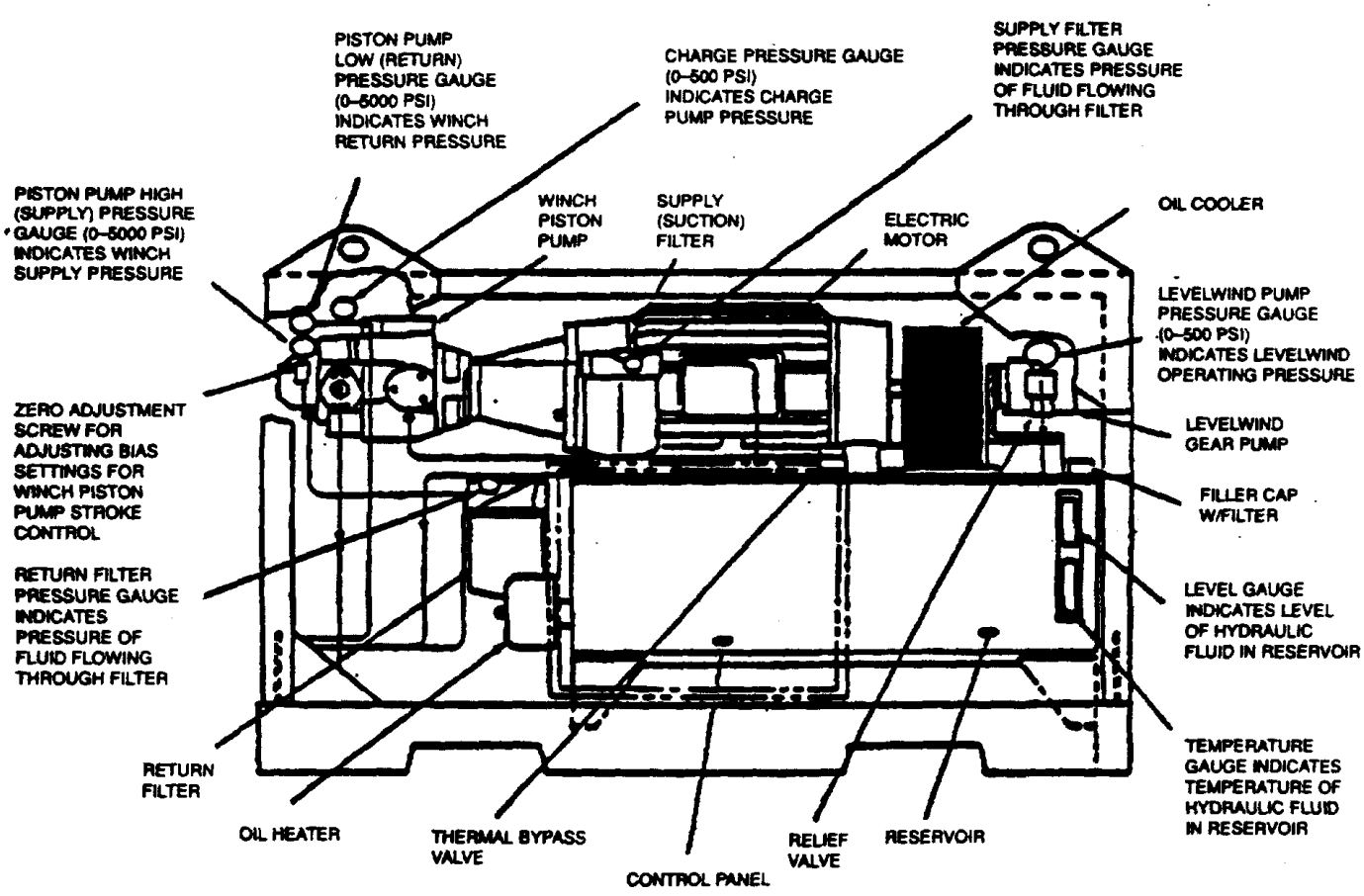


Figure 3-3. Hydraulic Power Unit Control Panel and Remote Start/Stop Switch



ON BARGE 1 PRESSURE GAUGES ARE ON HYDRAULIC POWER UNIT AS SHOWN. ON BARGES 2&3, PRESSURE GAUGES ARE ON CONTROL PANEL.

LOCATION: VOID 5

Figure 3-4. Hose Winch Hydraulic Power Unit

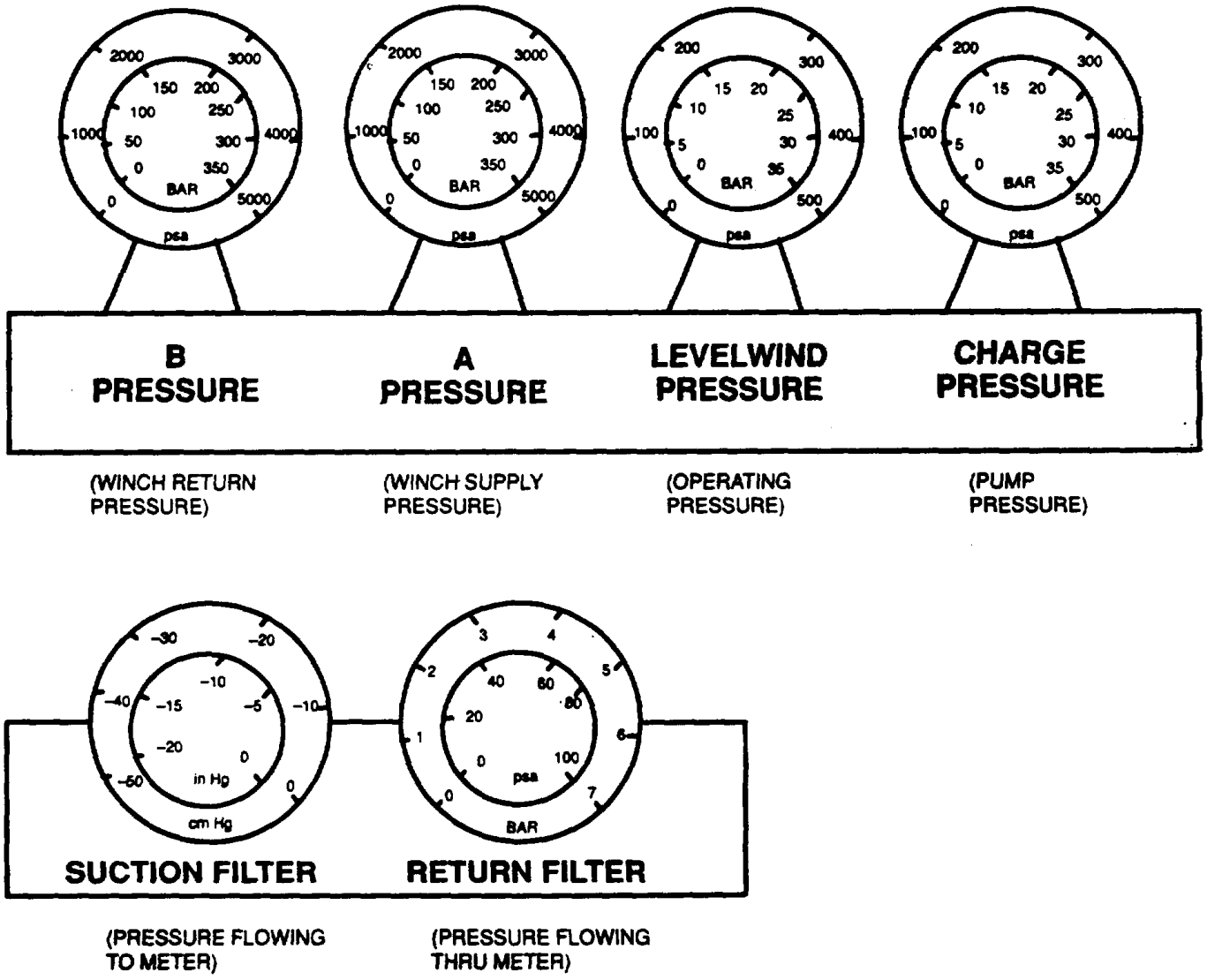


Figure 3-5. Hydraulic Power Unit Gauges (Barges 2 and 3)

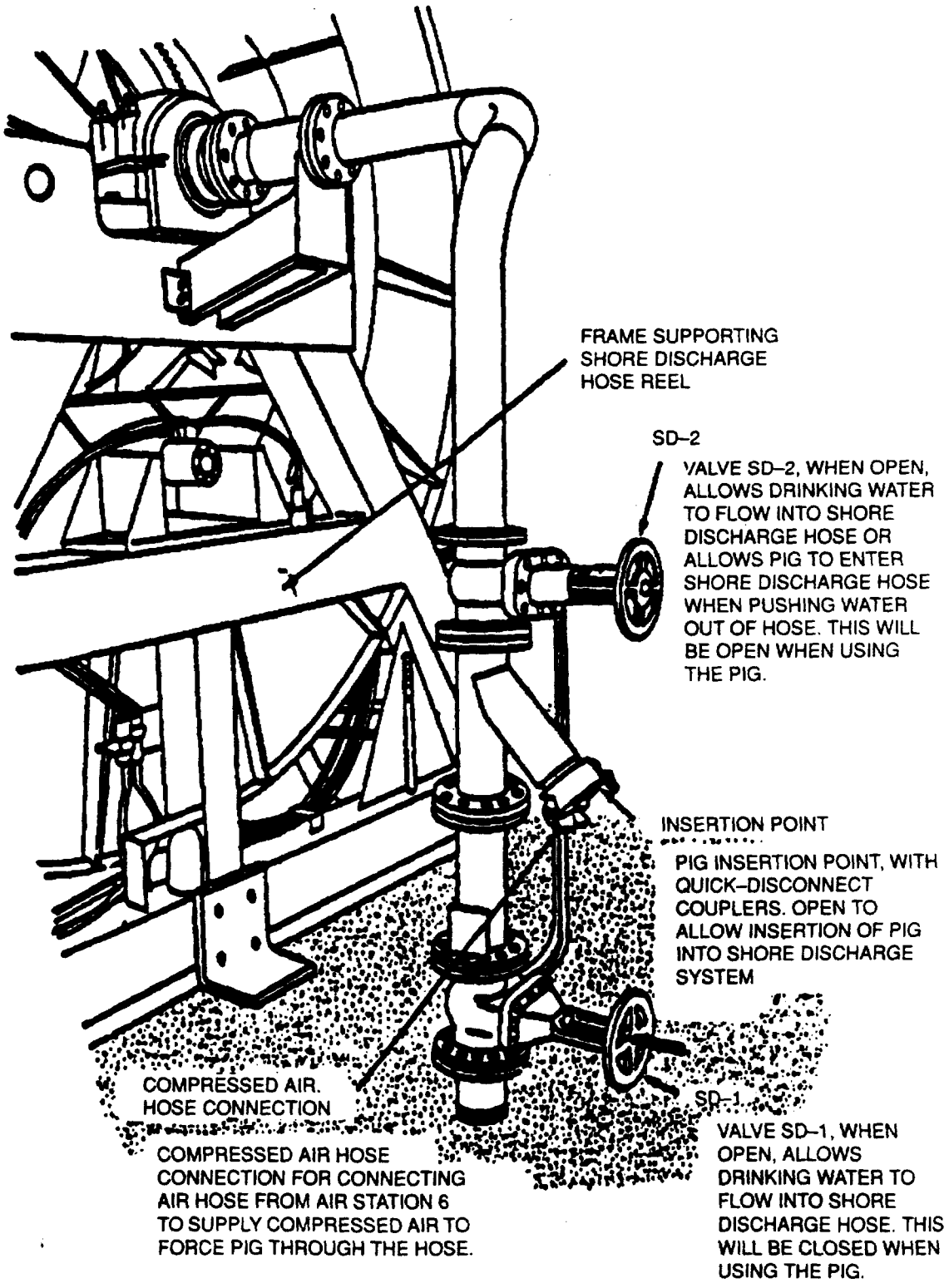


Figure 3-6. Valves and PIG Launcher Controls

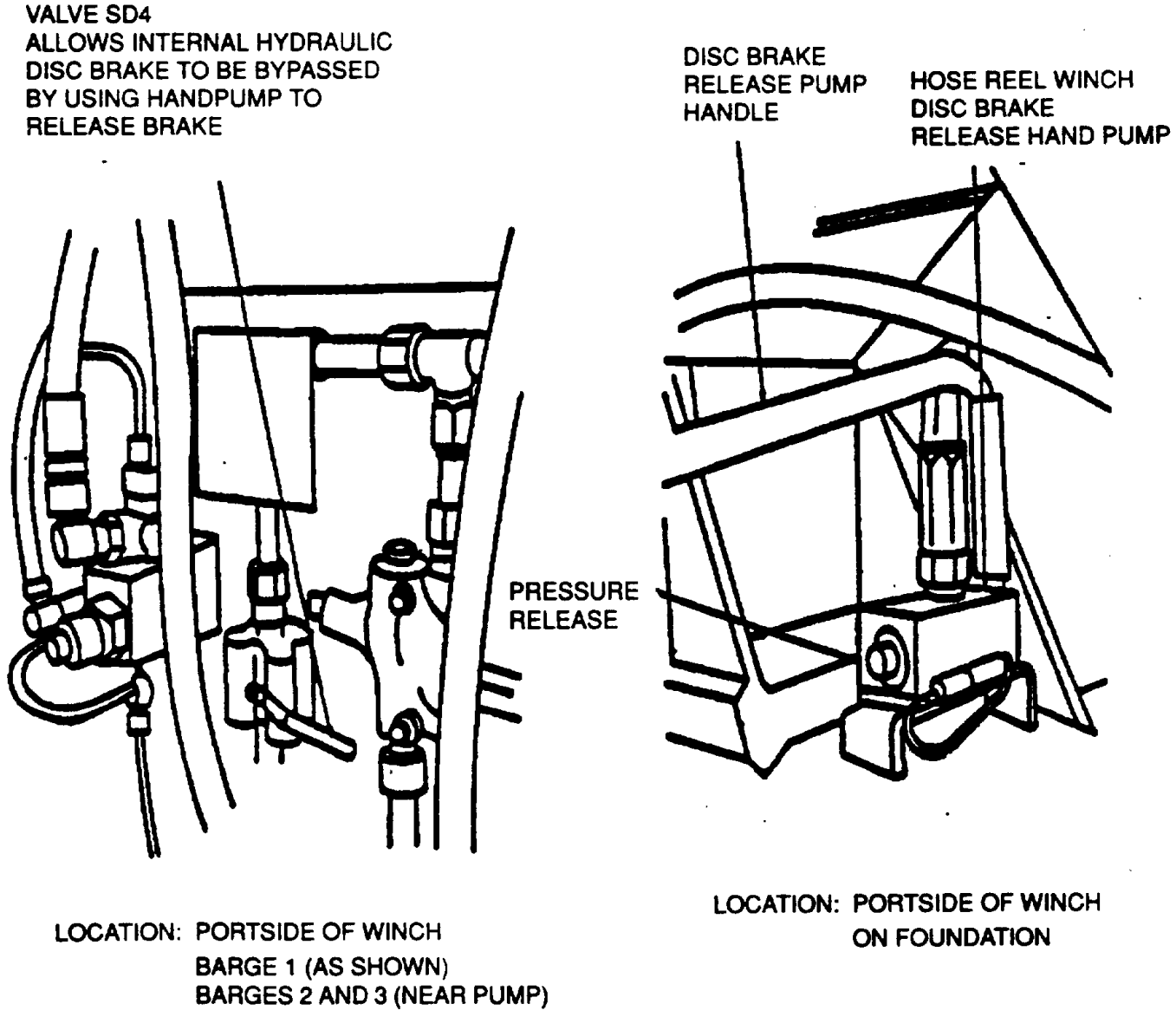


Figure 3-7. Hydraulic Disc Brake Release Controls

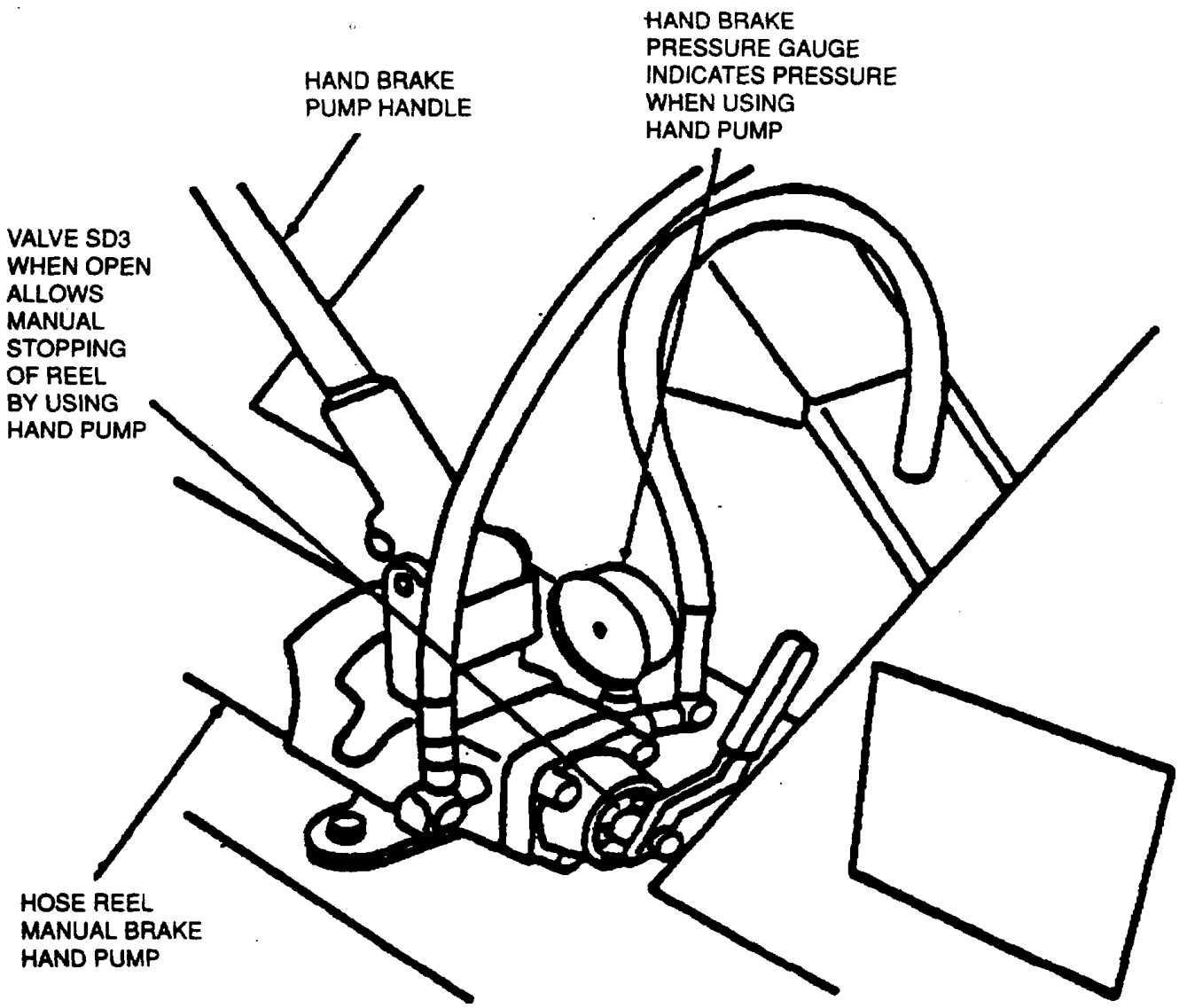


Figure 3-8. Band Brake Hand Pump Controls and Indicators

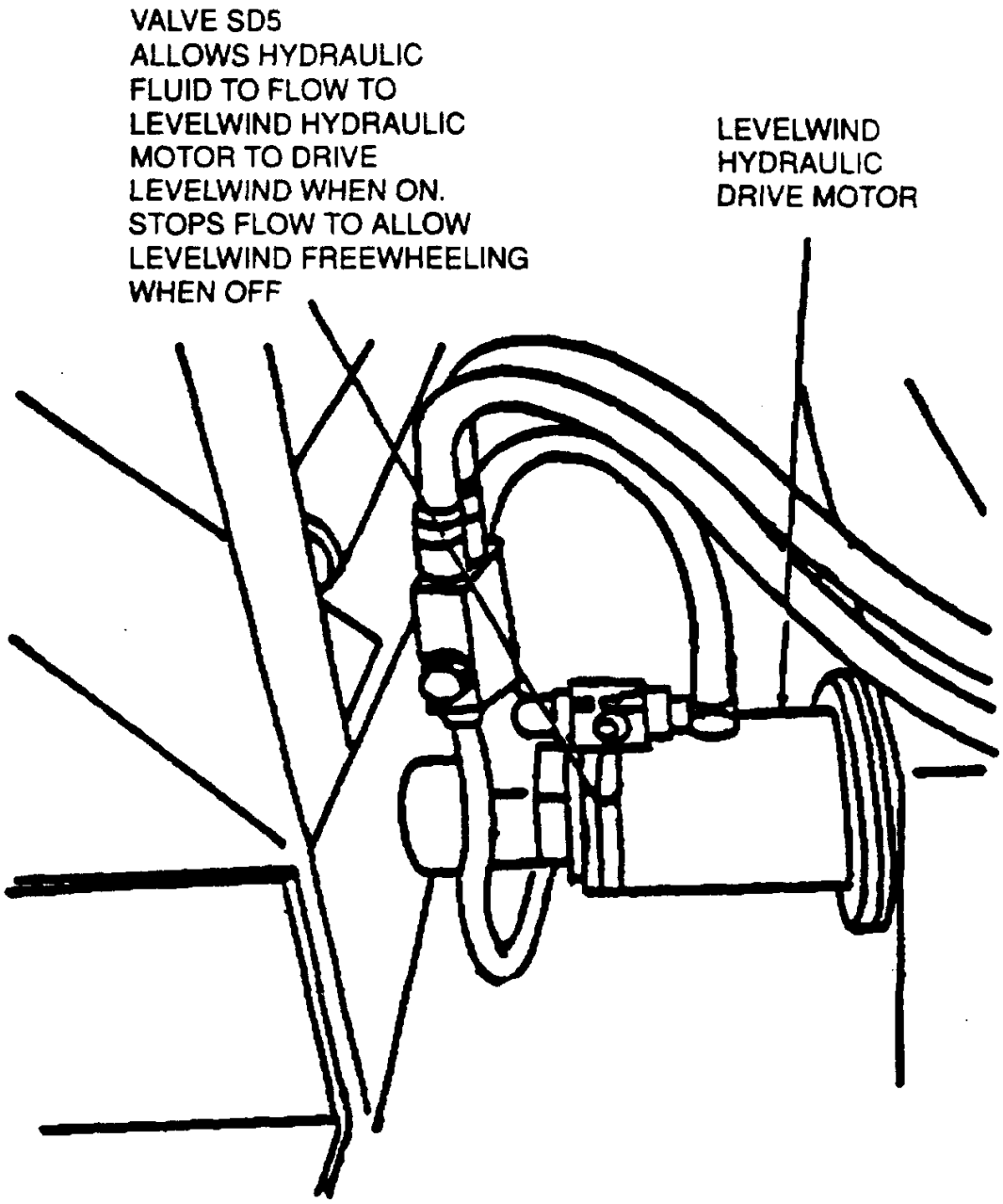


Figure 3-9. Levelwind Controls (Barges 2 and 3)

Table 3-2. Shore Discharge System Valves

Type	Figures 3-6 thru 3-9 Callout	Location	Label Identification and Valve Function
4-in. gate	SD1	In supply line to shore discharge winch reel	DRINKING WATER SUPPLY: Allows drinking water to flow to valve SD2
4-in. gate	SD2	In supply line to shore discharge winch reel	PIG LAUNCHER: Allows drinking water to flow to discharge hose when valve SD1 is open. Allows PIG to move to discharge hose when valve SD1 is closed and compressed air moves PIG
Ball valve	SD3	On starboard side of winch reel	HOSE REEL WINCH HAND BRAKE: Allows reel to be manually stopped by using handpump to engage band brake
Ball valve	SD4	On port side of winch reel	HOSE REEL WINCH HAND ROTATION: Allows internal disc brake to be bypassed by using handpump to release brake
Ball valve	SD5 Barges 2 and 3)	On levelwind hydraulic motor	LEVELWIND: Controls hydraulic fluid to levelwind drive motor to allow levelwind to operate under hydraulic power or to freewheel

d. Make sure winch band brake on starboard side of winch is set. If not, set as follows:
   (1) Open valve SD3 (Figure 3-8).
   (2) Obtain band brake pump handle from stowed position and insert in pump extension.

WARNING
While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE.

   (3) Pump until band brake piston enters cylinder and band is tight on the brake drum.
   (4) Position valve SD3 in neutral position (midway between OPEN and CLOSE position) to lock the cylinder in the set position.
   (5) Remove pump handle and return to stowed position.

e. Perform the following as appropriate:
   (1) On Barge 1:
      (a) Make sure valve SD4 (Figure 3-7) is in ON position.
      (b) Make sure that winch control and levelwind control levers (Figure 3-1) are in middle (neutral) position.
   (2) On Barges 2 and 3:
      (a) Make sure valve SD4 (Figure 3-7) is in ON position.
      (b) Make sure valve SD5 (Figure 3-9) is in OFF position to allow freewheeling of levelwind hydraulic drive motor.
      (c) Make sure that winch hose control and levelwind control levers are in neutral position.
      (d) Make sure disc brake lever is in ON position.

f. Close (ON) switchboard hose reel circuit breaker P12 (Figure 3-10) supplying power to hydraulic unit, electrical motor, and controls.

NOTE

Hydraulic power unit can also be started by pressing START push button on hydraulic unit remote START/STOP switch located on deckhouse aft bulkhead portside.

g. Push green START button on hydraulic power unit control panel located in void 5 (Figure 3-3). If motor does not start, troubleshoot as given in paragraph 4-4.1.

h. If initial. startup, check pump rotation as shown on identification plate.

i. If initial startup, or if system has not been operated for several days:

Barge 1 - Allow pumps to run with winch hose control and levelwind control levers in neutral position for not less than 5 minutes. This allows hydraulic oil to circulate at low pressure to remove entrapped air.

Barges 2 and 3 - Allow pumps to run with disc brake control in OFF position and winch hose and levelwind controls in neutral position for not less than 5 minutes.

j. Check for oil leaks and tighten fittings if necessary.

k. Make sure charge pressure gauge (Barge 1 - Figure 3-4; Barges 2 and 3 - Figure 3-5) on hydraulic power unit reads 250 psi. This is the minimum pressure needed for proper stroke control and make-up flow for winch circuit.

I. Check bias settings for piston pump stroke control. With winch control lever in neutral position on Barge 1 (Figure 3-1) or OFF position on Barge 2 and 3 (Figure 3-2), compare readings between piston pump low pressure gauge and high pressure gauge on hydraulic power unit (Figure 3-4). These gauges indicate pressure on two sides of winch circuit. If the two readings differ, bias should be zeroed by adjusting zero adjustment screen (socket-head screw) on end of stroke control on piston pump. This ensures that pump is fully destroked when winch hose control lever is in neutral position.

m. If winch drum is secured, release winch drum tiedown.

3-3.1.4 Deployment of messenger (tow) line

a. Make sure hose reel is installed and held in place by pins on each side to workboat.

b. Using workboat, carry end of messenger line to shore.

c. Unwind messenger line by turning handcrank on starboard side of winch and attach messenger line to shore winch. Leave enough slack so that workboat can back off from shore before line is taut.

d. Deploy line from workboat reel using winch handcrank while moving toward barge.

e. Attach messenger line bitter end to discharge hose pulling head assembly with shackle and shackle pin. Make sure shackle pin has been secured with wire or cotter pin to prevent loss during deployment to shore.

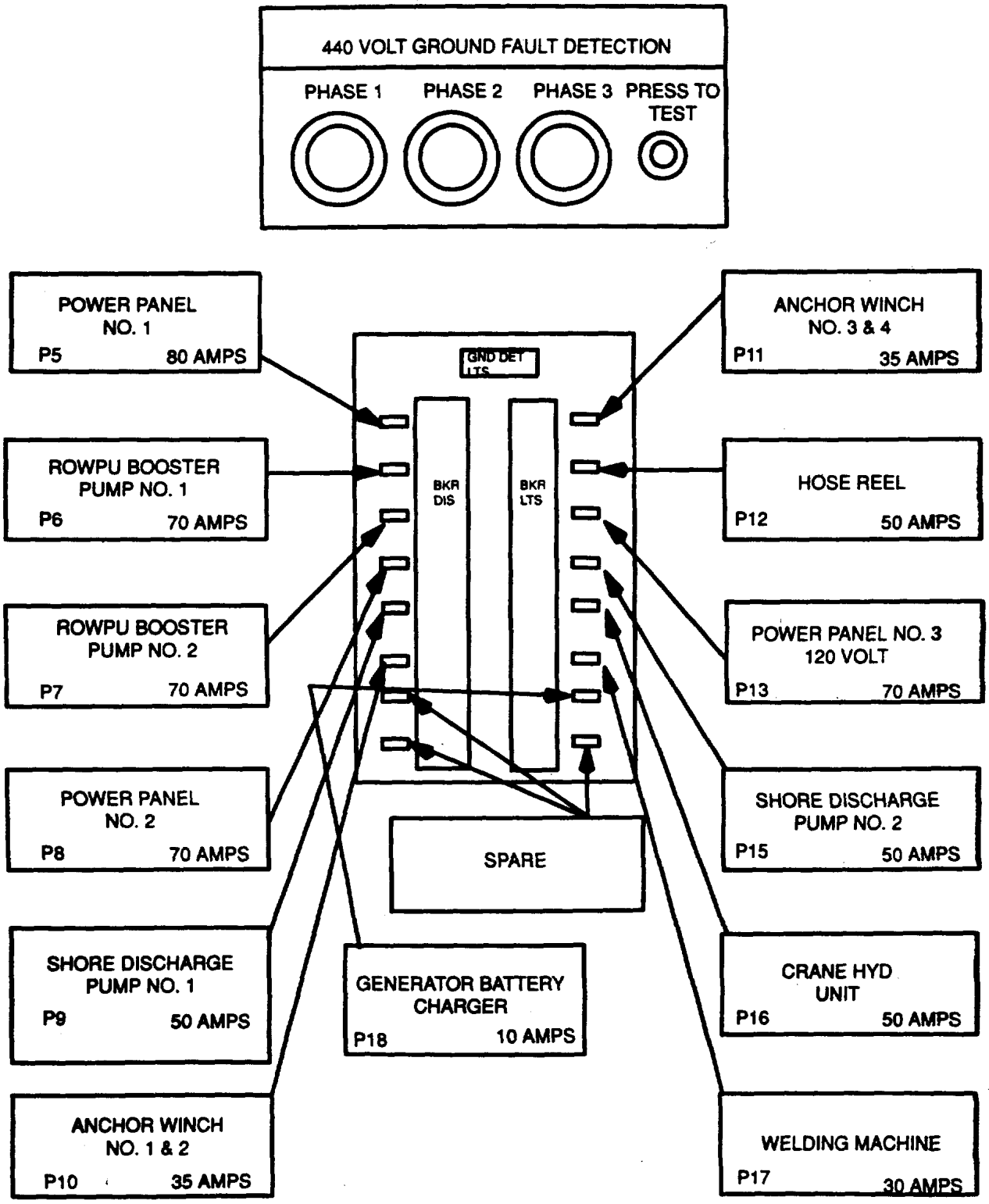


Figure 3-10. Location of Circuit Breaker P12 on Switchboard

3-3.2 Deployment of discharge hose (hose out)

WARNING
Make sure that nobody stands in front of or behind hose reel.

a. Make sure steel chute surface is smooth and free of any irregularities that could damage hose.

NOTE
If hydraulic power unit Is shut down or no electric power Is available, deploy discharge hose manually as given in paragraph 3-3.3.

b. Release band brake on winch as follows:
   (1) Close valve SD3 (Figure 3-8).
   (2) Obtain band brake pump handle from stowed position and insert in pump extension.

WARNING
While pumping, do not exceed 4,000 psi as shown on band brake pressure gauge.

   (3) Pump until band brake piston comes out of cylinder and there is a slight clearance between band brake material and brake drum.
   (4) Remove pump handle and return to stowed position.

c. Screw on hose end cap.

d. Deploy hose as follows:
   (1) On Barge 1 (Figure 3-1):

WARNING
During deployment on Barge 1, levelwind control lever must be operated. Use care to regulate speed of levelwind movement with hose movement.

      (a) Use winch control lever to deploy hose end cap while using levelwind control lever to control movement of levelwind.
      (b) Make sure hose end cap is pulled away from barge anchor lines to prevent entanglement.

   (2) On Barges 2 and 3 (Figure 3-2):

WARNING
During deployment on Barges 2 and 3, levelwind control lever must not be operated. Make sure valve SD5 (Figure 3-9) on levelwind hydraulic drive motor Is OFF and levelwind moves freely.

      (a) Push winch disc brake lever (Figure 3-2) to OFF to release disc brake.
      (b) Use winch hose control lever to deploy pulling head assembly.
      (c) Make sure hose end cap assembly is launched away from barge anchor lines to prevent entanglement.

WARNING
Barge winch deployment speeds and shore winch takeup speed must be the same but no faster than 30 feet per minute. Deploying 2000 feet of hose normally takes 70-90 minutes.

      (d) Deploy hose at same speed that shore winch takes it in, but no faster than 30 feet per minute Operate shore winch according to TM 55-1930-209-14&P-21. If a winch runaway situation start, to develop, perform procedures in 3-3.3. Otherwise, go to step e.

e. As hose is deployed, attach marker buoys with line to identify undersea discharge hose location. First marker must be 150 feet from shore, and all other markers must be spaced every hundred feet for remainder of hose deployed. If tactical situation permits and area near barge has considerable boat traffic, these marker buoys should be lighted at night to protect the undersea hose from damage.

Deployment of Marker Buoys:

Marker	Color	Location
First	White	150 feet plus distance of shore facility connection from beach
Second	Red	100 feet from first marker
Third	White	100 feet from second marker
Fourth, etc.	Alternate color	100 feet from previous marker

NOTE

Watch pulling head assembly floats to ensure that floats are visible at all times during discharge hose deployment.

f. Deploy discharge hose until flange is at desired location (near shore hose connection) on shore. Anchor with sandbags and stakes at least 70 feet of hose resting on shore to make sure it does not shift. While deploying hose, perform during operation checks and services in Appendix C and in Chapter 2, TM 55- 1930-20914&P-19.

g. Deploy additional length of hose onto seabed to protect hose and barge winch. Then, on:
   Barge 1 return winch control and levelwind control levers to neutral.
   Barges 2 and 3 return winch control lever to neutral and disc brake lever to ON.

NOTE

Barge crewmen must connect hose flange to shore facility flange.

h. Remove hose end cap, floats, and messenger line and attach hose flange to flange of shore connection.

i. Return hose end cap, floats, and messenger line to barge and stow.

j. Set band brake on barge winch as follows:
   (1) Open valve SD3 (Figure 3-8).
   (2) Obtain BAND BRAKE PUMP HANDLE from stowed position and insert in pump extension.

CAUTION

While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE

   (3) Pump until band brake piston enters cylinder and band is tight on the brake drum.
   (4) Position valve SD3 in neutral position (midway between OPEN and CLOSE position) to lock the cylinder in the set position.
   (5) Remove pump handle and return to stowed position.

k. Turn off hose winch hydraulic power unit by pushing red STOP button on control panel.

l. Open switchboard circuit breaker P12 to cut power to hose reel hydraulic unit and winch.

m. Shutdown shore winch according to procedures in TM 55-1930-209-14&P-21.

n. Display international rules of the road day shapes or night lights on mast above topdeck to warn that barge has a discharge hose deployed on the seabed.

Time	Top Signal	Middle Signal	Bottom Signal
Daytime	Black Ball	Black Diamond	Black Ball
Nighttime	White Light	Red Light	White Light

3-3.3 Controlling a runaway discharge hose. If a winch runaway situation develops, control runaway as follows:

a. Barge 1 - Position winch control lever in NEUTRAL.
b. Barges 2 and 3 - Push disc brake lever to ON.
c. If this fails to stop runaway, apply band brake as follows:
   (1) Open valve SD3.
   (2) Obtain BAND BRAKE PUMP HANDLE from stowed position and insert in pump extension.

WARNING
While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE gauge.

   (3) Pump until band brake piston enters cylinder, band is tight on the brake drum and stops rotation.
   (4) Position valve to neutral position (midway between OPEN and CLOSE position) to lock the cylinder in the set position.
   (5) If band brake begins to smoke, spray it with salt or fresh water to cool brake.
   (6) After band brake cools, close valve SD3.
   (7) Pump until band brake piston comes out of the cylinder and there is a slight clearance between the band brake material and brake drum.
   (8) Remove pump handle and return to stowed position.

3-3.4 Unpowered discharge hose deployment. If hydraulic power is not operating or electrical power is not available, deploy discharge hose as follows:

a. Position valve SD4 (Figure 3-7) to OFF to allow winch hydraulic drive motor to freewheel.
b. Disconnect hydraulic disc brake hose from disc brake valve and connect to hose reel winch hydraulic brake release handpump.
c. Obtain disc brake release pump handle from stowed position and insert into pump extension.
d. Open pump pressure release valve, located beneath pump handle, by turning it counterclockwise.
e. Pump until disc brake is released.
f. Close pump pressure release valve by turning it clockwise.

WARNING
While external source Is pulling hose from winch reel, use band brake as necessary to control deployment rate.

g. Prepare band brake to control winch drum rotation as follows:
   (1) Open valve SD3 (Figure 3-8).
   (2) Obtain BAND BRAKE PUMP HANDLE from stowed position and insert in pump extension.

WARNING
While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE.

h. As winch drum rotates, operate pump handle to control drum rotation.
i. When hose is deployed or power becomes available, return winch to normal powered operation as follows:

WARNING
For normal powered operation of winch, valve SD4 must be fully closed (ON), disc brake pressure release valve must be closed (ON), and brake hose must be connected to brake valve.

(1) Release brake line pressure by turning pressure release screw on hose reel winch hydraulic brake. release handpump counterclockwise. Disc brake will be automatically set.
(2) Position valve SD4 to ON (Figure 3-7).
(3) Disconnect hydraulic disc brake hose from hose reel winch hydraulic brake release handpump and connect hose to disc brake valve.
(4) Return disc brake release pump handle to stowed position.
(5) Set band brake as follows:
    (a) Open valve SD3 (Figure 3-8).

WARNING

While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE.

    (b) Pump until band brake piston enters cylinder and band brake is tight on the brake drum.
    (c) Position valve SD3 in neutral position (midway between OPEN and CLOSE position) to lock the cylinder in the set position.
    (d) Remove pump handle and return to stowed position.

3-4 Discharging drinking water to shore. When discharge hose has been deployed and shore receiving station is ready to receive drinking water, perform the following:

a. Open valve at shore receiving facility.
b. Open shore discharge valve SD1 and SD2 (Figure 3-6).
c. Make sure drinking water system is ready to discharge drinking water to shore, then start drinking water discharge pump.
d. While drinking water is being discharged to shore, perform during operation checks and services in Chapter 2, TM 55-1930-209-14&P-19.

3-5 Shutdown procedures. When shutting down shore discharge operation, coordinate hose retrieval with shore receiving station. First, blow out drinking water from hose (paragraph 3-5.1). Then, retrieve hose and secure winch (paragraph 3-5.2).

WARNING

Make sure good communications between barge and shore facility have been established to coordinate discharge hose retrieval.

3-5.1 Discharge hose pigging (hose blowout)

NOTE

Discharge hose must be emptied of Its water before retrieving hose. Removing water reduces weight of hose, making it easier to retrieve.

a. On barge, close valves SD1 and SD2 (Figure 3-6).
b. On shore, perform the following:
    (1) Close valve at shore facility.
    (2) Disconnect hose flange from shore facility flange.
    (3) Connect PIG receiver to hose flange.

c. On barge, perform the following:
   (1) Open PIG insertion point (Figure 3-6), insert PIG, and reinstall cap.
   (2) Connect 25-foot air hose between Compressed Air Station 6 and PIG insertion point air connection.
   (3) Open valve SD2.
   (4) Make sure compressed air system is operating. Start up and charge receiver if necessary.
   (5) When shore end of discharge hose has been disconnected and PIG receiver on shore is ready to receive PIG, open Compressed Air Station 6 supply valve.
   (6) When PIG arrives in PIG receiver on shore, close Compressed Air Station 6 supply valve and valve SD2.
   (7) On shore, remove PIG receiver and remove PIG. Return PIG to barge if reuseable (not badly worn or damaged).

NOTE

Pigging time is about 15 minutes. About 1,500 gallons of water will be discharged on shore.

   (8) On shore, connect hose end cap to hose flange. Make sure cap is tight to provide watertight connection. Return PIG receiver to barge and stow.

3-5.2 Discharge hose retrieval (hose in)

WARNING

Make sure that nobody stands In front of or behind hose reel. Make sure steel chute is smooth and free of any dents or cuts that could damage hose.

a. Attach floats to discharge hose end cap.
b. Make sure winch band brake on starboard side of winch is set. If not, set as follows:
   (1) Open valve SD3 (Figure 3-8).
   (2) Obtain BAND BRAKE PUMP HANDLE from stowed position and insert in pump extension.

WARNING

While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE.

   (3) Pump until band brake piston enters cylinder and band is tight on the brake drum.
   (4) Position valve SD3 in neutral position (midway between OPEN and CLOSE position) to lock the cylinder in the set position.
   (5) Remove pump handle and return to stowed position.
c. Make sure switchboard circuit breaker P12 is closed (ON).
d. Perform the following, as appropriate:
   (1) On Barge 1:
      (a) Make sure valve SD4 is ON (Figure 3-7).
      (b) Make sure that WINCH CONTROL and LEVELWIND CONTROL levers are in middle (neutral) position.
   (2) On Barges 2 and 3:
      (a) Make sure valve SD4 is ON (Figure 3-7).
      (b) Make sure DISC BRAKE lever is ON.

e. Startup winch as follows:

NOTE

Hydraulic power unit can also be started by pressing START button on hydraulic unit remote control switch located on stem weatherdeck bulkhead portside.

(1) Push green START button on hydraulic power unit control panel or on hydraulic unit remote control switch (Figure 3-3). If motor does not start, troubleshoot as given in paragraph 4-10.1.

(2) If system has not been operated for several days, allow hydraulic oil to circulate at low pressure to remove entrapped air.

Barge 1 - Allow pumps to run with winch control and levelwind control levers In neutral position.

Barges 2 and 3 - Allow pumps to run with disc brake control OFF and winch and levelwind control In neutral.

(3) Check for oil leaks and tighten fittings if necessary.

(4) Make sure charge pump pressure gauge on hydraulic power unit reads 250 psi.

NOTE

On Barge 1, levelwind is used during deployment and retrieval. Cn Barges 2 and 3, levelwind Is allowed to freewheel during deployment.

f. On Barges 2 and 3, turn valve SD5 ON (Figure 3-9).

g. Release band brake as follows:

(1) Close valve SD3 (Figure 3-8).

(2) Obtain BAND BRAKE PUMP HANDLE from stowed position and insert in pump extension.

CAUTION

While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE.

(3) Pump until band brake piston comes out of the cylinder and there is a slight clearance between the ban brake lining and brake drum.

(4) Remove pump handle and return to stowed position.

h. Connect washdown hose to washdown connection on deckhouse top. While retrieving discharge hose, wash mud and other foreign materials from hose.

i. As hose is retrieved, remove marker buoys and lines and stow in ROWPU space aft stowage area.

CAUTION

As each layer of hose comes on the reel, make sure transition to the next layer is smooth. If necessary, operate LEVELWIND control lever to gently form the first coil of the next layer.

j. Start retrieving hose by using winch control lever. Operate LEVELWIND control lever to form first layer of hose on drum. If necessary, operate LEVELWIND control lever to gently form the first coil of the second layer.

Then operate lever as needed to form remaining layers. On Barges 2 and 3, also operate disc brake lever when needed.

k. When the discharge hose is completely retrieved, tie hose end cap to barge.

I. Push red STOP button on hydraulic power unit to stop unit, or on hydraulic unit remote control switch.

m. Open switchboard circuit breaker P12.

3-5.3 Emergency shutdown

3-5.3.1 General. The barge has two emergency shutdown modes. One mode shuts down individual systems such as the ventilation system or a diesel high pressure pump, and the other shuts down all barge operating systems.

Both modes are activated by pushing a red button protected by a metal guard. On individual system shutdowns, either fuel or electrical power is shut off to that system only. On total shutdown, all fuel and electrical power is shut off to all operating systems.

Seven red system shutdown buttons are located on the ROWPU space starboard bulkhead just aft of the personnel door. These system shutdown buttons (Figure 3-10) control shore power, ventilation systems, ROWPU 1 diesel high pressure pump, ROWPU 2 diesel high pressure pump, ship auxiliary generator, ship service generator 1, and ship service generator 2.

Six red total shutdown buttons are located as follows:

- On ROWPU space starboard bulkhead aft of personnel door, above and forward of system shutdown buttons.
- Outside ROWPU space starboard door on weatherdeck.
- Outside ROWPU space port door on weatherdeck.
- Inside ROWPU space port door to weatherdeck.
- Outside dayroom door to weatherdeck.
- Inside dayroom door to weatherdeck.

3-5.3.2 Emergency shutdown procedures

a. In an emergency, push the appropriate red button to shut down either a selected system or all operating systems.
b. When emergency situation has been corrected, reset emergency button by turning collar behind button one-quarter turn clockwise. Button will pop out and again be in the ready position.
c. After emergency button is reset, any systems turned off by that emergency button must be restarted with their individual controls.

Section IV. Operation under extreme conditions

3-6 Operation under extreme conditions. Operation of shore discharge system in extreme cold creates a special problem with lubricants. Other problems occur during operation in extreme heat. These extreme conditions are discussed below. Additional information is contained in the manufacturers' service manuals/instructions listed in Chapter 6. See TM 55-1930-209-14&P-21 for operation of shore winch under unusual conditions.

3-6.1 Operation in extreme cold

a. Heaters. When oil temperature is 45 degrees F or less, set heater ON/OFF switch (Figure 3-3) to ON. Make sure heater indicator light comes on.
b. If hydraulic power unit motor does not start because temperature on weatherdeck is below 32 degrees F, it may be necessary to jog starter button (Figure 3-3) so that warmer oil in hydraulic power unit warms oil in lines on weatherdeck. If hydraulic power unit motor does not start after jogging starter button, it may be necessary to heat hydraulic lines on weatherdeck.

3-6.2 Operation in extreme heat. Motors. Electric motors may have a tendency to run hot and stop due to overload. It is best to allow the motor to start automatically after it cools off.

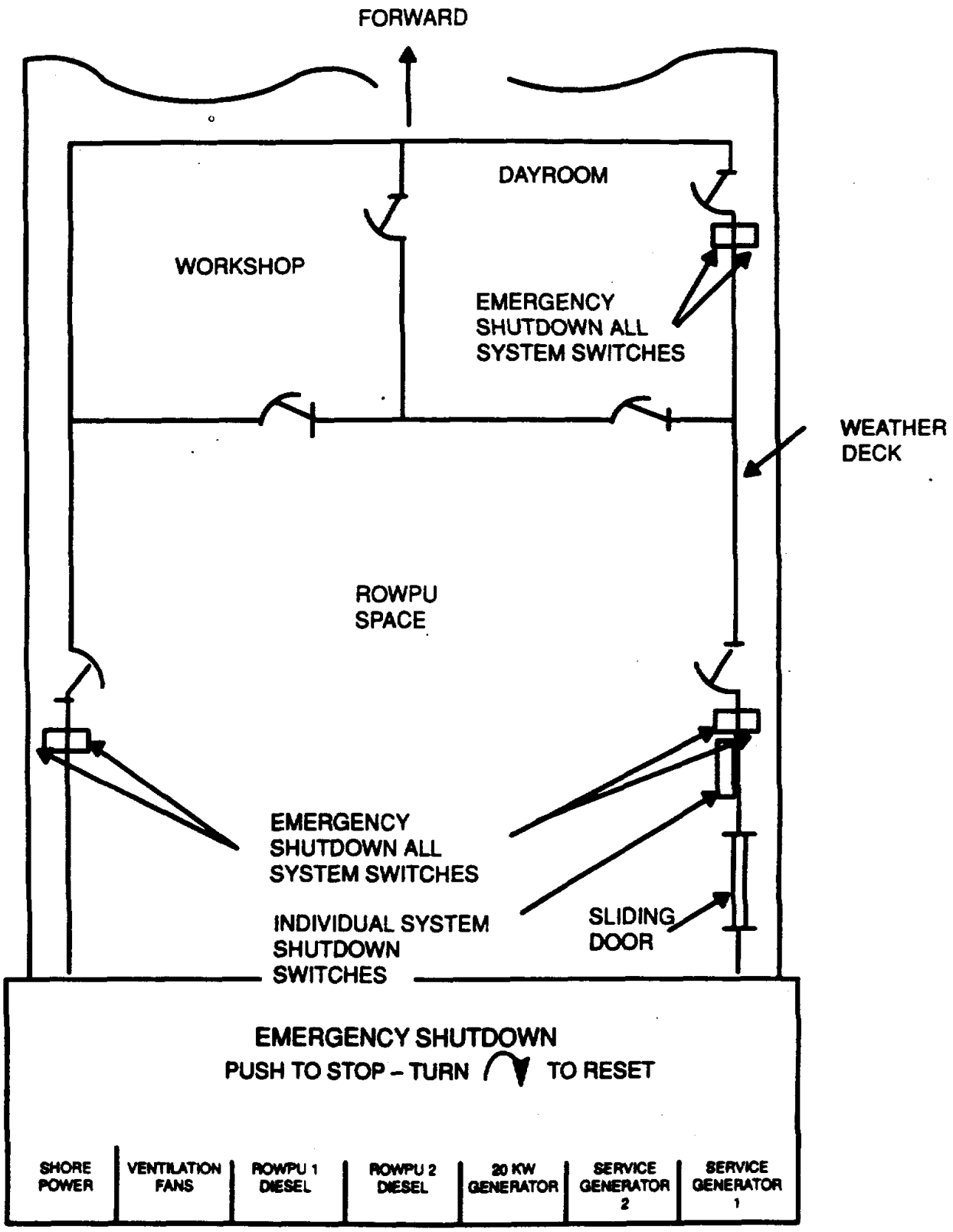


Figure 3-11. Emergency System Shutoff Buttons

CHAPTER 4 MAINTENANCE INSTRUCTIONS

Section I. General

4-1 Maintenance concept

4-1.1 Unit level and Intermediate Direct Support and Intermediate General Support (IDS/IGS) maintenance on ROWPU drinking water shore discharge system equipment is performed onboard by barge crewmembers whenever possible.

4-1.2 Any IDS/IGS maintenance beyond capability of crewmembers is provided by a shore-based area support maintenance unit. This unit also determines if depot support maintenance is required.

4-1.3 Intermediate support maintenance is accomplished by replacement of components or major end items.

4-1.4 Unless other intermediate support procedures are directed, IDS/IGS maintenance normally is provided by an Army Transportation Corps floating craft intermediate support maintenance unit serving terminal operating area. Components to be disposed of are processed by this unit.

4-1.5 Maintenance Allocation Chart (MAC) is in TM 55-1930-209-14&P-18. For maintenance of other equipment onboard, consult appropriate manual.

4-2 Maintenance procedures. Maintenance procedures are presented in the Sections that follow: Section II, Preventive maintenance checks and services; Section III, Troubleshooting; and Section IV, Maintenance procedures. See TM 55-1930-209-14&P-21 for shore winch maintenance procedures.

Section II. Preventive maintenance checks and services

4-3 See TM 55-1930-209-14&P-6, Appendix C for preventive maintenance checks and services for the Shore Discharge System. See TM 55-1930-209-1 4& P-1 9 for complete preventive maintenance checks and services for all ROWPU Barge Systems.

Section III. Troubleshooting

4-4 Component
4-4.1 Winch hydraulic drive motor. Troubleshoot motor as given in the manufacturer's service manual/instructions in Appendix B of this TM.
4-4.2 Levelwind hydraulic drive motor. Troubleshoot motor as given in in the manufacturer's service manual/instructions in Appendix B of this TM.
4-5 Shore discharge system. Troubleshoot shore discharge system as given in Table 4-1. Additional troubleshooting procedures are in manufacturer's service manual/instructions in Appendix B. This table lists only common malfunctions that may occur during operation. If a malfunction occurs that is not listed and the cause is not readily apparent, notify IDS or IGS maintenance for assistance.

Table 4-1. Shore Discharge System Troubleshooting

Problem	Probable Cause	Suggested Action
1. Water not being pumped to shore	a. Drinking water system not functioning	a. Troubleshoot drinking water system (TM 55-1930-209-14&P-5)
2. START button on hydraulic power unit or remote control button does not start motor and pumps	a. Circuit breaker P12 on switchboard open (OFF)	a. Close (ON) circuit breaker
	b. Low reservoir hydraulic fluid level.	b. Check sight gauge. Fill as necessary
	c. High oil temperature as indicated on reservoir temperature gauge (above 180° F)	c. Allow oil to cool (below 180° F)
	d. Low oil temperature (below 45° F)	d. Turn on oil heater
	e. Supply or return filter clogged	e. Check filter pressure gauge reading. Replace filter if necessary
	f. Hydraulic power unit conrol panel malfunctioning	f. Troubleshoot control panel. Replace fuses if necessary
	g. Remote START/STOP switch malfunctioning	g. Troubleshoot remote switch
3. Winch rotation not normal or will not rotate when using winch control lever	a. See b thru d in problem 2	a. Same as b thru d in problem 2
	b. Disc brake set	b. Release disc brake
	c. Band brake set	c. Release band brake
	d. Winch hydraulic drive motor malfunctioning	d. Troubleshoot drive motor (See Appendix 20 in Appendix B)
	e. Hydraulic power unit mal functioning	e. Troubleshoot hydraulic power unit (See manufacturer's service manuals in Appendix B)
4. Levelwind not operating normally or will not operate when using levelwind control lever	a. See b thru d in problem 2	a. Same as b thru d in problem 2
	b. Levelwind hydraulic drive motor malfunctioning	b. Troubleshoot drive motor (see Appendix 27 in Appendix B)
	c. Levelwind malfunctioning	c. Troubleshoot levelwind (Appendix B)
	d. Barges 2 and 3-valve SD5 closed	d. Open valve SD5

Table 4-1. Shore Discharge System Troubleshooting (continued)

Problem	Probable Cause	Suggested Action
5. PIG stuck or slowly moving through discharge hose	a. Valve SD2 closed	a. Open valve
	b. Station 6 compressed air valve closed	b. Open valve
	c. PIG launcher compressed air flange leaking	c. Tighten flange or replace seal
	d. Compressed air system malfunctioning	d. Troubleshoot compressed air system (TM 55-1930-209-14&P-7)

Section IV. Maintenance procedures

4-6 General. Maintenance of this system consists of disassembling, repairing, and/or replacing and reassembling the items requiring repair parts listed in TM 55-1930-209-14&P-18. No special tools are required. When performing maintenance, be sure to follow these general shop procedures.

WARNING

Turn off electrical power before performing maintenance on this system. OPEN circuit breaker and redtag circuit breaker or motor controller with an appropriate warning. Observe safety precautions In this TM and In manufacturers' manual/instructions.

a. Always use new seals and gaskets, same as original, when reassembling components that have been disassembled for repair. Carefully install so as not to damage during assembly.

b. When replacing gaskets, make sure all mating surfaces are clean and free of old gasket material, adhesive oil, or grease. These precautions will ensure a leakproof joint.

c. When replacing O-ring seals, make sure all surfaces are thoroughly clean and free of grit, dirt, and foreign material. Prior to installation, apply a thin coat of protective lubricant to O-ring for ease of assembly. Protect the O-ring by applying tape over threads, sharp comers, or edges.

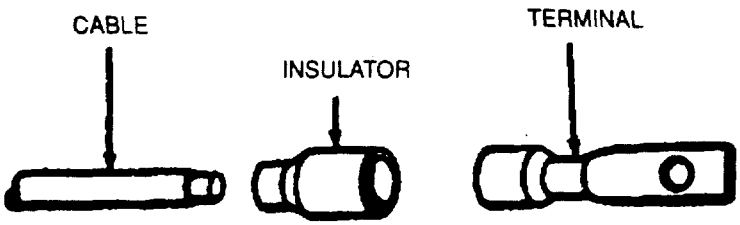
d. When replacing or repairing electrical components, follow procedures for soldering in TB SIG 222. Crimp connections as shown in Figure 4-1. Check all groundings. Check that all current-carrying members are properly insulated to avoid short circuiting. Check for abrasion and chafed insulation on wires and cables. Repair with tape or replace as necessary.

e. When replacing bearings, follow procedures in TM 9-214. Lubricate bearings with recommended lubricant. When installing bearing on shafts, apply pressure to inner race. When installing bearings in housing, apply pressure to outer race.

f. Weld in accordance with TM 9-237. Welding can be used to repair cracks and breaks in steel parts such as bracket, panels and light framework. Weld only when replacement parts are not available because of a chance of failure later.

WARNING

Be sure that electric power is off before performing maintenance. Observe all safety precautions In this manual and manufacturers' manuals and instructions.



1. Strip cable insulation equal to depth of terminal well.
2. Slide insulator, if used, over cable.
3. Insert cable into terminal well and crimp.
4. Slide insulator, if used, over crimped end of terminal.

Figure 4-1. Replacement of Crimped Terminals

NOTE

Due to this vessel's mission and crew capabilities, maintenance normally assigned to organizational level or higher echelons may be assigned to the crew by the Bargemaster.

4-7 Component. Component maintenance information is contained in the appendices under manufacturers' service manual/instructions in Appendix B.

4-8 Shore discharge system. Lubrication and repair of the shore discharge system involving repair parts listed in TM 55-1930-209-14&P-18 are described herein.

WARNING

Shut down shore discharge system before attempting any repair. Be sure to open circuit breaker P12 on switchboard. Redtag circuit breaker with: WARNING - DO NOT ACTIVATE. REPAIRS BEING MADE."

CAUTION

Always cover open hydraulic lines and component ports to keep out dirt.

4-9 Lubrication

4-9.1 Hydraulic power unit. Use Gulf Harmony 46 AW or equivalent as recommended in Appendix B by the manufacturer.

WARNING

Wear safety glasses. In case of eye contact, wash with lots of water. In case of skin contact, wipe and then wash with soap and water.

4-9.1.1 Adding fluid. When reservoir oil level sight gauge (Figure 3-4) indicates hydraulic fluid level in reservoir is 80 percent or lower, add fluid as follows:

a. Remove filler/breather cap.
b. Clean filter.
c. Add fluid until sight gauge indicates 100 percent full.
d. Replace cap.
e. Wipe clean reservoir and immediate area.

4-9.1.2 Changing fluid. Replace hydraulic fluid as follows:

a. Place container under reservoir to catch hydraulic fluid.
b. Remove drain plug. Drain fluid into sludge tank by sucking up fluid with bilge drain system foot valve.
c. When reservoir is completely drained, replace plug. Wipe clean plug and area around plug.
d. Remove and clean suction strainer.
e. Remove filler/breather cap.
f. Clean filter if necessary.
g. Fill reservoir until oil level sight gauge indicates 100 percent full.
h. Replace cap.
i. Wipe clean reservoir and immediate area.

NOTE
Levelwind reduction gear box Is called levelwind primary reduction box on Barge 1.

4-9.2 Levelwind reduction gear box. See Manufacturer's Data in Appendix B for recommended and equivalent oil to be used.

4-9.2.1 Adding oil

a. Remove oil level plug in gear box located on portside of levelwind.
b. Check oil level. Oil level must be near bottom of oil level plug hole.
c. If oil has to be added, remove breather plug.

NOTE
If oil cannot be filled through breather hole, Install street elbow in hole to aid in filling.

d. Fill slowly through breather hole until oil begins to drain from oil level plug.
e. Replace oil level plug. Wipe clean oil plug and area around plug.
f. Remove street elbow if installed previously.
g. Replace breather plug.
h. Wipe clean gear box and immediate area.

4-9.2.2 Changing oil

a. Place container under drain plug and remove drain plug.
b. Allow oil to drain completely. Replace drain plug. Put dirty oil in sludge tank.
c. Remove oil level plug and breather plug.

NOTE
If oil cannot be filled through breather hole, Install street elbow In breather hole to aid In filling.

d. Fill slowly through breather hole until oil begins to drain from oil level plug.
e. Replace oil level plug.
f. Remove street elbow if installed previously.
g. Replace breather plug.

4-9.3 Levelwind secondary reduction gear box (Barge 1 only). See manufacturer's data in Appendix B for recommended and equivalent oil to be used.

4-9.3.1 Adding oil. Perform procedure in paragraph 4-9.2.1.

4-9.3.2 Changing oil. Perform procedure in paragraph 4-9.2.2.

4-9.4 Main winch reduction gear box. See a manufacturer's data in Appendix B for recommended and equivalent oil to be used.

4-9.4.1 Adding oil

a. Remove oil level check plug.
b. Check oil level. Oil must be near bottom of oil level check hole.
c. If oil has to be added, remove oil fill plug.
d. Add oil into fill hole until half full. Oil will drain out of check plug hole.
e. Replace oil level check plug and oil fill plug.
f. Wipe clean gear box and immediate area.

4-9.4.2 Changing oil

a. Place container under drain plug and remove drain plug.
b. Allow oil to drain completely. Replace drain plug. Put dirty oil in sludge tank.
c. Remove oil level plug and oil fill plug.
d. Add oil into fill hole until half full. Oil will drain out of check plug hole.
e. Replace oil level check plug and oil fill plug.
f. Wipe clean gear box and immediate area.

4-9.5 Bearings. Lubricate following bearings with a No. 2 bearing grease or equivalent:

- Ten bearings on levelwind traveler head
- Ten roller shafts on levelwind traveler head rollers
- Two thrust bearings on band brake drive shaft
- Levelwind gear pump outboard bearing
- Two bearings on winch hose roller

Lubricate two winch shaft bearings as recommended by the manufacturer in Appendix B.

4-9.6 Hydraulic power unit electric motor

a. Replace one pipe plug on one end shield with grease fitting.
b. Remove other pipe plug for grease relief.

NOTE

Use Mobil Oil Co. Mobilux #2, Shell Oil Co. Alvania #2, Exxon Beacon 325, Standard Oil Company of California Chevron SR1 No. 2, or some military equivalent lithium based grease unless a special grease is recommended on the motor nameplate.

c. Using a low-pressure grease gun, pump in grease until new grease appears at grease relief hole.

d. Remove grease fitting and replace pipe plug.
e. Repeat steps a thru d on other end shield.
f. After lubricating both end shields, allow motor to run for 10 minutes before replacing relief plugs.

4-9.7 Swivel joint. Add No. 2 bearing grease through grease fitting. Do not overlubricate. Make sure swivel joint rotates freely.

4-9.8 Motor/pump coupling. See manufacturer's data in Appendix B for recommended or equivalent grease to be used.

a. Remove both grease plugs.
b. Insert grease fitting in one of the grease plug holes.
c. Fill until excess grease comes out of opposite hole.
d. Replace both grease plugs.

4-10 Hydraulic winch repair

4-10.1 Discharge hose repair. Minor damage to the discharge hose outer jacket, such as surface tears, cuts, and scratches need not be repaired. If the entire outer jacket layer is damaged to the next layer, repair the damage as follows, using outer jacket repair kit:

a. Set hot air gun on 3.
b. Hold gun about 1 inch from area to be repaired to melt material around the damage.

NOTE

Use original outer jacket material. Add new material only If necessary. During repair use stainless steel bands if needed to hold outer jacket in place.

c. When outer jacket material melts, use putty knife to press softened material into damaged area until repair is completed as shown in Figure 4-2.
d. If necessary, use stainless steel bands to hold the repaired area as shown in Figure 4-3.

4-10.2 Winch hydraulic motor repair

a. Remove, disassemble, and repair winch motor as given in Appendix B, manufacturers' service manual/ instructions. Replace seals, rotors, coupling shaft, and drive link listed in TM 55-1930-209-14&P-18.
b. Clean motor, secure to winch with appropriate hardware, and connect hoses.
c. Check for normal operation and leaks.

4-10.3 Handpump replacement

4-10.3.1 Removal

a. Disconnect hoses.
b. Remove attaching hardware.
c. Remove old pump.
d. Drain pump.
e. Clean up spills.

4-10.3.2 Installation

a. Attach handpump to foundation.
b. Connect hoses.
c. Check for normal operation and leaks. Bleed air.

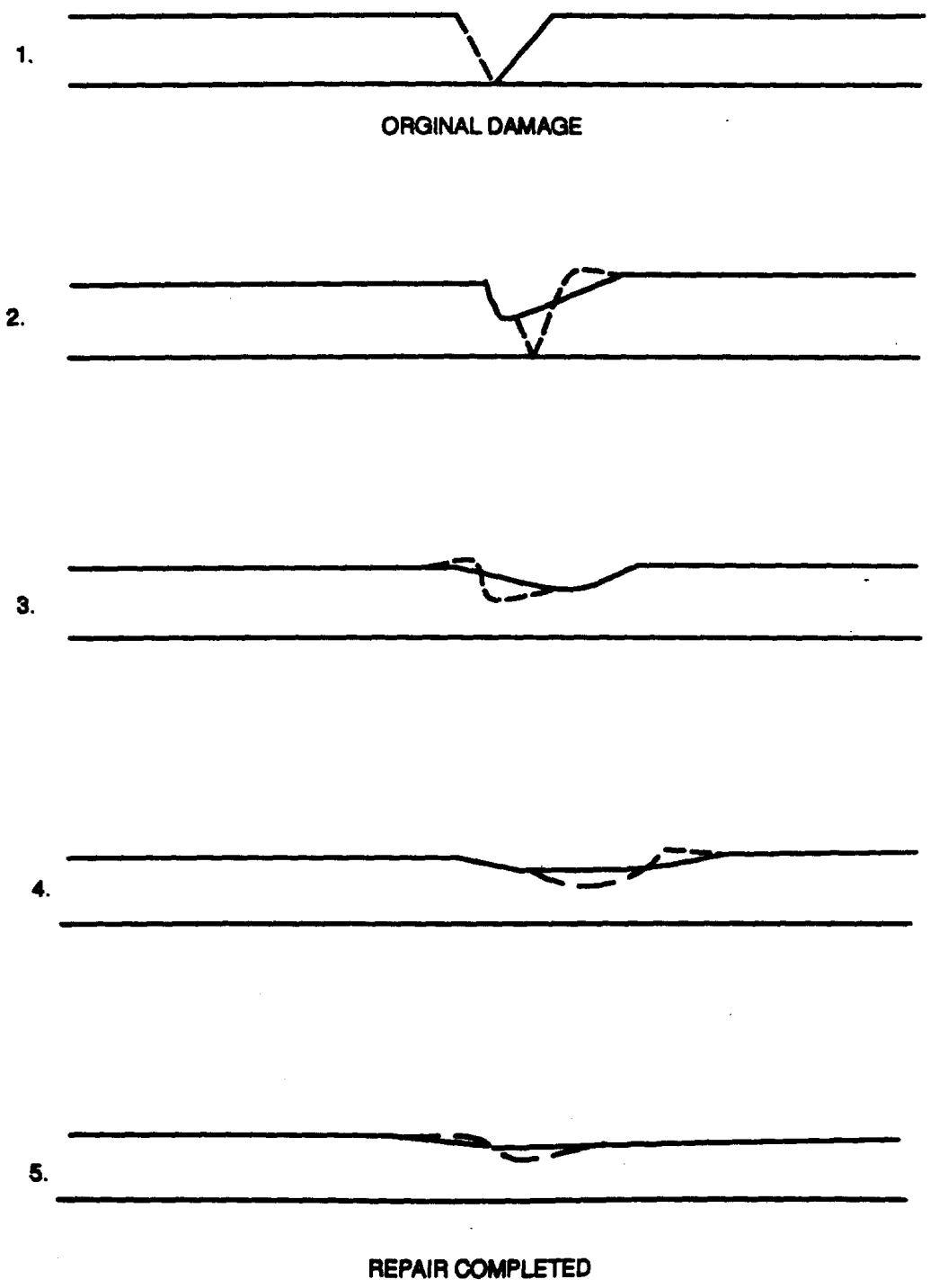


Figure 4-2. Repair of Outer Jacket Damage on Discharge Hose

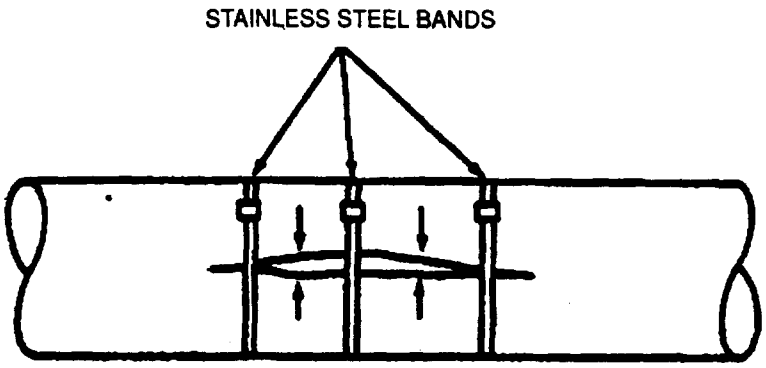


Figure 4-3. Typical Stainless Steel Band Installation on Discharge Horn

4-10.4 Winch disc brake. Remove, disassemble, repair and assemble, and install as given in Appendix B, manufacturer's service manual/instructions. Replace parts using repair parts listed in TM 55-1930-209-14&P-18.

4-11 Hydraulic power unit repair

4-11.1 Suction filter replacement. When indicator shows that filter has to be replaced, replace as follows:

a. Unscrew old filter (Figure 3-4).
b. Coat gasket of new filter with light coat of oil.
c. Screw on new filter.
d. When operating after replacement, check for leaks and make sure indicator is operating normally.

4-11.2 Return filter replacement. When indicator shows that filter has to be replaced, replace as follows:

a. Turn bypass valve to bypass filter (Figure 3-4).
b. Unscrew old filter.
c. Coat gasket of new filter with light coat of oil.
d. Screw on new filter.
e. Turn bypass valve to allow flow through filter.
f. When operating after replacement, check for leaks and make sure indicator is operating normally.

4-11.3 Gear pump coupling replacement

a. Remove gear pump.
b. Loosen set screws.
c. Slide coupling from gear pump shaft.
d. Clean shaft. Check for and remove burrs..

4-11.32 Installation

a. Align coupling keyway with shaft key and slide on coupling. If coupling does not slide on easily, check shaft for burrs. Remove burrs.

b. Check alignment as follows:

(1) Place scale at top and side of coupling to check alignment of both halves.
(2) Use a 0.005-inch feeler gauge under scale to check final parallel and angular alignment.
(3) Run coupling to see if it separates or tends to move. Recheck angular alignment.
(4) Tighten set screws.

4-11.4 Gear pump repair

4-11.4.1 Removal. Remove gear pump.

4-11.4.2 Disassembly, repair, and assembly. Disassemble, repair, and assemble gear pump as given in Appendix B, manufacturer's service manual/instructions. Replace parts using repair parts listed in TM 55-1930-209-14&P-18.

4-11.4.3 Installation. Install gear pump.

4-11.5 Motor/heater control panel repair. Repair motor/heater control panel using repair parts listed in TM 55-1930-209-14&P-18.

4-11.6 Counterbalance valve cartridge replacement. Screw out old cartridge and screw in new cartridge. Wipe clean.

4-12 Levelwind repair.

4-12.1 Levelwind coupling replacement

4-12.1.1 Removal. Perform procedure in paragraph 4-11.3.1.

4-12.1.2 Installation. Perform procedure in paragraph 4-11.3.2.

4-12.2 Levelwind hydraulic motor repair

4-12.2.1 Removal

a. Disconnect hoses.
b. Remove motor.

4-12.2.2 Disassembly, inspection, repair, and assembly. Disassemble, inspect, repair, and assemble levelwind motor as given in Appendix B, manufacturer's service manual/instructions.

4-12.2.3 Installation

a. Install motor.
b. Connect hoses. When viewed from output end of coupling, connect hose to pressure port 'A' for coupling clockwise rotation and-port 'B" for counterclockwise rotation.
c. Check for normal operation and leaks.

4-12.3 Levelwind primary reduction gear box repair. Repair as given in Appendix 28A in manufacture's service manual/instructions in Appendix B. Repair using repair parts listed in TM 55-1930-209-14 &P-18.

4-12.4 Levelwlnd secondary reduction gear box repair. Repair as given in Appendix 28B in manufacturer's service manual/instructions in Appendix B. Repair using repair parts listed in TM 55-1930-209-14&P-18.

4-12.5 Swivel Joint seal replacement. Replace seals as given in Appendix B, manufacturer's service manual/instructions.

4-13 Valve replacement. Replace or repack worn or damaged valves according to TM 55-503

CHAPTER 5 STORAGE

5-1 Short-term storage. If the barge is to be taken out of service for more than 7 days but less than 30 days and shore discharge hose remains deployed, perform following procedure as appropriate.

5-1.1 Discharge hose deployed

a. Make sure hydraulic power unit is off. If not off, push red STOP button on hydraulic power unit control panel.
b. Make sure ROWPU system is stopped and drinking water shore discharge pumps are off.
c. Close valves SD1 and SD2 (Figure 3-6).
d. Make sure marker buoys are attached and status signals are displayed on mast located on top of deckhouse.
e. Make sure hose is secure on barge and on shore.
f. Make sure winch band brake on starboardside is set. If not, set as follows:
   (1) Open valve SD3 (Figure 3-8).
   (2) Obtain BAND BRAKE PUMP HANDLE from stowed position and insert in pump extension.

WARNING
While pumping, do not exceed 4,000 psi as shown on BAND BRAKE PRESSURE GAUGE.

   (3) Pump until band brake piston enters cylinder and band is tight on brake drum.
   (4) Position valve SD3 in neutral position (midway between OPEN and CLOSE position) to lock cylinder in set position.
   (5) Remove pump handle and return to stowed position.
g. During storage, inspect as follows and repair as necessary.
   (1) Check for corrosion, damage, and pilferage.
   (2) Make sure hose winch and hose are secured.
   (3) Make sure marker buoys and status signals are in place.

5-1.2 Discharge hose retrieved

a. Open (OFF) switchboard circuit breaker P12.
b. Make sure hydraulic power unit is off. If not off, push red STOP button on hydraulic power unit control panel (Figure 3-3).
c. Close valves SD1 and SD2.
d. Make sure discharge hose end cap is installed tightly and is tied down.
e. Perform after operation preventive maintenance checks and services in Chapter 2, TM 55-1930-209-14&P-19.
f. During storage, check for corrosion, damage, and pilferage. Repair as necessary.

5-2 Administrative storage. If barge is to be taken out of service for more than 30 days, but less than 6 months, barge remains a unit responsibility and shall be maintained by unit personnel.

5-2.1 Processing for administrative storage. Process for administrative storage as specified in steps a thru I.

a. Make sure hydraulic power unit is off. If not off, push red STOP button on hydraulic power unit control panel (Figure 3-3).
b. Make sure valves SD1 and SD2 are closed (Figure 3-6).
c. Make sure discharge hose end cap is on tight and tied down.
d. Make sure bandbrake is set. If necessary, set as given in step d in paragraph 3-3.1.3.
e. Open (OFF) switchboard circuit breaker P12.
f. Make sure marker buoys, signal markers, and all loose equipment are stowed.
g. Add fluid to hydraulic power unit reservoir and lubricate components as given in paragraph 4-10.
h. Clean glass pressure gauges and indicators with a clean, lint-free cloth.
i. Clean grease-coated surfaces with a clean, lint-free cloth moistened with cleaning solvent (P-D-680, Type II). Scrub off hard deposits with a bristle brush dipped in solvent. Dry surfaces with a clean, lint-free cloth.
j. Thoroughly clean all other external surfaces to remove any corrosion or other foreign matter. Clean all surfaces except electrical parts with soapy water and a stiff bristle brush. Flush with clean water. Clean hydraulic power unit control panel by wiping with a clean cloth moistened with silicone spray lubricant Remove corrosion by wire brushing or sanding.
k. Touch up paint, as necessary, to prevent further corrosion. Match paint to surrounding areas in accordance with TB 43-0144. DO NOT PAINT THREADS OR LABELS.
I. Perform periodic checks and services according to TM 55-1930-209-14P&P-6, Appendix C or Chapter 3, TM 55-1930-209-14&P-1 9.

5-2.2 Administrative storage inspection. While in administrative storage, inspect shore discharge system at least every 30 days as follows:

a. Check for corrosion, damage, and pilferage.
b. Check hydraulic power unit reservoir fluid level. Add fluid if necessary.
c. Verify that periodic inspections and services required in TM 55-1930-209-14&P-6, Appendix C or Chapter 3, TM 55-1930-209-14&P-19.

5-3 Long-term storage. If barge is to be taken out of service for 6 months or more, turn it in to depot for preparation and placement into long-term storage. If barge is in administrative storage and is to be taken out of service and placed in depot long-term storage (6 months or more), process shore discharge system for normal operation as specified below before releasing to depot.

a. Perform before operation preventive maintenance checks and services in TM 55-1930-209-14&P-6, Appendix C or Chapter 2, TM 55-1930-209-14&P-19.
b. Perform during operation preventive maintenance checks and services in TM 55-1930-209-14&P-6, Appendix C or Chapter 2, TM 55-1930-209-14&P-19.
c. Check that shore discharge system operates satisfactorily.
d. Perform after operation preventive maintenance checks and services in TM 55-1930-209-14&P-6, Appendix C or Chapter 2, TM 55-1930-209-14&P-19.
e. Upon successful completion of this operational inspection, turn in shore discharge system to depot for their preparation and placement in long-term storage.

CHAPTER 6 MANUFACTURERS' SERVICE MANUALS/INSTRUCTIONS

6-1 General. The manufacturers' service manual/instructions listed below provide additional information on components of the drinking water shore discharge system. A copy of each manual/instructions is contained in Appendix B. It may be necessary to refer to both the manual and the drawings listed in Appendix A while performing the procedures in this TM.

Component	Document title	Manufacturer
Shore discharge system H-830462	Operation & Maintenance Manual US Army ROWPU Barge Drinking Water Discharge System	Coflexip & Services, Inc. 4242 Southwest Freeway Suite 600 Houston, TX 77027 Ph: (713) 6278540

6-1(6-2 Blank)

CHAPTER 7 MANUFACTURERS WARRANTIES/GUARANTEES

7-1 General. Information on the warranty/guarantee for components of the drinking water shore discharge system is supplied below.

Component	Manufacturer	Duration	Coverage
Shore discharge system H-830462 Winch	Coflexip & Services, Inc. 4242 Southwest Freeway Suite 600 Houston, TX 77027 Ph: (713) 627-8540	1 year from delivery*	Material, design, and workmanship except purchased components*
Hose		**	Materials and workmanship

*See individual manual/set of instructions in appendices contained in manufacturers' service manual/instructions in Appendix B.

** See warranty statement on following page.

Coflexip & Services, Inc.
4242 Southwest Freeway, Suite 600
Houston, Texas 77027
Ph: (713) 627-8540
Twx: 910-881-1159

Reference: Coflexip Drinking Water Discharge System, Unit No. 840464

WARRANTY CLAUSE FOR OFFSHORE PIPELINES 8 RISERS

Coflexip and Services, Inc. (CSI), guarantees its products to be free of defects in workmanship or material at the date of factory acceptance pressure test.

If at any time during the 18 month period from factory acceptance pressure test, or 12 months from installation on site, whichever occurs first, the product should fail to perform its intended application, as described in CSI's proposal, under normal working conditions, due to any defect of workmanship or material, then CSI agrees to replace or repair, at CSI's option, the defective product.

The foregoing warranty is valid only if the product is handled, transported, stored, and installed in accordance with a procedure approved by CSI. Such warranty does not include the cost of removing, transporting, and' reinstalling the product if such is necessary.

This warranty and the pressure test certificate are not intended to guarantee that the product will never fail nor potentially cause harm thereby, and CSI expressly disclaims any liability other than that assumed in the foregoing warranty.

The obligations assumed by CSI in this warranty are in lieu of any and all other warranties, express or implied, and no person is authorized by CSI to offer any different or greater obligation by it nor is any person authorized to assume any other liability for it in connection with the sale of the product described above.

Coflexip will guarantee the winch for 1 year from delivery date, against defective materials, design, and workmanship, except for purchased components, which will be guaranteed as per the manufacturers' guarantee. The guarantee becomes void it the winch is used or operated beyond its design limits.

APPENDIX A

REFERENCES

A-1 U.S. Army Belvoir Research and Development Center Drawings

A-2 Painting of Vessels

A-3 Demolition to Prevent Enemy Use

TM 750-244-3	Procedures for Destruction of Equipment to Prevent Enemy Use

A-4 Cleaning

Federal Specification	Metal Cleaning Solvent for Army Use P-C-680

A-5 Maintenance

TB SIG 222	Solder and Soldering
TM 9-214	Inspection, Care and Maintenance of Antifriction Bearings
TM 9-237	Welding Theory and Application
TM 38-750	Army Equipment Records Procedures
TM 55-503	Marine Salvage and Hull Repair
TM 55-1930-209-14&P-21	Operator, Organizational, Direct and General Support Maintenance Manual: Winch, Double Drum Diesel Engine Driven, 40,000 lb Capacity, CONMACO Model 270

A-6 Shipment and Storage

TB 740-97-2	Preservation of USAMEC Mechanical Equipment and Storage
TM 740-90-1	Administrative Storage of Equipment

APPENDIX B

MANUFACTURERS' SERVICE MANUAL/INSTRUCTIONS

Component	Document title	Manufacturer
ROWPU Drinking Water Discharge System	Operations and Maintenance Manual	Coflexip and Services, Inc.

APPENDIX C

Preventive maintenance checks and services (PMCS) for the Shore Discharge System

C-1 Introduction to PMCS

NOTE

TM 55-1930-20-14&P-19 contains PMCS for all systems on the ROWPU Barge. This appendix contains only PMCS for the Shore Discharge System

a. General.

(1) Systematic (B) before, (D) during, (A) after, and scheduled periodic PMCS are essential to ensure that the Reverse Osmosis Water Purification Barge is in operational readiness at all times. The purpose of the PMCS program is to discover and correct deficiencies and malfunctions before they cause serious damage or failure of the barges and their support systems. An effective PMCS program requires that operators report all unusual conditions noticed before, during and after operation as well as while performing periodic PMCS. All deficiencies and malfunctions discovered during maintenance inspections must be recorded, together with the corrective action taken, on DA Form 2404 (Equipment Inspection and Maintenance Worksheet).

(2) A schedule for preventive maintenance inspections and service should be established and adhered to. When operating under unusual conditions, such as extreme heat or cold, it may be necessary to perform PMCS more frequently.

(3) The PMCS items have been arranged and numbered in a logical sequence to provide for greater efficiency and the least amount of downtime required for maintenance.

b. PMCS columnar entries.

(1) Item Number Column. Checks and services are numbered in chronological order regardless of interval. This column is used as a source of item numbers for the 'Item Number column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, in recording results of PMCS.

(2) Interval Column. The interval columns tell you when to do a certain check or service: before, during, or after operation. Sometimes a dot may be placed in more than one interval column which would mean you should do the check or service at each of those intervals.

(3) Item to Be Inspected Column. This column lists the common name of the item to be inspected such as 'Air Filters." (4) Procedures Column. This column tells you how to do the required checks and services. Carefully follow these instructions.

(5) Equipment is Not Ready/Available if Column. This column tells you when and why your equipment cannot be used.

NOTE

The terms "Ready/Available" and "Mission Capable" refer to the same status: equipment Is on hand and Is able to perform Its combat missions. (See DA PAM 738-750).

(6) increased Inspections. Perform weekly as well as Before Operations PMCS if:

(c) You are the assigned operator and have not operated the item since the last weekly PMCS.
(d) You are operating the item for the first time.

(7) Leakage definitions. In checking for fluid leaks, the following leakage definitions apply to all ROWPU barges and barge equipment, product water, and seawater leakage by class type.

(a) Class I - Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
(b) Class II - Leakage of fluid great enough to form drops, but not enough to cause drops to drip from the item being checked/inspected.
(c) Class III - Leakage of fluid great enough to form drops that fall from the itep,, being checked/inspected.

CAUTION

Equipment operation is allowable with minor leakages (Class I or II). However, the fluid level or operating pressure of the item being checked/inspected must be considered. When in doubt, notify the shift leader or bargemaster.

When operating with Class I or Class II leaks, continue to check fluid levels as required by PMCS and operating Instructions.

(8) The following fuel and hazardous material leakage procedures apply for any fuel, chemical, or bilge system.

WARNING

Class I, II or III leaks or seepage occurring in a fuel, chemical, or bilge container, tank, line, piping, or valve can cause fire or health hazards.

(a) If any leaks or seepage from a fuel, chemical, or bilge container, tank, or fluid line is detected, it must be immediately reported to the shift leader or bargemaster for corrective action.
(b) To prevent combustible or toxic fumes from collecting or contaminated material from spilling, exercise extreme caution after detecting leaks or seepage of flammable or hazardous material.

c. Continuous operation. When equipment must be kept in continuous operation for extended periods of time, check and service only those items that can be checked and serviced without disturbing operations. Perform complete checks and services when the equipment can be shut down.
d. Maintenance log. Always record the time and date of PMCS, any deficiencies noted, and corrective action taken in the PMCS log book.

C-2 Major components. The shore discharge system consists of winch with flexible hose winch hydraulic motor, hydraulic power unit, levelwind, chute, PIG, PIG launcher, PIG receiver, gate, valve, control station, (winch hydraulic power unit remote switch, shore winch, valves, piping, and start/stop electrical circuitry). Chapter 1 lists the major components of the shore discharge system, their basic function and location on the barge.

C-3 Shore discharge system description. This system transfers drinking water from barge storage tanks to holding/storage facilities ashore. The system can move 300,000 gallons of water per day under optimum conditions and has been designed to operate in conditions not exceeding Sea State 3.

Table C1. Preventive Maintenance Checks and Services for Shore Discharge System

B - Before **D - Daily** **Q - Quarterly**
D - During **W - Weekly** **S - Semiannually**
A - After **M - Monthly** **A - Annually**

Item No.	Interval B	D	A	D	W	M	Q	S	A	Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
										SHORE DISCHARGE SYSTEM	**WARNING** **Be sure electrical power is off before performing maintenance or repair on this system. OPEN circuit breakers. Redtag circuit breakers or motor controller with "WARNING - DO NOT ACTIVATE. REPAIRS BEING MADE." Observe safety precautions listed at the beginning of this manual.**	
1	•		•	•						All Components	a. Wipe components clean, especially gauges and control panels.	
	•		•	•							b. Check for leaks, paying special attention to joints, valves, fittings, and piping. Report leaks to shift leader or bargemaster.	Class III leaks.
	•		•	•							c. Check for loose or missing securements or fasteners. Tighten or replace as necessary.	
	•		•	•							d. Check for damage, especially to pressure gauges, filters, and control panels. Notify shift leader or bargemaster so repairs can be made.	Pressure gauge damaged.
			•		•						e. Remove rust and corrosion. Touch-up or paint in accordance with TB 43- 0144 as necessary. Do not paint threads or labels.	
2	•		•	•						Wiring	a. Check wiring for loose connections and frayed cables. Secure as necessary. Repair or replace damaged cables.	Cables frayed or connections loose.
		•									b. Visually check wiring for loose connections. If sparks are seen report to shift leader or bargemaster. Shut power off.	Sparks are seen.

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

B - Before	**D - Daily**	**Q - Quarterly**
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A - After	**M - Monthly**	**A - Annually**

Item No.	Interval									Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
	B	D	A	D	W	M	Q	S	A			
3	•			•						Hydraulic Power Unit Reservoir Level Gauge	a. Check reservoir level gauge (Void 5) to assure reservoir full of oil. Add oil if necessary (use proper grade for extreme heat/cold). b. When oil temperature is 450F or less, set heater ON/OFF switch to ON. c. Replace hydraulic fluid in the hydraulic power unit reservoir. Fill with Gulf Harmony 46 AW or military equivalent as follows: 1) Place container under reservoir to catch hydraulic fluid. 2) Remove drain plug. Drain fluid into sludge tank by sucking up fluid with bilge drain system foot valve. 3) When reservoir is completely drained, replace plug. Wipe plug and area around plug clean. 4) Remove and clean suction strainer. 5) Remove filler/breather cap. 6) Clean filter if necessary. 7) Fill reservoir with Gulf Harmony 46 AW or military equivalent until oil level sight gauge indicates 100 percent full. 8) Replace cap. 9) Wipe clean reservoir and immediate area.	
4		•								Hydraulic Power Unit Charge Pressure Gauge	Check that charge pressure gauge on hydraulic power unit reads no less than 250 psi. Minimum pressure needed for proper stroke control and makeup flow for winch circuit.	
5				•						Hydraulic Power Unit Level Gauge	Check hydraulic fluid level is 80 percent or more full. Add fluid if necessary as follows:	

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

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Item No.	Interval									Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
	B	D	A	D	W	M	Q	S	A			
6							•			Hydraulic Power Unit Electric Motor	**WARNING** **Wear safety glasses when adding hydraulic fluid. In case of eye contact, wash with lots of water. In case of skin contact, wipe and then wash with soap and water.** 1) Remove filler/breather cap. 2) Clean filter. 3) Add Gulf Harmony 46AW or military equivalent hydraulic fluid until level gauge indicates 100 percent full. 4) Replace cap. 5) Wipe reservoir and immediate area clean. **NOTE** **Use Mobil Oil Co. Mobilux #2, Shell Oil Co. Alvania #2, Exxon Beacon 325, Standard Oil Company of California, Chevron SR1 No. 2, or some military equivalent lithium-based-grease unless a special grease is recommended on the motor nameplate.** a. Lubricate hydraulic power unit electric motor as follows: 1) Replace one pipe plug on one end shield with grease fitting. 2) Remove other pipe plug for grease relief. 3) Using a low-pressure grease, pump in grease until new grease appears at grease relief hole. 4) Remove grease fitting and replace pipe plug. 5) Repeat steps a thru d on other end shield. 6) After lubricating both end shields, allow motor to run for 10 minutes before replacing relief plug.	
							•				b. Lubricate hydraulic power unit motor/ pump coupling as follows: 1) Remove both grease plugs. 2) Insert grease fitting in one of the grease plug holes.	

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

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Item No.	Interval B	D	A	D	W	M	Q	S	A	Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
											NOTE **Electric motors have a tendency to run hot and atop due to overload. Allow motor to start automatically after It cools off.** 3) Fill until excess No. 2 bearing grease or military equivalent grease comes out of opposite hole. 4) Replace both grease plugs.	
7		•								Hydraulic Power Unit Piston Pump	a. With hose reel winch control lever in NEUTRAL position on Barge 1 or in OFF position on barges 2 and 3, check that piston pump low (return) and high (supply) pressure gauge readings are the same.	
		•									b. If the 2 readings differ, zero bias by adjusting zero adjustment screen (socket-headscrew)on end of piston pump.	
8		•					•			Hydraulic Power Supply and Return Filters	a. Check supply pressure gauge. If necessary replace filter element as follows: 1) Unscrew old filter. 2) Coat gasket on new filter with light coat of oil. 3) Screw on new filter. 4) When operating after replacement, check for leaks and make sure indicator is operating normally.	Pressure gauge cracked or broken
		•					•				b. Check return pressure gauge. if necessary, replace filter element as follows: 1) Turn bypass valve to bypass filter. 2) Unscrew old filter. 3) Coat gasket on new filter with light coat of oil. 4) Screw on new filter. 5) Turn bypass valve to allow flow through filter. 6) When operating after replacement, check for leaks and make sure indicator is operating normally.	Pressure gauge cracked or broken.

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

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Item No.	Interval B	D	A	D	W	M	Q	S	A	Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
9				•						Discharge Hose Outer Jacket	**NOTE** **Minor damage to the discharge hose outer jacket, such as surface tears, cuts, and scratches need not be repaired. If the entire outer jacket layer is damaged to the next layer, repair the damage as follows, using outer jacket repair kit.** Check that hose is secure and outer jacket is not damaged. Repair as necessary as follows: 1) Set hot air gun on 3. 2) Hold gun about 1 in. repaired to melt material around the damage. **NOTE** **Use original outer Jacket material. Add new material only if necessary. During repair use stainless steel bands if needed to hold outer jacket in place.** 3) When outer jacket material melts, use putty knife to press softened material into damaged area until repair is completed as shown in Figure 3-13. 4) If necessary, use stainless steel bands to hold the repaired area.	Hole is visible in hose. from area to be
10				•						Hand (Band) Brake	a. Check brake forexcessive wear and that hand brake holds when set. Notify shift leader or bargemaster of deficiencies. b. Make sure hand brake on starboard side of winch is set.If not, set as follows: 1) Open valve SD3. 2) Obtain hand brake pump handle from stowed position and insert in pump extension. **CAUTION** **While pumping, do not exceed 4,000 psi as Indicated on hand brake pressure gauge.**	Excessively worn.

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

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Item No.	Interval B	D	A	D	W	M	Q	S	A	Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
				•							**WARNING** **Pressure should not exceed 4000 psl.** 3) Pump until hand brake piston enters cylinder and band is tight on brake drum. 4) Position valve SD3 in NEUTRAL position (midway between OPEN and CLOSE position) to lock the cylinder in the set position.	
11				•						Buoys	Check that buoys are in place. Replace if missing.	
12				•						Status Signals/ Lights	Check that status signal/lights are displayed as follows on top of deckhouse center most: Time: Daytime — Top Signal: Black Ball — Middle Signal: Black Diamond — Bottom Signal: Black Ball Nightime — Top Signal: White Light — Middle Signal: Red Light — Bottom Signal: White Light	Any light is inoperable
											CAUTION **Roughness on steel chute surfaces could damage hoses.**	
13				•						Steel Chute Surfaces (weatherdeck aft)	Check that surfaces are smooth and free of gouges, damage, or roughness. Repair as necessary.	
14						•				Reduction Gear Boxes	a. Check fluid level in levelwind reduction gear boxes as follows: **NOTE** If oil cannot be filled thru breather hole, Install street elbow in hole to aid In filling. 1) Remove oil level plug in gear box located on portside of levelwind. 2) Check oil level. Oil level must be near bottom of oil level plug hole. 3) If Gulf Harmony 43 AW or military equivalent oil has to be added, remove breather plug. 4) Fill slowly thru breather hole until oil begins to drain from oil level plug.	Fluid level low

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

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Item No.	Interval									Item To Be Inspected	Procedures Check For And Have Repaired Or Adjusted As Necessary	Equipment Is Not Ready/ Available If
	B	D	A	D	W	M	Q	S	A			
						•					5) Replace oil level plug. Wipe clean oil plug and area around plug. 6) Remove street elbow if installed previously. 7) Replace breather plug. 8) Wipe gear box and immediate area dean.	
						•					b. Check and if necessary add fluid in main winch reduction gear box as follows: 1) Remove oil level check plug. 2) Check oil level. Oil must be near bottom of oil level check hole. 3) If #8GL32HT or military equivalent oil has to be added, remove oil fill plug. 4) Add oil into fill hole until half full. Oil will drain into check plug hole. 5) Replace oil level check plug and oil fill plug. 6) Wipe gear box and immediate area clean.	Fluid level low.
15						•	•			Bearings	Lubricate the following with No. 2 bearing grease or military equivalent: 1) Ten bearings on levelwind traveler head. 2) Ten roller shafts on levelwind traveler head. 3) Two thrust bearings on band brake drive shaft. 4) Levelwind gear pump outboard bearing. 5) Two bearings on winch hose roller. 6) Replace fluids in the following components: (a) Levelwind reduction gear box (primary for Barge 1). (b) Secondary levelwind reduction gear box. (c) Main winch reduction gear box. (d) Two winch shaft bearings.	
									•			

Table C-1. Preventive Maintenance Checks and Services for Shore Discharge System (Continued)

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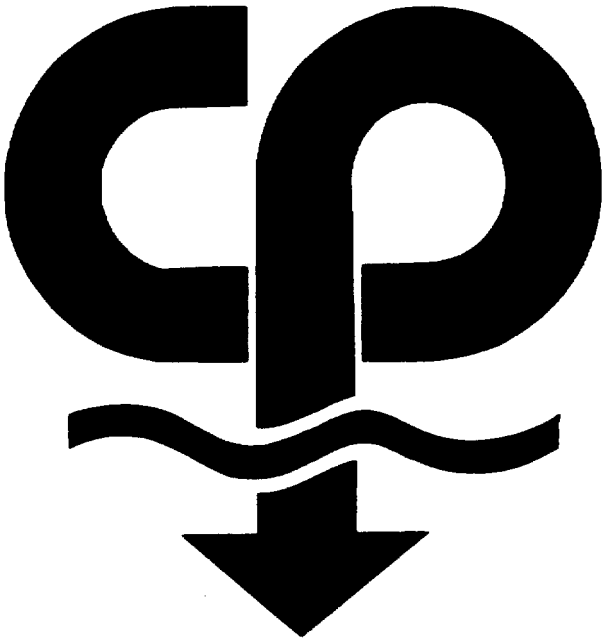
	B	D	A	D	W	M	Q	S	A			
											(7) Replace hydraulic fluid in power unit reservoir. Fill with Gulf Harmony, 46 AW or Military equivalent.	
16						•				Swivel Joint	Lubricate with No. 2 bearing grease or military equivalent.	

C O F L E X I P



U.S. ARMY ROWPU BARGE

DRINKING WATER DISCHARGE SYSTEM

OPERATIONS AND MAINTENANCE MIANUAL

UNIT NO. 840464-B

August 1985

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COFLEXIP
& services inc

OPERATIONS & MAINENTANCE MANUAL

U.S. ARMY ROWPU BARGE

DRINKING WATER DISCHARGE SYSTEM

FOR
V.S.E. CORPORATION
ALEXANDRIA, VIRGINIA

BY
COFLEXIP & SERVICES INC.
HOUSTON, TEXAS

JUNE 1985

COFLEXIP
& services inc

U.S. ARMY ROWPU DRINKING WATER DISCHARGE SYSTEM

OPERATIONS AND MAINTENANCE

MANUAL

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COFLEXIP
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I. SYSTEM GENERAL DESCRIPTION

The Coflexip Drinking Water Discharge System is to be used aboard the U.S. Army ROWPU barge, and will provide a means of discharging 300,000 gallons per day of drinking water via a flexible pipeline to a storage area ashore. See Figure I-1

The system can be operated from the ROWPU barge anchored in waters up to 50 feet deep and in currents up to 3 knots. Sand and mud conditions are expected on the sea bottom. An active surf zone developed by a sea state 3 is expected over an unimproved beach.

The Coflexip Drinking Water Discharge System has been designed and built according to the following general requirements:

- maximum operating pressure: 275 psi
- flowrate capacity: 300,000 gallons per day
- flexible pipeline length: 2,500 feet
- minimum deployment time
- long service
- maintain a high standard of corrosion resistance
- limited maintenance
- minimal training of personnel who will operate the ROWPU

- proven components meeting standard design concepts
- operating capability in various environments and conditions
- ambient temperatures from 0° F to 120° F.

The Coflexip Drinking Water Discharge System includes the following primary components:

- One (1) Coflexip Drinking Water Discharge Line, 3.8" ID,
  2,500 ft. length terminated with ANSI 150# flanges.
- One (1) Storage/Handling electro-hydraulic winch, equipped with:
  - Hydraulic power pack
  - Swivel joint at pipe inlet for continuous discharge operation
  - Corrugated rubber guide on drum
  - Level wind

- One (1) Steel chute
- One (1) Pigging System
- One (1) Pipe outer jacket repair kit

See Figure I-2

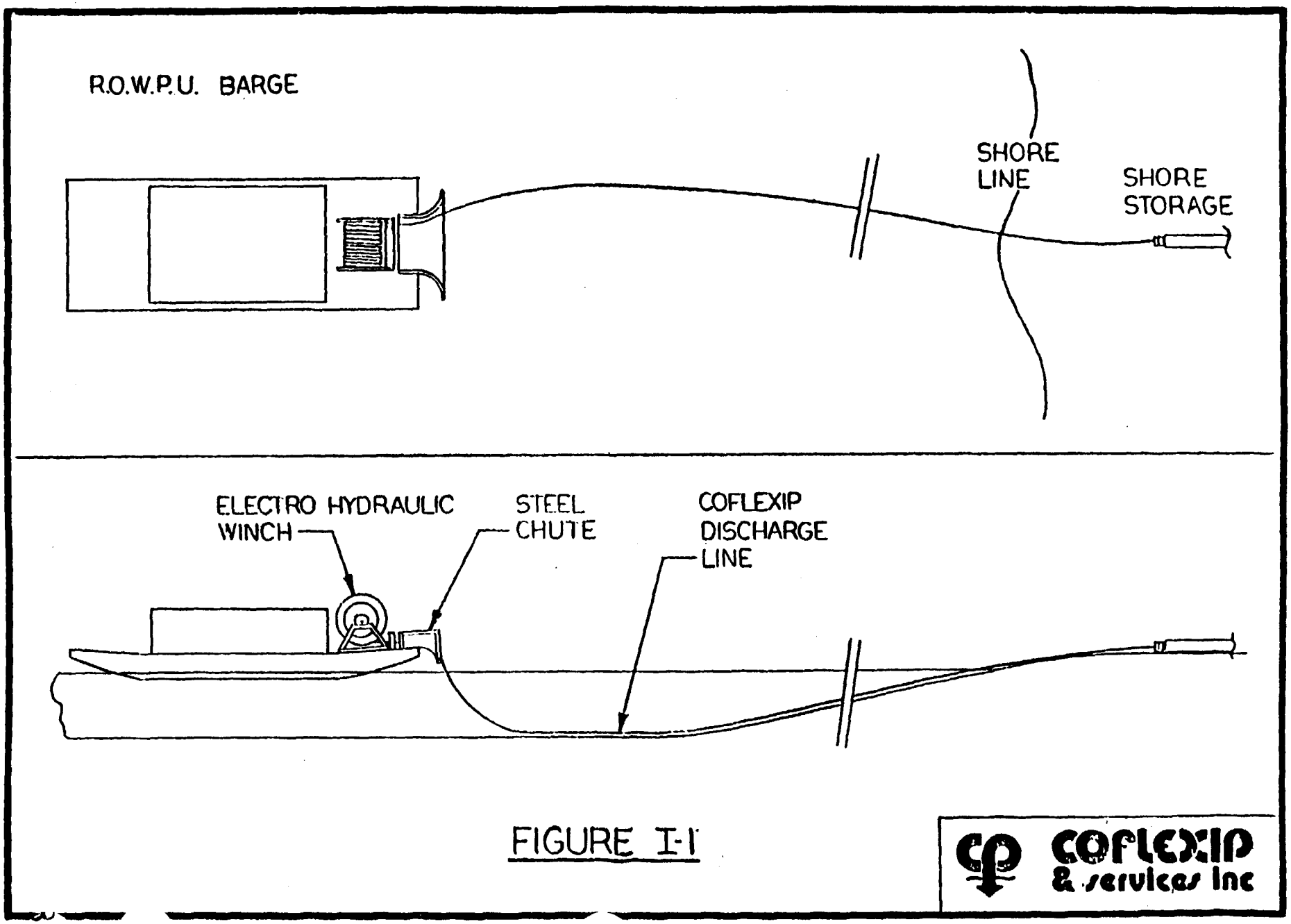

FIGURE I-1

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II. COFLEXIP PIPE AND COUPLING

Coflexip pipe is primarily made of steel and thermoplastic, and its structure is based on the modular assembly of independent layers; the steel components insure the mechanical properties of the pipe, while the plastic sheaths render it leak and corrosion proof.

For the ROWPU barge Drinking Water Discharge System, a heavy duty structure has to be used, since the flexible line will have to be handled in a general environment which cannot be anticipated or controlled. Also deployment of the line will be carried out very rapidly during less than favorable weather conditions. Therefore, it is necessary that a reinforced structure be used so that the integrity of the line be ensured.

The structure of the Drinking Water Discharge System includes six (6) layers:

- The inner polyethylene tube renders the pipe leak proof and protects it from corrosion and abrasion.

- The galvanized, interlocked steel carcass provides resistance to internal and external pressures. It also resists mechanical crushing and kinking.

- proven components meeting standard design concepts
- operating capability in various environments and conditions
- ambient temperatures from 0° F to 120° F.

The Coflexip Drinking Water Discharge System includes the following primary components:

- One (1) Coflexip Drinking Water Discharge Line, 3.8" ID, 2,500 ft. length terminated with ANSI 150# flanges.
- One (1) Storage/Handling electro-hydraulic winch, equipped with:
    - Hydraulic power pack
    - Swivel joint at pipe inlet for continuous discharge operation
    - Corrugated rubber guide on drum
    - Level wind
- One (1) Steel chute
- One (1) Pigging System
- One (1) Pipe outer jacket repair kit

See Figure I-2

- An intermediate polyethylene sheath separates the steel carcass from the crosswound armors and provides an extra leak proof layer.
- Double crosswound armors resist axial and torsional loads.
- The polyethylene outer sheath protects the pipe from external corrosion and ensures binding of the underlying armors.
- The Rilsan outer jacket provides an extra protection during the bottom tow of the flexible pipe on the seafloor.

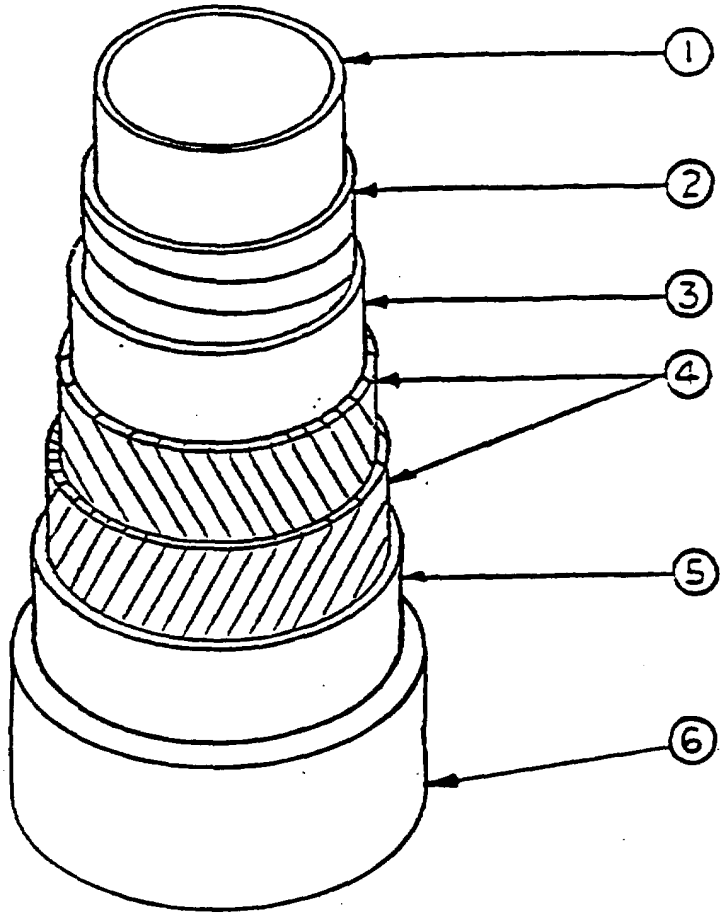
See Figures II-1 and II-2.

Coflexip pipe is manufactured in long continuous lengths which are spooled on storage/installation reels. The connections are mounted at both ends of each section, and the entire lengths are subsequently pressure tested in the factory. The end connections have reached such a high degree of reliability that they retain all the characteristics of the pipe with a substantial safety factor. The end connections also undergo a Ni-Kanigen corrosion protection treatment. This treatment consists in anchoring, by a non-electrolytic process, a penetrating layer of nickel into the steel.

The total length of the Drinking Water Discharge line is 2,500 feet, made in one continuous section. Each end is equipped with an ANSI B 16.5 series 150, raised face flange.

See Figures 11-3 and 11-4.

A repair kit is provided to restore the integrity of the Rilsan outer jacket, should it be damaged during deployment, service or retrieval. It is recommended that the flexible pipe be visually inspected during each retrieval operation, and the rilsan outer jacket be repaired from any major cut or tear. Instructions for the use of the repair kit are given in Section VI.7.



1. POLYETHYLENE INNER TUBE
2. PRESSURE CARCASS
3. POLYETHYLENE INTERMEDIATE SHEATH
4. CROSSWOUND ARMORS
5. POLYETHYLENE OUTERSHEATH
6. RILSAN OUTERJACKET

FIGURE II-1

FIGURE II-1

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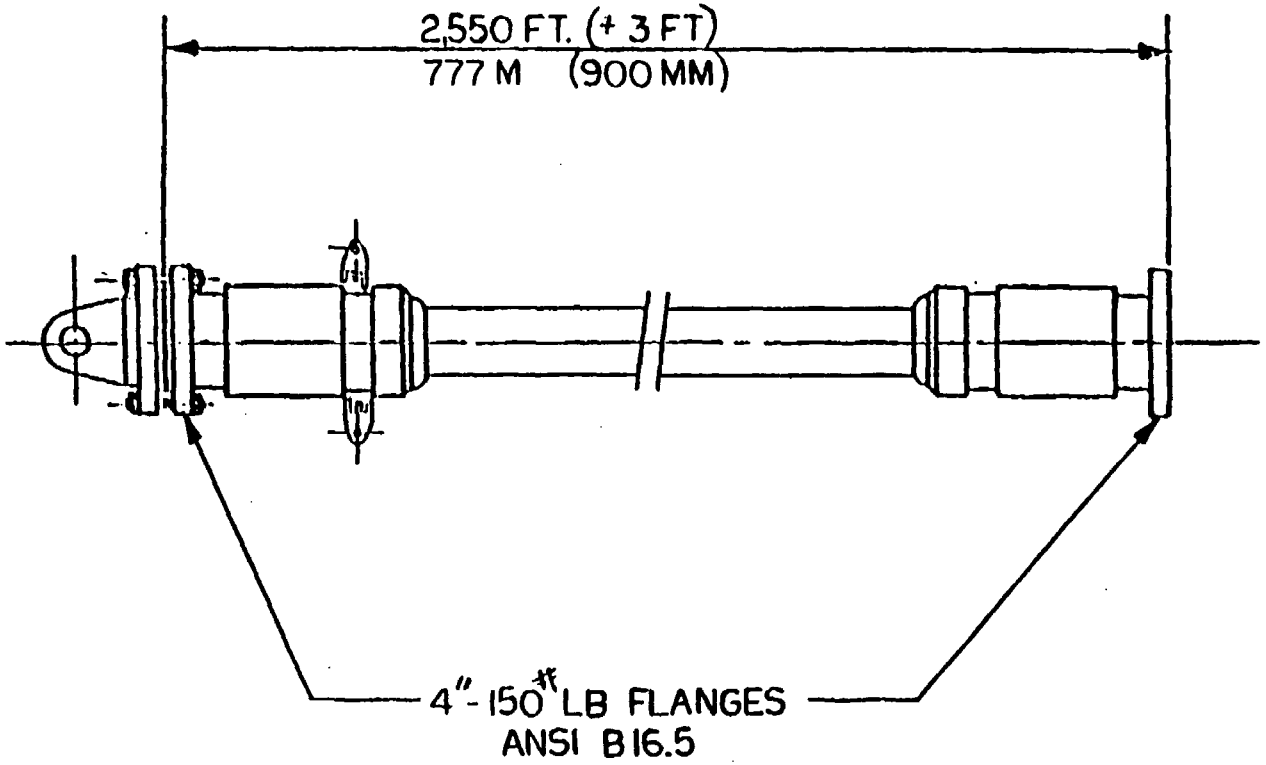
DRINKING WATER DISCHARGE LINE

TECHNICAL DATA SHEET

DIAMETER	Internal	3.8 inch
	External	6.1 inch
PRESSURE	Working	275 psi
	Test	415 psi
	Hydrostatic Collapse	700 psi
WEIGHT	In air, empty	18.6 lbs/ft
	In air, full	23.7 lbs/ft
	In water, empty	5.8 lbs/ft
	In water, full	10.9 lbs/ft
SPECIFIC GRAVITY		
DAMAGING PULL in straight line		50,000 lbs
DAMAGING TORQUE in straight lin		15,000 ft-lbs
MINIMUM BENDING RADIUS for storage		3.5 ft.

FIGURE II-2



3.8" ID. DRINKING WATER DISCHARGE LINE

FIGURE II-3

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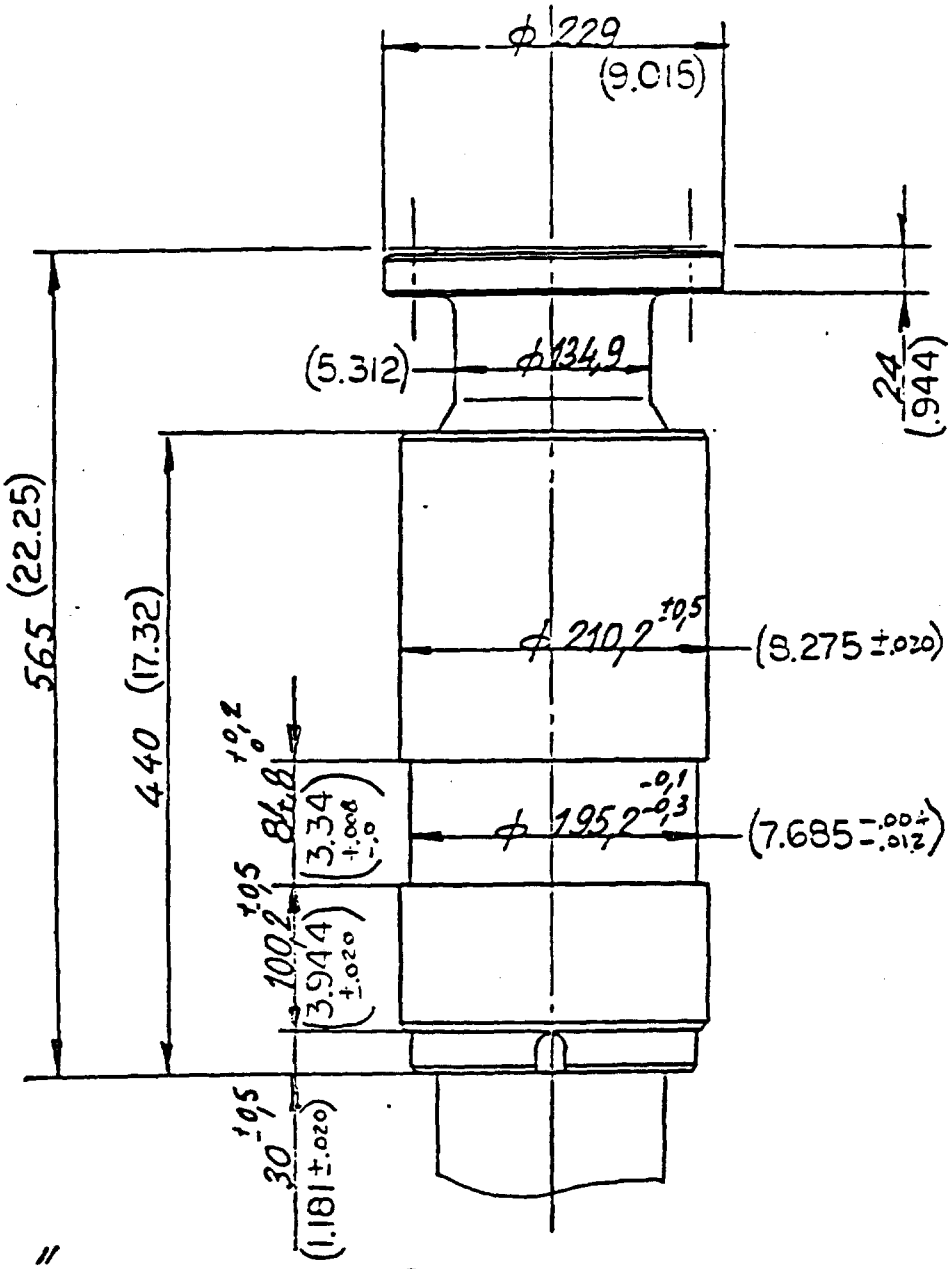


4" END FITTING

TERMINATION 4" FLANGE ANSI B 16.5
150 LBS RF

FIGURE II-4

NOTE: DIMENSIONS ARE IN MILLIMETERS. EQUIVALENT IN INCHES ARE IN PARENTHESES.

COFLEXIP & services Inc

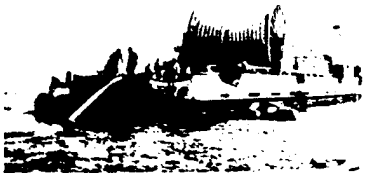
Cutting offshore construction costs with flexible pipe

Coflexip can save offshore construction dollars because it can be installed more quickly and easily than rigid pipe. More than a dozen different companies, including four majors, are now using it in the Gulf of Mexico for various applications.

Subsea flowlines

Coflexip flowlines can be laid in the Gulf of Mexico with a workboat or other small vessel. Mobilization of a lay barge is generally unnecessary which, in itself, cuts the cost.

Coflexip avoids expensive downtime caused by waiting-on-weather delays because the flexible pipe can be installed in shorter weather windows.

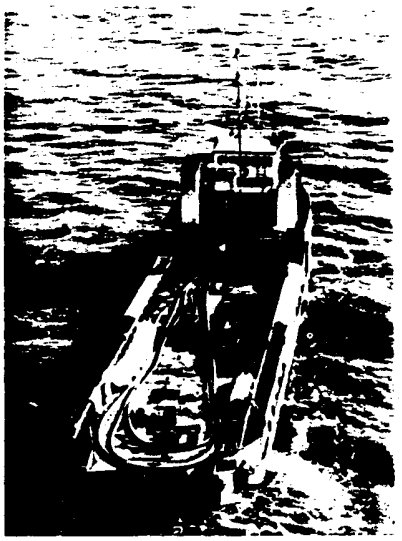


Coflexip flowlines are much easier to install than, conventional pipe. In most conditions, only light vessels are required.

There's no need for a stinger in laying Coflexip. The line is simply paid off a reel into the water. Installation is accomplished without constant tension as the pipe is lowered over the gutter to the sea floor. In the Gulf of Mexico, this simple procedure allows the laying of Coflexip lines year-round.

Flexible risers

A Coflexip riser offers many technical advantages over a rigid riser. It can also reduce costs. This is true for replacement of damaged risers, as well as new construction. A look at various procedures shows exactly why Coflexip installations work so fast.



The built-in flexibility of Coflexip allows installation in short weather windows and there are no limits on water depth. The flexible pipe is always self supporting with a collapse resistance far above the hydrostatic pressure.

Clamp-on risers, flexible versus rigid

To install a clamp-on riser of rigid pipe, a barge must first be mobilized. It's expensive and often causes delay. Rigid pipe may require days, even weeks, of barge time to get perfect underwater positioning before connections.

With Coflexip flexible pipe, the entire installation of a clamp-on riser can be done using only a workboat.

Underwater connection is much more efficient when the necessity of precise positioning is removed. Just lay the end of the flexible pipe close to the end of the other pipe. Divers can then proceed with light underwater handling equipment to pull the end of the flexible pipe into place. Any kind of flange can be mounted. As a result, both laying time and diver time are greatly decreased.

In a previous installation in 27 feet of water, 4 risers were positioned in 20 working hours. The flexible pipes were 4" and 6" I.D. with a working pressure of 1,440 psi. Gas production through the line began 48 hours later.

A clamp-on riser can be installed with no barge, no precise underwater measurements, no heavy underwater handling device. On the average, Coflexip completes the job twice as fast as with rigid pipe, for a lot less.

In the case of replacing a damaged riser with a Coflexip riser, a new flange, if not already existing. is installed on the pipeline to terminate it. The flange can be installed *on-bottom*, if there's no need to raise the pipeline. Any type of approved underwater connector or underwater welding can be used to install the flange.

The topside end of the flexible riser is transferred from the workboat to the platform using the platform crane or an air tugger. Subsequently, the flexible riser is paid off the back of the boat into the water.

On the seabed, the flanged end of the Coflexip riser is mated to the pipeline. The connection is easy because the riser is flexible. In addition, maneuvering the riser into the clamps is simplified by the pipe's flexibility. These two Coflexip advantages decrease the potential diver time, thus expense.

J-tube risers, flexible versus rigid

Replacing a J-tube riser with a new one of rigid pipe presents a costly and large-scale operation because of the

A Coflexip riser can be pulled through a J-rube or 1-tube with only the platform crane or an air tugger. It is nor necessary to mobilize an expensive barge.

normal need for a barge. With Coflexip you can avoid both the water-depth difficulties and the barge.

If the jacket has an available i-tube, the new Coflexip riser can be pulled through it using a workboat and a platform-mounted crane or small tugger.

If there is no available J-tube, you can install a clamp-on riser even in depths where J-tube risers are usually required. It's easy to install a Coflexip clamp-on riser in great water depths because there's no need for the precise alignments that have to be made with rigid clamp-ons.

The Coflexip clamp-on riser retains another advantage of the original J-tube riser. It can be clamped to the inside of the jacket where the jacket protects it, and there's no need for a riser guard.

A reliable riser for less

The technical and financial advantages of using Coflexip for risers and flowlines can be summarized as:

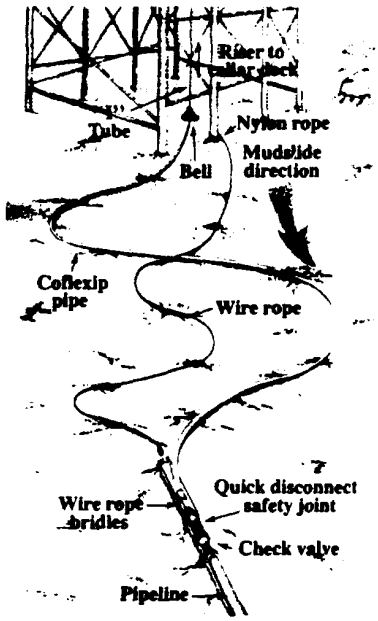
- no need for a large support vessel
- no need for heavy underwater handling devices
- no stalking-on
- no precise underwater measurements or alignments to be made
- no clamping problems
- no need for a long weather window
- no special provisions for thermal expansion and contraction, other than some slack at either end.

Major oil companies are now using Coflexip flexible risers all over the world in working pressures up to 10,000 psi.

Mudslide protection

For protecting a pipeline from underwater soil movement, Coflexip offers a much greater degree of safety than rigid pipe solutions.

Sediment creep and mudslides are a constant threat to offshore flowlines at the mouths of rivers,



In a mudslide, the built in flexibility and the slack of the Coflexip preventer riser damage due to the relative pipeline movement.

and where there are severe bottom currents, earth tremors, or bottom faults. The Mississippi Delta and Southern California are prime examples.

Rigid pipe, even with ball joints.
cannot long withstand severe soil movements. Coflexip can.

In areas of unstable soil, you can ward off a break by incorporating into a pipeline a section of Coflexip laid out in an "S" or "U" configuration. The Coflexip can be bent to a very small radius of curvature; a 10-inch I.D. line will bend to an eight-foot radius before damage. "Slack" in this section allows the soil movement to displace the pipeline instead of damaging it.

When the slack is taken up by a movement of the soil, a new "S" or "U " section can be inserted. Of course a Coflexip riser or flowline can be laid out with enough slack to act as its own mudslide protector.

As with rigid pipe. the pipeline can be protected by check valves and a safety joint. Three major oil companies are now' using Coflexip very successfully for mudslide protection in the Gulf of Mexico.

Case history

A major oil company recently installed a Coflexip mudslide protector in South Pass Block 49 off Louisiana, a very bad mudslide area. Slides here reach as far as 30 feet above and 70 below the normal mudline and cover a wide area in the horizontal plane.

In this installation. 1,000 feet of Coflexip 10-inch I.D., 1.440-psi line was laid out in an "S" configuration, spanning a distance of 200 feet from the base of the jacket to the end of the rigid flowline.

Coflexip designed a special end fitting so the line could be pulled through the platform's 16-inch "1" tube. After the line was pulled through, the pulling head was cut off of the end fitting and a standard 10-inch ANSI flange was welded on.

Flexible pipe for interplatform connections

Quite often, high-pressure lines are needed above sea level between two platforms or other structures that require allowances for relative movement. There are two common solutions-ordinary pipe with swivel joints or large-diameter loops of rigid pipe.

Coflexip has a better solution. Flexible jumper lines are easily installed with a flange at each end. They have a minimum pressure drop, and virtually no maintenance because of greater fatigue resistance. less erosion, and fewer places for leaks to develop.

Oil companies are now employing Coflexip jumper lines extensively in the Gulf of Mexico. Because of the flexible pipe's unique properties it has proven less vulnerable to damage by wind and waves.

New production economics

The easy installation and recovery of Coflexip flowlines open up several profitable new alternatives.

Temporary production systems for marginal fields

Coflexip flowlines are not only easy to lay, they are easy to retrieve. After a well has played out, the Coflexip flowline can be reeled back onto a workboat and used on another well.

The cost of the line is distributed over several wells instead of just one.

This way the net cost of a flowline system is reduced even further and many marginal fields become commercial.

Early, production systems

Coflexip flowlines require a fraction of the installation time needed by rigid pipe. They can often go in earlier, too; sometimes months earlier because they can be ordered from stock and laid year-round in short weather windows.

This makes possible rapid partial production in a field that would come on stream at a later date. Result: early cash flow.

Other production applications

Coflexip flexible pipe is also used as vent and flare lines, and pipeline expansion joints. Its combination of flexibility, strength, easy installation, and low maintenance gives it an edge over rigid pipe in each of these applications.

Coflexip flowlines have been used for temporary production systems in the Gulf of Mexico to provide early production and cash flow.

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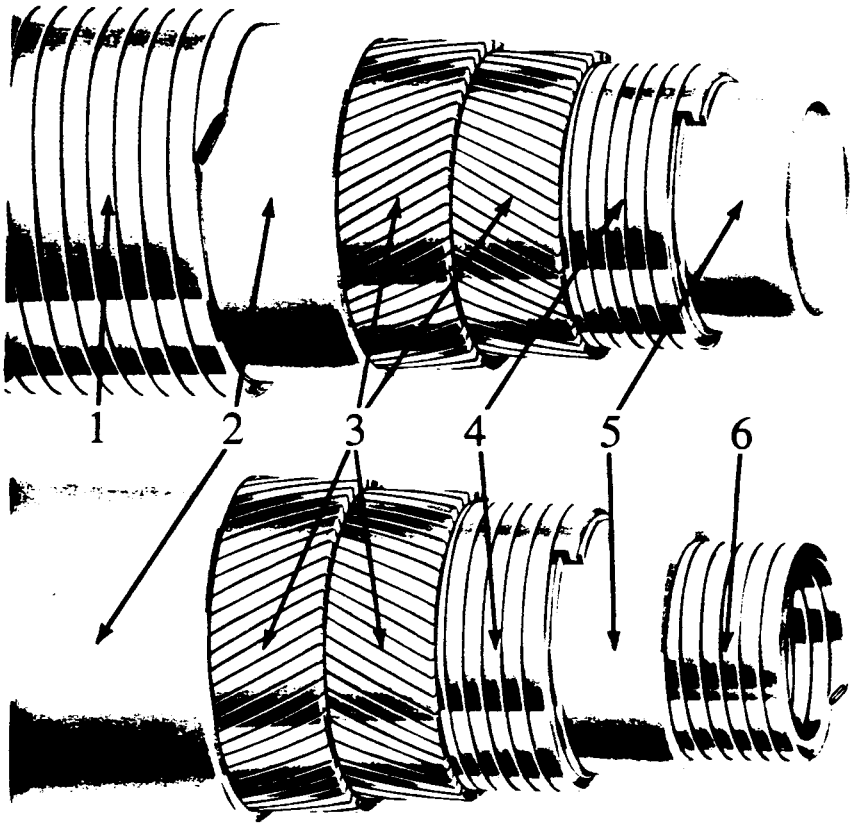
Flexible pipe: What it really is and how it solves so many problems



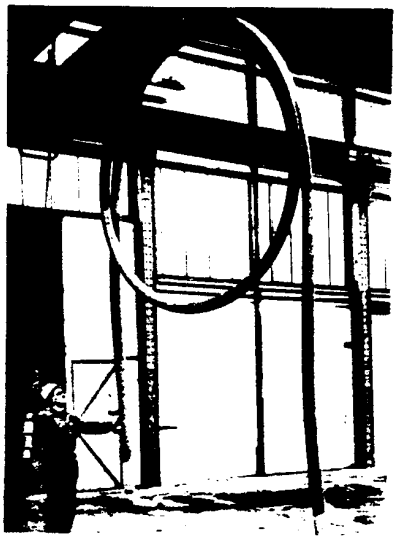
1. *Interlocking stainless steel outer wrap protects outer thermoplastic layer.*
2. *Outer thermoplastic layer protects steel structural components from corrosion; resists abrasion and chemicals.*
3. *Contiguous layers of spiraling steel wire provide tensile strength.*
4. *Steel carcass of interlocking, spiraled Z-section withstands high internal and external pressures, resists kinking.*
5. *Inner thermoplastic liner makes the assembly leaktight, isolates steel components from fluids, resists abrasion and chemicals.*
6. *Interlocking stainless steel liner protects the thermoplastic layer from damage by TFL tools.*

"Flexible pipe" isn't just a fancy advertising name for another kind of hose. Coflexip flexible pipe actually has the pressure rating, crush strength and safety factors of rigid API steel pipe, and the flexibility of reinforced rubber hose. For most sizes and pressure ratings, it actually has a smaller bending radius than the same size hose.

By combining these two qualities, Coflexip solves a host of drilling and production problems.

Flexibility saves in offshore construction

Since 1972, over 1,000,000 feet of Coflexip lines have been installed for production systems. Flexibility makes Coflexip much simpler and cheaper to use than rigid pipe for many applications. In the Gulf of Mexico, for example, a Coflexip riser can be installed with a smaller crew and vessel, in less time, with greater tolerances, in a shorter weather window, and with a fraction of the equipment cost. Workboats and small platform cranes can take the place of huge lay barges and derrick barges. Plus, Coflexip lines are designed to outlast rigid line.



This 10.000-psi WP., three-inch Coflexip line has the same safety factor and crush strength as rigid API spec pipe, yet has a smaller bending radius than rubber hose with the same I.D. and pressure rating (36" vs. 48").

Our literature on production applications gives step-by-step comparisons of Coflexip versus rigid pipe installations.

In drilling, it outperforms both hose and pipe with swivel joints

Coflexip flexible pipe lowers costs and raises the safety factor on drilling rigs.

Coflexip initially costs more than other Alternatives for choke and kill lines, cementing/acidizing/fracking lines and other drilling jobs. But it lasts so much longer that the cost is actually lower in the long run. That's based on the materials cost alone. If the downtime cost avoided by a line that lasts longer is included, Coflexip is cheap compared to other solutions.

For many jobs, Coflexip is a lot safer than rubber or pipe with swivels because of its strength, durability, and corrosion resistance. What price can be put on that?

Our literature on drilling applications tells exactly how and where Coflexip can save you money.

Actually tougher than rigid steel pipe

In comparison to API 5LX steel pipe, Coflexip flexible steel pipe generally has better abrasion resistance, better corrosion resistance, and better resistance to vibration and flexing fatigue.

It requires less maintenance in most applications and it is compatible with more chemicals, including H2S.

Compared to reinforced rubber hose, Coflexip has greater crush strength, abrasion resistance, ultraviolet resistance, and flexing-fatigue resistance. It stands up to a wider range of chemicals, including H_2S, and suffers almost no aging damage.

Coflexip works because of a unique design

Coflexip is a unique combination of high-strength steels and thermoplastic.

In the basic Coflexip construction, the carcass of interlocking Z-section steel handles the radial loads, including internal pressure, and keeps the pipe

Crush strength of Coflexip pipe is demonstrated by parking a truckload of drill pipe on a piece of rotary hose. The pipe remains perfectly round under the 9.000-lb. direct load.

from kinking or collapsing. Alternating spiral layers of heavy steel wire handle the tension loads and give the pipe a tensile strength comparable to rigid pipe.

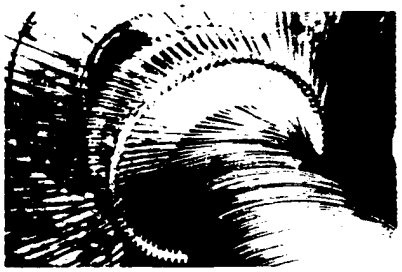
Outside and inside, thermoplastic layers protect the steel components against corrosion and make the pipe leakproof. There is no bonding between layers. When the pipe bends, each layer

The interlocking spiral of steel - section is the structural element that withstands radial loads from internal and external pressures. and keeps the pipe from kinking.

moves independently. That's why the fatigue resistance of Coflexip is much higher than that of reinforced hoses.

For most drilling applications. the outer thermoplastic layer is covered with a stainless steel wrap for extra protection. For production applications, an extra stainless steel layer goes on the inside, to prevent damage from TFL tools.

That's the basic structure. Dozens of Coflexip structures have been developed for specific applications in sizes from I to 22 inches I.D., with working pressures up to 15,000 psi, and continuous lengths of more than one mile.



There is no bonding between layers in the Coflexip structure as there is in the structure of reinforced rubber hose.

That's why Coflexip has such extreme' high resistance to flex fatigue. Four inch Coflexip pipe has withstood 1,600,000 flexing cycles under a 10.0(0 psi maximum working pressure before failure due to the unnaturally induce temperature of +1001°C.

A long list of uses

Since 1972, Coflexip has been successfully used in almost every major oilfield in the world. In the Gulf of Mexico and onshore, it serves as:

- Offshore platform risers
- Subsea flowlines
- Jumper lines
- Subsea mudslide protectors
- Vent and flare lines
- Temporary production systems
- Permanent production systems

- Expansion joints
- Test lines
- Hydraulic lines
- Rotary and vibrator lines
- Choke and kill lines
- Choke manifold lines
- Acidizing/cementing/fracking lines
- Tank roof drains
- Skimmer lines
- Foam lines

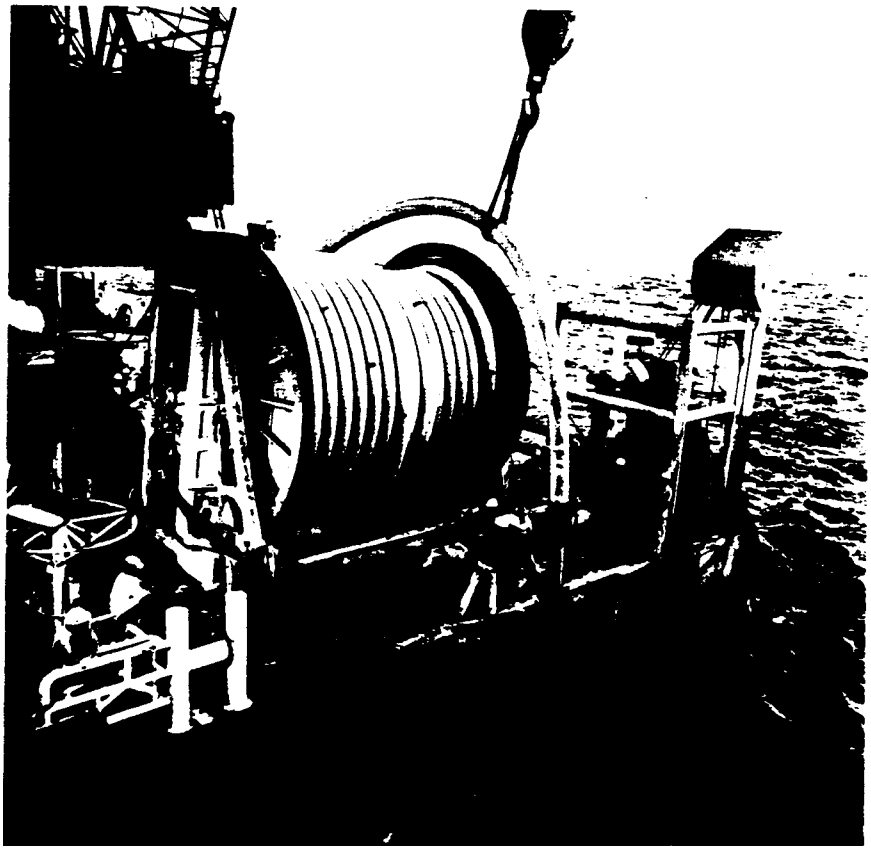
Coflexip lines are available from stock in the U.S.

We stock miles of Coflexip, in a variety of diameters, structures, and pressure ratings, right here in the U.S.

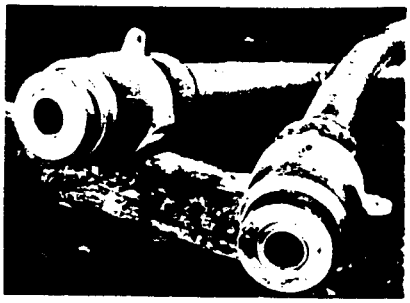
Our technical services group in Houston will engineer the Coflexip line to fit your need. Our assembly plant in New Orleans will cut the line to length and attach the specified end fittings with a sophisticated bonding process.

Every finished line undergoes a hydrostatic test certified by an independent lab. Customers are welcome to attend.

Our New Orleans plant is easily accessible to workboats and barges for fast offshore installations in the Gulf. All the tools and equipment for installing the Coflexip line are right at hand, and our specialized laying teams assist you during offshore operations.



10-inch I.D. flexible pipe being peed off during a Gulf of Mexico installation. A special Coflexip winch is used here to control the rotation of the drum.



Coflexip lines are available with an! type of end connections. The connector-to-pipe bond is even stronger than the flexible pipe itself. End connections are internally flush with the I.D. of the pipe.

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SAFETY PRECAUTIONS

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

WARNING This symbol is used to warn of possible serious personal injury.

CAUTION This symbol refers to possible equipment damage.

PROPRIETARY NOTE

This Operations and Maintenance Manual has been issued for the sole use of proper operations and maintenance of the DeckMaster Winch Model No. WHR-102-12525 and Hydraulic Power Package Model No. HPP-30EC-50.

This manual should not be duplicated, used, or disclosed in whole or part for any purpose other than operation and maintenance of the subject Winch and Hydraulic Power Package.

TABLE OF CONTENTS

NOTE

All pages with as asterisk (*) after the page number indicates changes from the first ROWPU Winch OPERATIONS and MAINTENANCE Manual.

1.0 INTRODUCTION

This manual covers the detailed description of the Drinking Water Discharge Winch System and the required operation and maintenance tasks. Whenever a CAUTION and/or WARNING is indicated, the operator should follow the required task(s) in detail to prevent personal injury and/or component damage.

Section 2.0, System Description presents the basic description of the winch system components, namely:

- Winch
- Levelwind
- Hydraulic power package

Component specifications and the theoretical power analysis are presented. Section 3.0, Structural System, briefly describes the structural aspects of the three winch system components.

Section 4.0 Hydraulic System is a detailed description of the complete hydraulic system. Similarly, Section 5.0, Electrical System, covers the Electrical System.

Section 6.0, System Installation, covers in detail the required tasks for proper installation of the winch, levelwind, hydraulic power package, and water hose. The mechanical, electrical, and hydraulic aspects are covered. Section 7.0 System Operation presents the detailed methodology for proper winch system operation.

Section 8.0, System Maintenance, covers the handling, shipping, and maintenance of the Winch System. A detailed spares list is presented covering three levels of spares; I, consumables, II, repair parts/kits, and III, replacement components. Two extreme spares levels are presented:
maximum coverage and minimum coverage. Also presented are recommendations relative to long term storage, shipping, and record keeping.

Section 9.0 Component Description and Appendices 1 through 31 are detailed description of all components used on the Winch System. Additional vendor furnished maintenance and spare parts information is presented for the major/critical components.

This manual presents sufficient information for the proper operation and maintenance of the Drinking Water Discharge Winch System.

2.0 SYSTEM DESCRIPTION

The Drinking Water Discharge Winch System is an electro-hydraulic Winch System composed of three components,

- Winch
- Levelwind
- Hydraulic Power Package

Each component are separate units with the only inter-connection being hydraulic hoses.

2.1 Drive System Analysis

A theoretical system drive analysis was conducted to establish component selection and input power requirements. The inputs into the analysis were as follows:

10,000 lbs pull @ mid layer

18,000 lbs brake @ mid layer

25 FPM hose speed @ mid layer

The basic winch configuration was dictated by available deck space. This limitation established a winch hub O.D. of 102.5 inches. Assuming five wraps of a 6-inch O.D. hose, the mid layer diameter becomes 132.5 in O.D. (66.25-inch radius). The above values become inputs into the Drive System Analysis.

The following Tables at the ends of this section are a summary of the Drive System Analysis:

Table 2-1 -Power Required Condition

Winch Drum to Electric Motor

The resultant analyses indicated that the 30 Horsepower electrical input and the components selected would result in a system fulfilling the pull, brake, and speed requirements.

2.2 Band Brake Analysis

The Drinking Water Discharge Winch System incorporates a manually operated band brake. This brake is totally independent of the electro-hydraulic system disc brake. The theoretical analysis for the band brake is presented in Table 2-6.

2.3 Winch System Configuration

The resultant winch configuration is presented in Figures 2-1, levelwind configuration is presented in Section 6.0, System Installation, and the Hydraulic Power Package Configuration is presented in Section 4.0, Hydraulic System, Figure 4-2 and 4-3.

Table 2-1
POWER REQUIRED CONDITIONS
Theoretical Drive Train Analysis:
Winch Drum to Electric Motor

1.0 DRUM TORQUE

Pull = 10,000 lbs @ 66.25 inch radius (mid-layer)
Pulling Torque = 10,000 x 66.25
= 662,500 in-lb
Brake = 18,000 lbs @ 66.25 inch radius (mid-layer)
Braking Torque = 1,192,500 in-lbs

2.0 DRUM SPEED

Line Speed = 25 FPM @ 66.25 inch radius
Drum Speed = 0.721 RPM

3.0 REDUCTION GEAR SET

Special: Ring Gear = 3 DP/200PA/181 Teeth/60.333 PD/
4 inch wide
Pinion Gear = 3 DP/200PA/15 Teeth/5.00 PD/
4 inch wide
Ratio: 12.066:1.0
Efficiency: η_{gs} = 0.95
Required Input Torque = 662 500/12.066 (0.95)
= 57,796 in-lbs Pulling
= 104,033 in-lbs Braking
Required Input Speed = 0.721 (12.066) =
= 8.70. RPM

4.0 REDUCTION GEAR BOX

Fairfield Torque Hub No. S6A1-33-32
Ratio: 32.31:1
Efficiency: η_{gb} = 0.95
Required Input Torque = 57,736 in-lbs/(32.31) (0.95)
= 1833 in-lbs Pulling
= 3,389 in-lbs Braking
Required Input Speed = 8.70 (32.31)
= 281.1 RPM

5.0 BRAKE

Ausco No. 31025
Rated Torque: 3800 in-lbs

6.0 HYDRAULIC MOTOR

TRW Ross No. MAB-10-0-Q2-A1
Displacement = 7.4 in^3/Revolution
Efficiency Torque = η_T = 0.87
Volumetric = η_V = 0.92
Overall = η_{OA} = 0.80
Torque = 118 in-lbs/100 PSI (theoretical)
Required Input Hydraulic Pressure

$$= \frac{1883}{1.18} \cdot \frac{1}{0.87}$$

$$= 1834 \text{ PSI}$$

Required Input Flow

$$= (281.1 \text{ Rev/min})\ (7.4\ in^3/\text{Rev})\ \left(\frac{1 \text{ gal}}{231\ in^3}\right)\ \left(\frac{1}{0.92}\right)$$

$$= 9.8 \text{ GPM}$$

7.0 HYDRAULIC PUMP

Sundstrand No. 20-2065-HDC
Rated Pressure = 3,000 PSI
Efficiency: Volumetric η_V = 0.95
Overall η_{OA} = 0.90
Flow = 14.6 GPM @ 1750 RPM
Assume System Pressure Drop of 300 PSI
Required Pump Output Pressure = 2134 PSI
Required Electric Horsepower

Max.

$$= \frac{(2134)\ (14.6)}{(1714)\ (0.90)}$$

= 20.2 Horsepower

Normal

$$= \frac{(2134)\ (9.8)}{(1714)\ (0.90)}$$

= 13.6 Horsepower

Table 2-2

POWER AVAILABLE CONDITIONS

Theoretical Drive Train Analysis:
Electric Motor to Winch Drum

1.0 ELECTRIC MOTOR

30 Horsepower
1750 RPM
Efficiency = 0.91

2.0 HYDRAULIC PUMP

Sundstrand No. 20-2065-HDC
Rated Pressure = 3000 PSI
Flow @ 1750 RPM = 14.6 GPM
= 3,373 in^3/min
Efficiency: Volumetric = η_V = 0.95
Overall = η_{OA} = 0.95
SET System Pressure @ 2150 PSI
Power Consumed

$$= \frac{(2150)\ (14.6)}{(1714)(0.95)}$$

= 20.3 Horsepower

3.0 HYDRAULIC MOTOR

TRW ROSS No. MAB-10-0-02-A1
Displacement 7.4in3/Rev.
Efficiency: Volumetric = η_V = 0.92
Torque = η_T = 0.87
Overall = η_{OA} = 0.80
Torque = 118 in-lbs/100 PSI (theoretical)
Assume 300 PSI system pressure drop
Output Torque = (2150-300) (1.18) (0.87)
= 1,899 in-lbs
Output Speed $\frac{(3373)\ (0.92)}{7.4}$
= 419 RPM

4.0 BRAKE

AUSCO No. 31025
Rated Torque = 3,800 in-lbs

5.0 REDUCTION GEAR BOX

Fairfield Torque Hub No. S6A1-33-32
Ratio : 32.31:1
Efficiency: η_{GB} =0.95
Output Available Torque (Pulling) = (1899)(32.31)(0.95)
= 58,289 in-lbs
Output Available Torque (Braking) = (3800)(32.31)(0.95)
= 116,639 in-lbs
Output Speed = 419/32.31 = 12.97 RPM

6.0 REDUCTION GEAR SET

Ratio: 12.066:1
Efficiency: η_{GS} = 0.95
Output Torque (Pulling) = 58 289(12.066) (0.95)
= 668,149 in lbs
Output Torque (Braking) = 116,639(12.066)(0.95)
= 1,336,988 in-lbs
Output Speed = 12.97/12.066 = 1.07 RPM

7.0 DRUM

Holding Tension (Brake) @ 66.25 inch radius (mid layer)

$$= \frac{1,366,998}{66.25}$$

= 20,181 lbs

Pulling Tesnion @ 66.25 inch radius (mid layer)

$$= \frac{668,149}{66.25}$$

= 10,085 lbs

Line Speed @ 66.25 inch Radius
= (1.07) (2π) (66.25/12)

= 37.1 FPM

Table 2-3

MAXIMUM POWER AVAILABLE CONDITIONS

Theoretical Drive Train Analysis:
Electric Motor to Winch Drum

1.0 ELECTRIC MOTOR

30 Horsepower
1750 RPM
Efficiency = 0.91

2.0 HYDRAULIC PUMP

Sundstrand No. 20-2065-HDC
Rated Pressure = 3000 PSI
Efficiency: Volumetric η_V 0.95
Overall η_{OA} 0.90
Flow @ 1750 RPM = 14.6 GPM
= 3,373 in^3 /min

SET System Pressure @ 3000 PSI

Power Consumed = $\frac{(3000)\ (14.6)}{(1714)\ (0.90)}$

= 28.4 Horsepower

3.0 HYDRAULIC MOTOR

TRW ROSS No. MAB-10-0-02-A1
Displacement 7.4 in^3/Rev.
Torque = 118 in-lbs/100 PSI (theoretical)
Efficiency: Volumetric η_V 0.95
Torque η_T 0.87
Overall η_{OA} 0.80
Assume 300 PSI system pressure drop

Output Torque = (3000-300) (1.18) (0.87)
= 2,771.8 in-lbs
Output Speed = (3373)(0.92)(7.4)
= 419 RPM

4.0 BRAKE

AUSCO No. 31025
Rated Torque = 3,800 in-lbs

5.0 REDUCTION GEAR BOX

Fairfield Torque Hub No. S6A1-33-32
Ratio: 32.31:1
Efficiency • η_{GB} 0.95

Output Available Torque (Pulling) = (2 771.8) (32.31) (0.95.
= 85,079 in-lbs
Output Available Torque (Braking) = (3,800)(32.311(0.95)
= 116,639 in-lbs
Output Speed = 419/32.31 = 12.97 RPM

6.0 REDUCTION GEAR SET

Ratio: 12.066:1
Efficiency: η_{GS} = 0.95

Output Torque (Pulling) = 85,079 (12.066)(0.95)
= 975,235 in lbs

Output Torque (Braking) = 116,639 (12.066)(0.95)
= 1,336,998 in-lbs
Output Speed = 12.97/12.066 = 1.07 RPM

7.0 DRUM

Holding Tension (Brake) @ 66.25 inch radius (mid layer)

$$= \frac{1{,}366{,}998}{66.25}$$

= 20,181 lbs

Pulling Tension @ 66.25 inch radius (mid wrap)

$$= \frac{975{,}235}{66.25}$$

= 14,721 lbs

7.0 DRUM (continued)

Line Speed @ 66.25 inch Radius

= (1.07) (2 π) (66.25/12)
= 37.1 FPM

TABLE 2-4

POWER REQUIRED CONDITIONS

Theoretical Drive Train Analysis
Levelwind Traveler Head to Electric Motor

1.0 SIDE LOAD

1,000 lb.

2.0 SPEED

Drum Speed = 1.07 rpm
Hose Diameter = 6.045 in. OD
Traveler Speed = (6.045)(1.07) = 6.47 in/min

3.0 CHAIN DRIVE

Drive Sprocket Pitch Dia. = 6.68 in.
Efficiency = 0.75

$$\text{Required Torque} = \frac{(1000)\,(6.68/2)}{0.75} = 4{,}453 \text{ in-lb}$$

$$\text{Required Speed} = \frac{6.47}{(6.68)\,(\pi)} = 0.31 \text{ rpm (constant rate)}$$

Assume Required Rate to be 3 times the constant rate.
Required output speed of gearbox = (3)(0.31) = 0.93 rpm

4.0 GEARBOX

Eurodrive FAF70
Reduction Ratio = 69.31:1
Efficiency = 0.90

$$\text{Required Input Torque (Motor Output)} = \frac{4453}{(69.31)(0.90)} = 71.4 \text{ in-1}$$

Required Input Speed (Motor Output) = (0.93)(69.31) = 64.5 rpm

5.0 HYDRAULIC MOTOR

TRW Ross MAF-06-0-06-A1
Displacement = 3.0 in^3/ rev.
Torque (theoretical) = 0.47 in-lb/psi

Efficiencies: Volumetric = 0.93
Torque = 0.81
Overall = 0.75

Required Input Hydraulic Pressure

$$= \frac{(71.4)(2\pi)}{(3)\ (0.81)} \qquad = 185 \text{ psi}$$

Required Input Flow

$$= \frac{(64.5)(3) =}{(0.93)} \qquad = 208\ in^3/\text{min} = 0.90 \text{ gal/min}$$

6.0 HYDRAULIC PUMP

Commercial Shearing P15H301GEAB5-17
Rated Pressure = 2,000 psi
Flow (@ 500 psi) = 5.06 gal/min
Efficiencies: Volumetric = 0.85
Overall = 0.70

Assume System Pressure Drop of 100 psi.
Required Pump Output Pressure = 185 + 100 = 285 psi.

Required Motor Power = $\frac{(2\ 85)(5.06)}{(1714)(0.70)}$ = 1.20 HP

Note: The above analysis has assumed three times the required levelwind traveler head speed.

TABLE 2-5

POWER AVAILABLE CONDITIONS

Theoretical Drive Train Analysis
Electric Motor to Levelwind Traveler Head

1.0 ELECTRIC MOTOR

30 HP (total)
1750 rpm

2.0 HYDRAULIC PUMP

Commercial Shearing P15H301GEAB5-17
Rated Pressure = 2,000 psi
Flow (@ 500 psi) = 5.06 gal/min = 1169 in^3/min

Efficiencies: Volumetric = 0.85
Overall = 0.70

System Pressure set to 300 psi.

Power Consumed = $\frac{(500)(5.06)}{(1714)(0.70)}$ = 1.27 HP

3.0 HYDRAULIC MOTOR

TRW Ross MAF-06-0-06-A1
Displacement = 3.0 in^3/rev
Torque (theoretical) = 0.47 in-lb/psi
Efficiencies: Volumetric = 0.93
Torque = 0.81
Overall = 0.75
Assume 100 psi system pressure drop.

Output Torque = (300-100)(0.47)(0.81) = 76.1 in-lb
Output Speed = (1169)(0.93)/3.0 = 362.3 rpm

4.0 REDUCTION GEARBOX

Eurodrive FAF70
Ratio = 69.31:1
Efficiency = 0.90

Available Output Torque = (76.1)(69.31)(0.90) = 4747 in-lb

Available Output Speed = 362.3/69.31 = 5.23 rpm

5.0 CHAIN DRIVE

Drive Sprocket pitch diameter = 6.68 in.
Efficiency = 0.75

Available Traveler Pulling Tension

$$= \frac{(4747)\ (0.75)}{(6.68/2)} = 1{,}066 \text{ lb}$$

Available Traveler Speed = (5.23)(6.68)(π) = 109.7 in/min

= 9.1 ft/min

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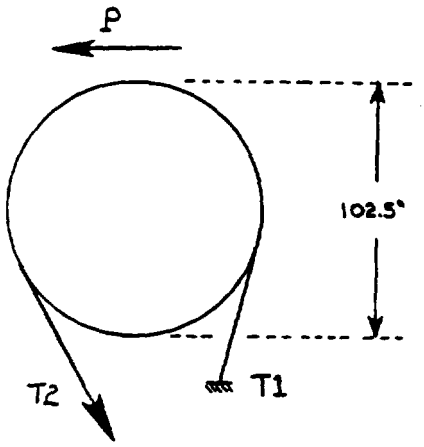
TABLE 2-6

BAND BRAKE ANALYSIS



1.0 INPUTS

Inputs: Band brake width = 3.75 inches
Asbestos thickness = 0.375 inches
Stainless steel band = 0.500 inches thick

Brake Capacity = 18,000 lbs @ mid layer = 66.25 inches

Brake Capacity @ 51.25" radius (hub) =

$$\frac{18{,}000(66.25)}{51.25} = 23{,}500 \text{ lbs}$$

Assume: a = angular band contact
= 2700
f = friction coefficient
= 0.4

2.0 ANALYTICAL RELATIONSHIPS

$T1 - T2 = P$
$T1/T2 = 10^b$
$b = 0.0076fa = 0.8208$

$$T2 = \frac{P}{10^b - 1}$$

$$= \frac{23500}{10^{0.8208} - 1}$$

= 3,550 lbs 0

T1 = P- T2
= 19,950

2.0 ANALYTICAL RELATIONSHIPS(continued)

Stress in band = $\frac{T}{wt}$

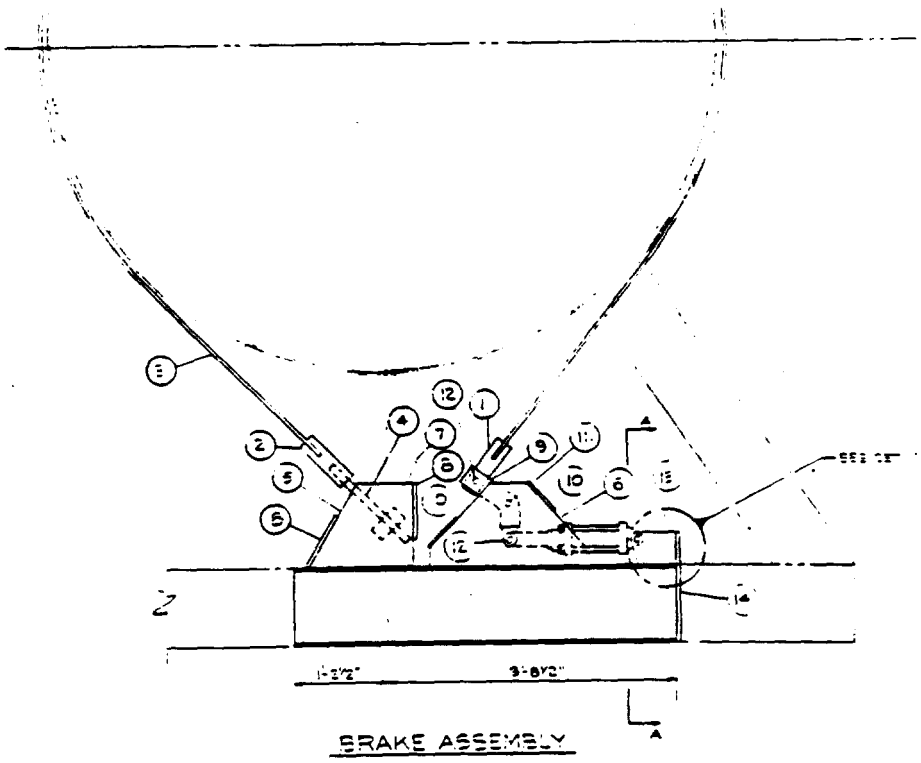
= $\frac{19,950}{(3.75)(0.375)}$

= 14,187 psi

3.0 BRAKING FORCE

T_2 = 3,550

Using a 2" x 1"x 6: stroke hydraulic cylinder (see appendix 31D) and a 1:1 linkage ratio, the pressure required to exert a 3,550 lbs force by the cylinder is 1550 psi. To be conservative and to account for linkages losses, the hydraulic cylinder/pump system that actuates the band brake (shown below) is capable of operating at pressures up to 3000 psi.



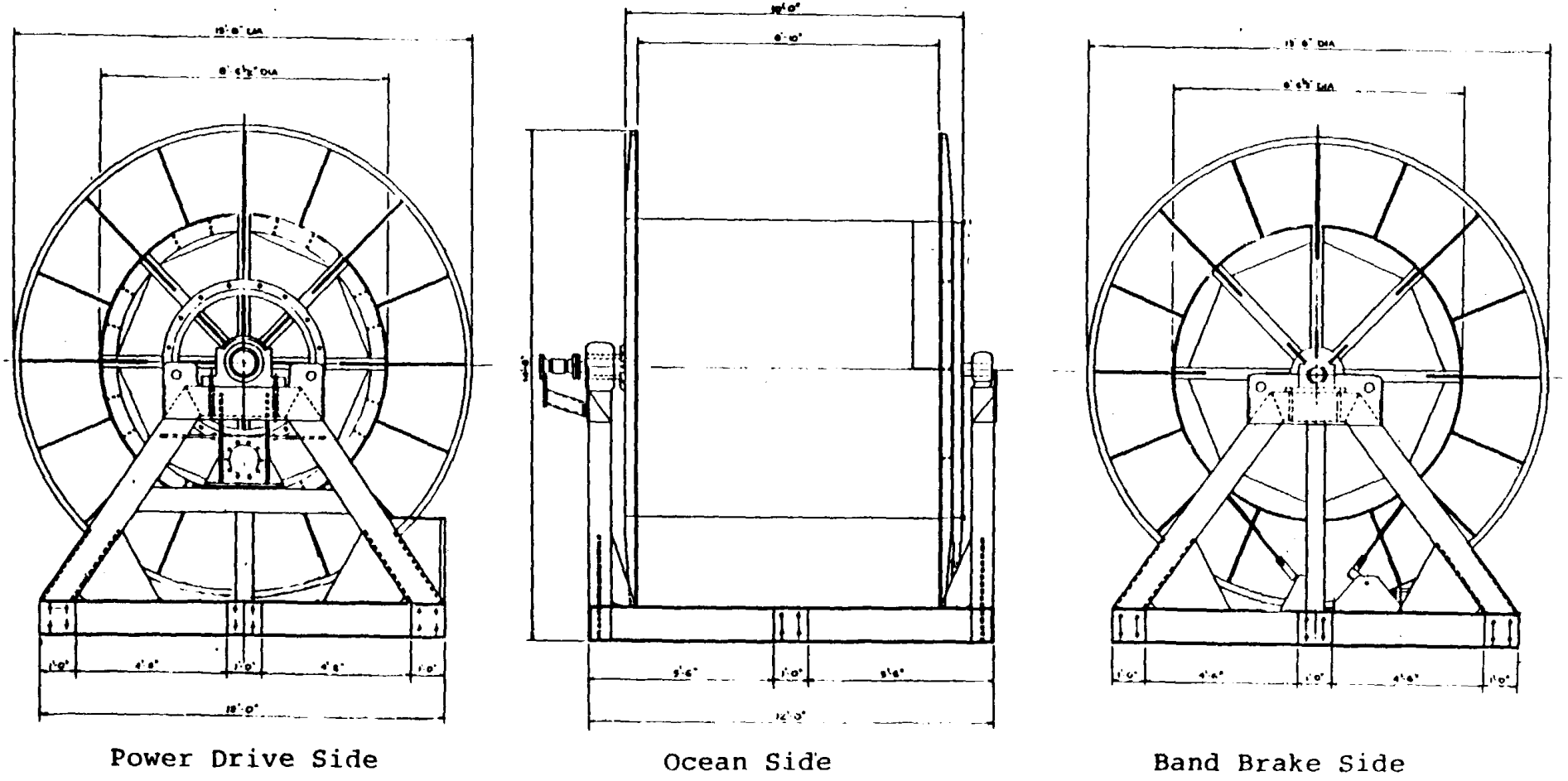


Figure 2-1. Drinking Water Discharge Winch

2.4 Winch System Specifications

The specifications of the Drinking Water Discharge Winch System delivered are as follows:

WINCH

Dimensions:	length	13' 8"
	width	12' 0"
	height	14' 8"
	base	12' x 12'
Drum:	flange	13' 8"
	hub	8' 61/2
	width	8' 10"
Capacity:	2500 feet of 6-inch O.D. flexible pipe (5 wraps on drum)	
Bearings:	sealed lubricated	
Finish:	sandblasting with zinc primer with two-coat (epoxy and urethane) overcoat Haze Gray color.	
Drive System:	Electric Motor; 30 H.P. TEFC, double ended with internal heater, 460 VAC, 3-phase 6n Hz Variable displacement pump gear pump disc brake reduction gear spur/pinion gear set	

WINCH (continued)

Controls:	Drum: Single lever Joystick, variable speed, spring centered to neutral position. Disc Brake: Manual control Band Brake: Manual control
Performance:	10,000 lbs pull 25 FPM mid layer 16,000 lbs hold disc brake @ mid layer 18,000 lbs hold band brake @ mid layer
Safety Factors: 1.5 on Pull requirement	1.5 on Brake requirement 3.0 on Structure (above at rated condition)
Handling:	Padeyes for 4-part lift Bolt-on Weld-down point
Other:	4-inch swivel connection hydraulic cooling system for operation in hot environment automatic system shut-down for - Low oil - Low oil temperature - High oil temperature - Motor overload elapse time clock

Other(continued)	disc brake over-ride to free rotate drum when system is in the OFF condition heaters in motor and function box
Levelwind	Rated at 2,000 lbs lateral load 8 feet per minute maximum Hydraulic power/reduction gear/ chain drive. Operating Mode: Manual

3.0 STRUCTURAL SYSTEM

The Drinking Water Discharge Winch System components, winch, levelwind, and hydraulic power package have been designed and constructed based on operating characteristics and space limitations.

3.1 Winch

The general winch configuration is presented in Figures 3-1, 3-2, and 3-3. Details of the drum are shown in Figure 3-4. Except for specialty components, e.g., shafts, gears, and bolts. The material used for the construction of the winch were:

ASTM A-36 steel:	Plates, angles, channels, and I-beams
ASTM A500-B steel:	Rectangular tubing

3.2 Levelwind

The Levelwind structural members are ASTM A-36 steel. The traveler head rollers or NYLATRON GSM, and the roller shafts are 316 stainless steel. Fastening hardware are all stainless steel.

3.3 Hydraulic Power Package

The foundation for the Hydraulic Power Package as shown in Figure 3-5, was fabricated from ASTM A-36 steel. The 2" x 2" square tubing was ASTM - A500-B steel.

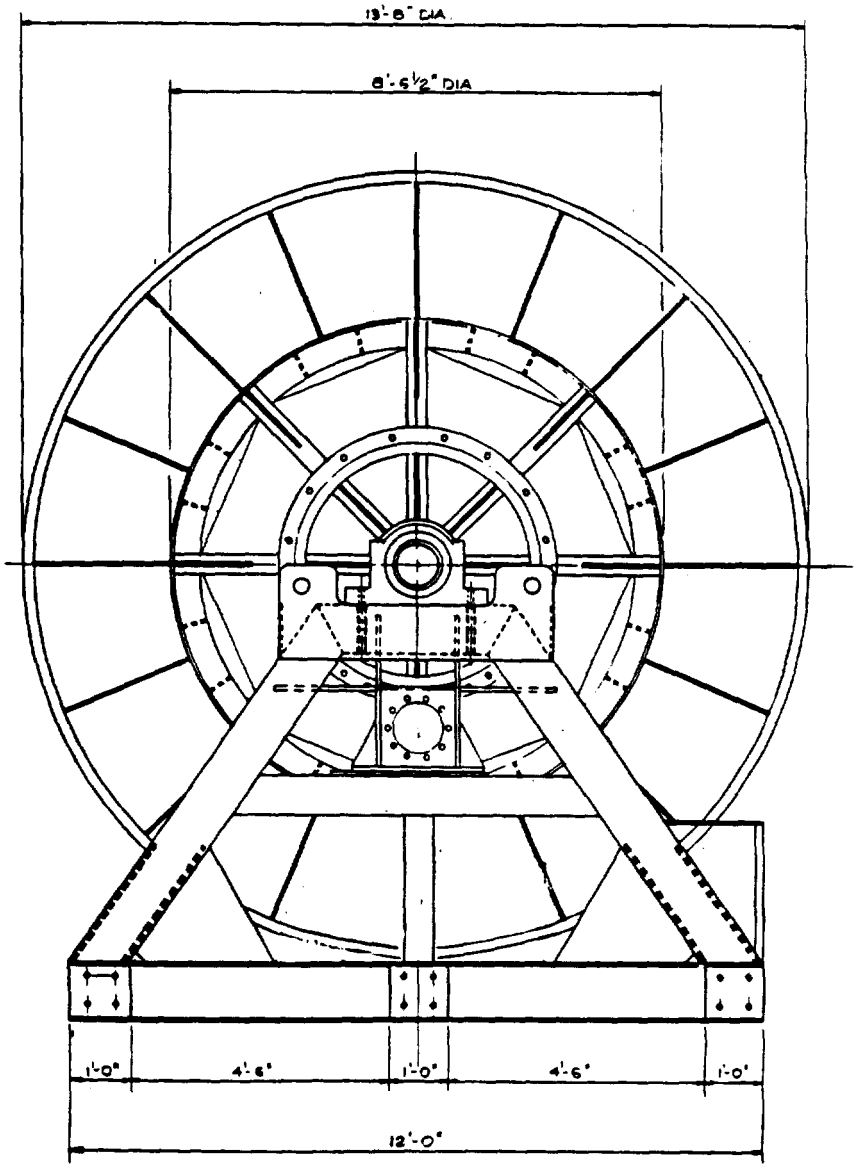


Figure 3-1. Drinking Water Discharge Winch Power Drive Side

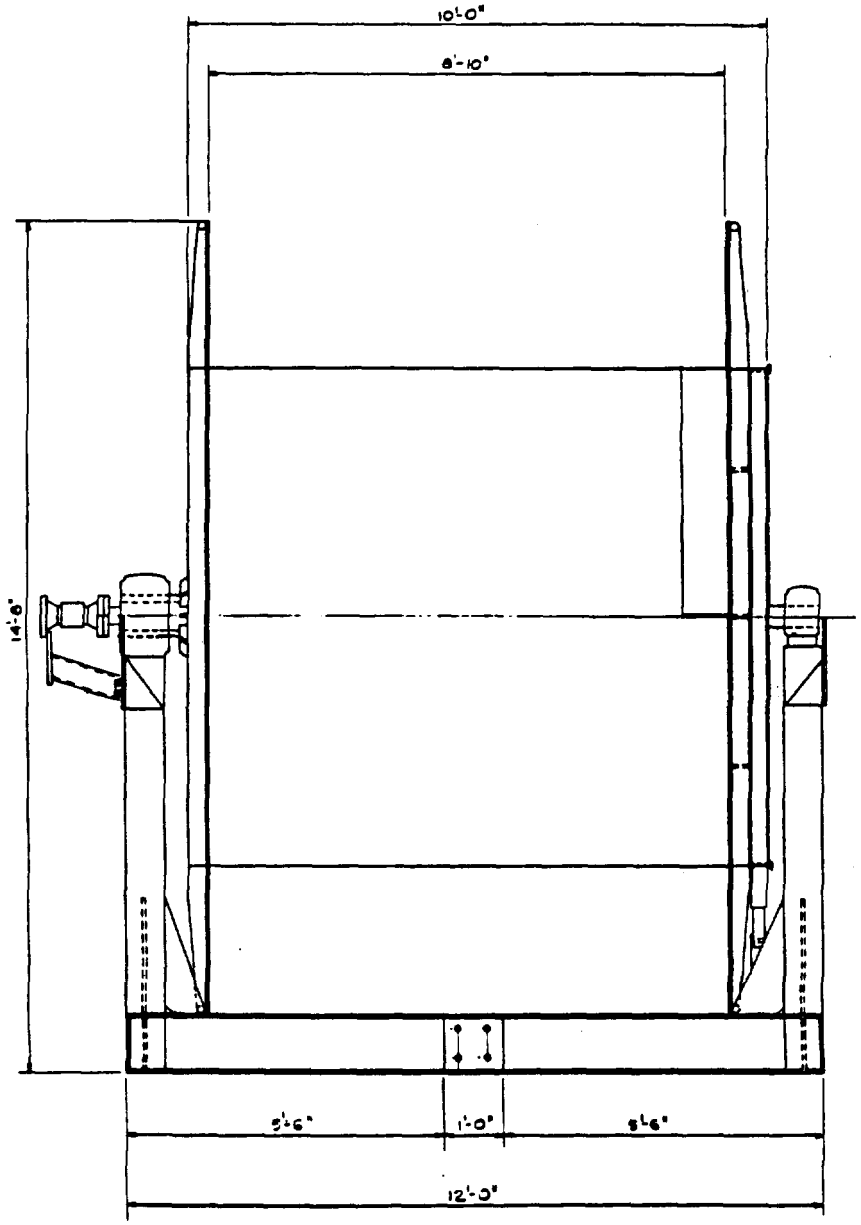


Figure 3-2. Drinking Water Discharge Winch Front (Ocean) Side

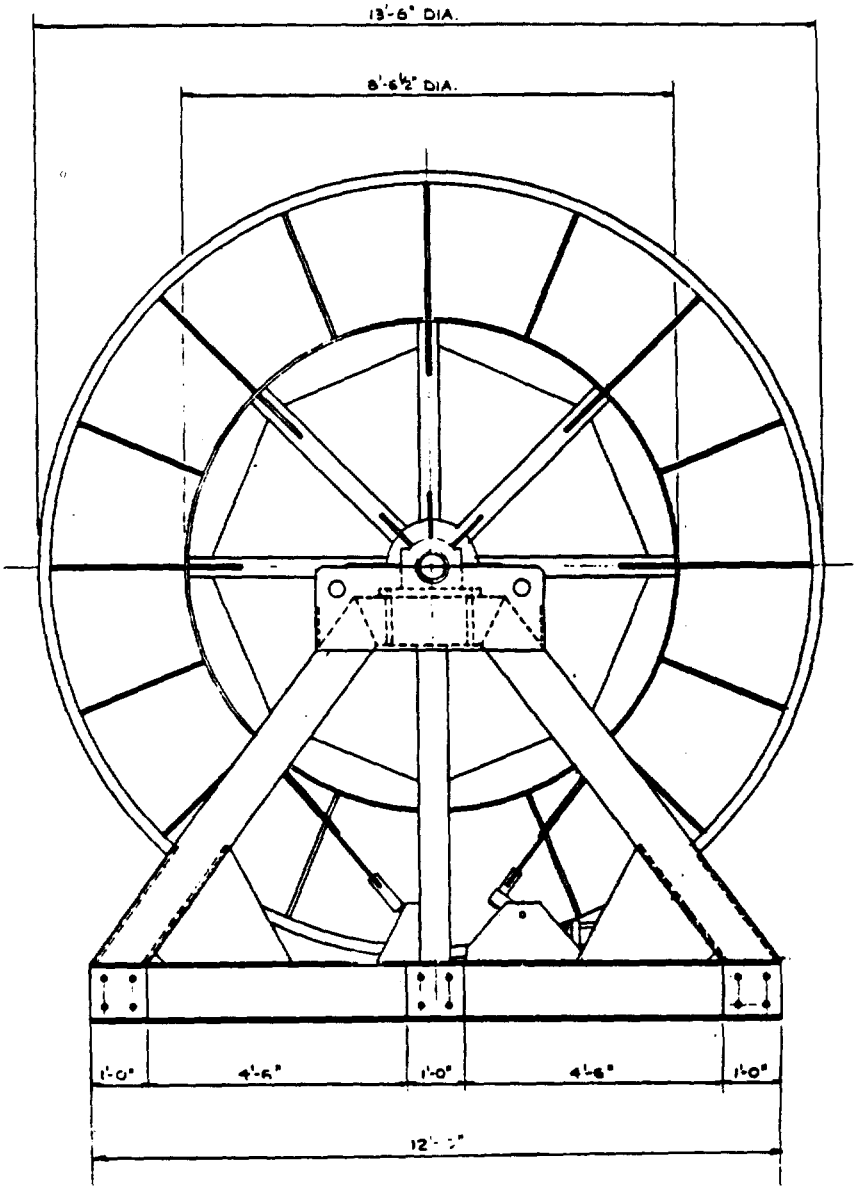


Figure 3-3. Drinking Water Discharge Winch Band Brake Side

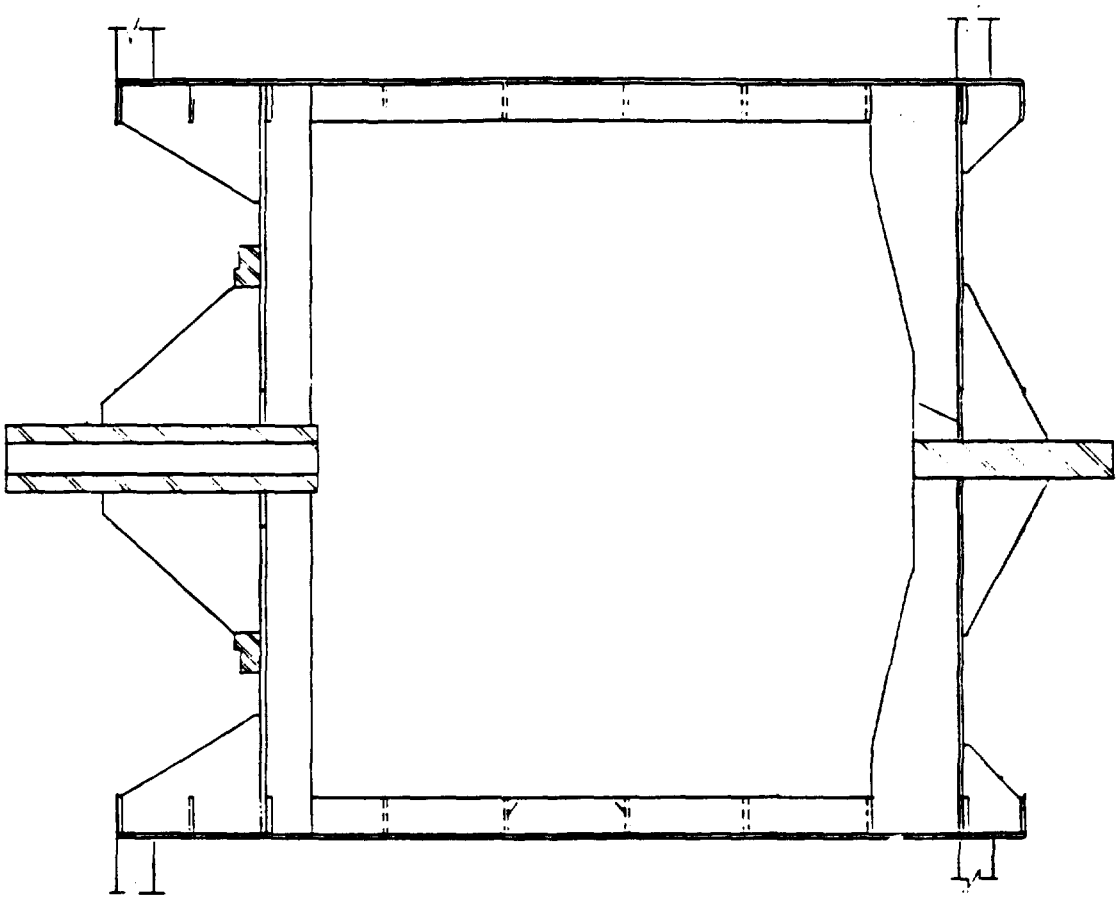


Figure 3-4. Winch Drum Configuration

* Orientation of hydraulic power connections have been changed from location 1 to location 2.

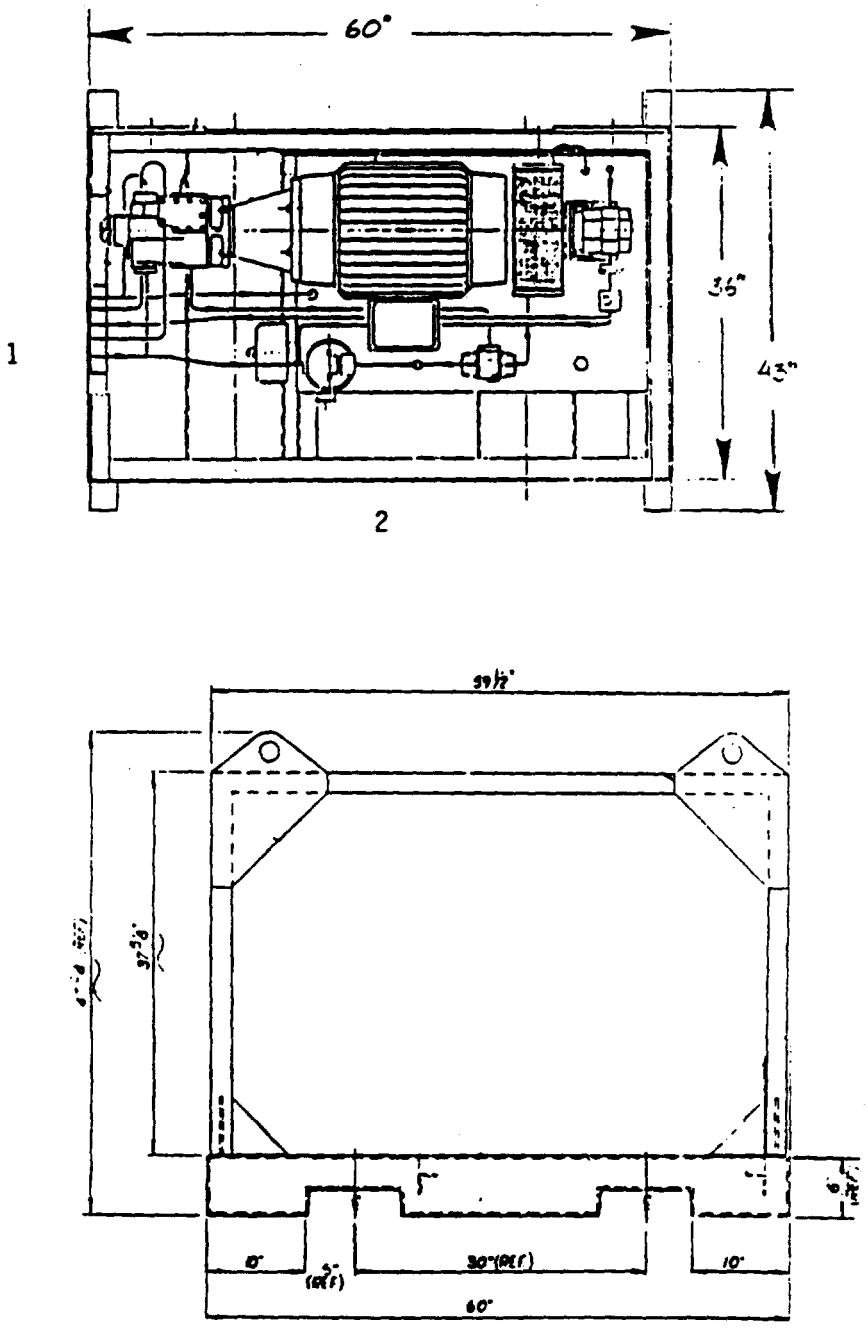


Figure 3-5. Hydraulic Power Package Structural Configuration

4.0 HYDRAULIC SYSTEM

The Drinking Water Discharge Winch and Levelwind are driven by a dual hydraulic power system. The winch is driven by a closed-loop circuit with a variable displacement piston pump, and the levelwind is driven by an open loop circuit with a fixed displacement gear pump.

Figure 4-1 shows the circuit schematic for the system. The hydraulic power package component arrangement is shown in Figures 4-2 and 4-3. The item numbers in this section refer to the numbers indicated on the schematic. Specific information pertaining to the hydraulic components is contained in the Appendices.

Certain elements of the hydraulic system are common to both circuits. The immersion oil heater in the reservoir (13) is used to bring the hydraulic fluid up to the proper operating temperature and viscosity in cold weather conditions. It is controlled by the rotary switch on the electrical enclosure, and by the automatic control system. A red indicator light is illuminated when the heater is in operation. The level/temperature switch (12) in the reservoir is used to shut down the system in the event of excessively high or low oil temperature or low oil level.

The heater contactor will automatically open if any one of four conditions exist:

- Low oil level (level switch open)
- High oil temperature (high temperature switch open above 180° F)
- Thermostat open (set for 100° F)
- Manual rotary switch turned off by operator.

The electric motor can be started and stopped by the operator using the push buttons on the electrical enclosure. The automatic control will open the motor contactor if any one of five conditions exist:

- Low oil level (level switch open)
- High oil temperature (high temperature switch open above 180° F)
- Low oil temperature (low temperature switch open below 45° F)
- Motor overload
- Stop button pushed by operator.

CAUTION

The automatic control system is designed to protect the equipment from damage. DO NOT ATTEMPT TO BYPASS OR DISABLE THESE CONTROLS.

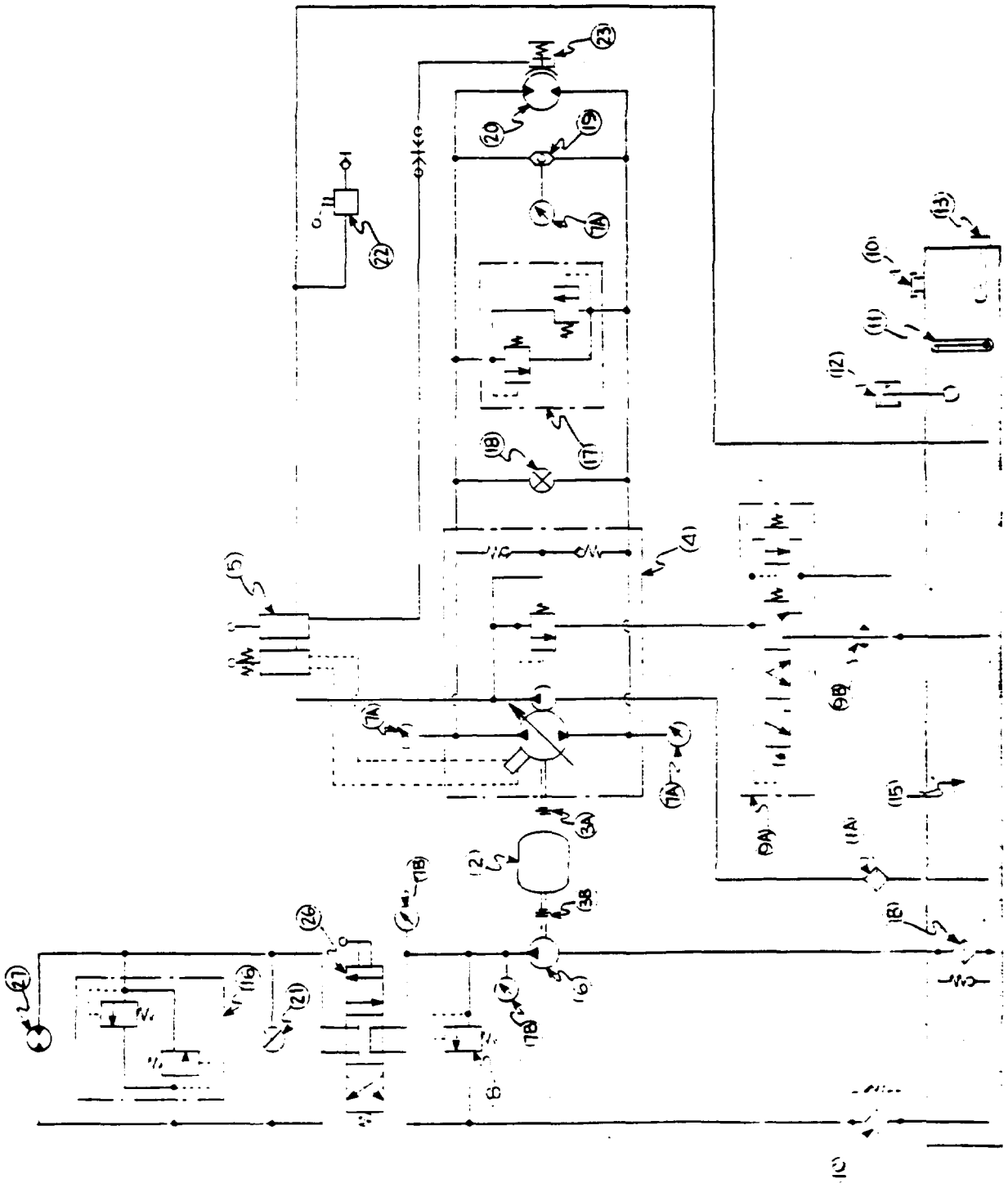


Figure 4-1. Drinking Water Discharge Winch Hydraulic Schematic

4.1 Winch Drive

The closed loop circuit for the winch drive employs a swashplate type, variable displacement piston pump (4A).

Hydraulic oil is drawn from the reservoir through the suction filter (1A) to the integral charge pump. The charge pump provides make-up oil to the circuit as required through the check valves to the low pressure side of the circuit. It also supplies a flow to the pressure regulating joystick (5), which operates the disc brake (23) and controls the stroke of the piston pump. The excess flow from the charge pump above that required for these two functions passes through the relief valve to the pump case for cooling and lubrication.

The pump case drain then runs through the thermal bypass valve (9A). At low oil temperatures this valve directs flow around the oil cooler (9B) and back to the reservoir. This allows for a quicker warm-up of the system. As the system warms, the bypass valve begins to open to pass some of the case drain flow through the cooler, and as the temperature rises further all of the flow is directed through the cooler for maximum cooling. The thermal bypass valve also incorporates a relief valve to protect the cooler from excessive pressure.

The joystick (5) is a pressure regulator which takes flow from the charge pump and sends pressure signals to the disc brake (23) and the stroke control (4B) on the piston pump. These signals are operator-controlled through the handle positions on the joystick. The exhaust flow from the joystick is returned to the reservoir.

The disc brake on the hydraulic motor (20) is of the spring-loaded, normally-on type. When the brake handle is shifted to the OFF position, pressure is applied to release the brake. When the brake handle is returned to the ON position, the pressure is released, and the brake is reapplied.

As the winch handle is shifted the pressure to the stroker is increased, shifting the swashplate angle in the pump and causing the displacement of the pump, and therefore the flow from the pump, to increase. The winch handle is spring-centered, so that when the handle is released the pump displacement and flow return automatically to zero.

The dual relief valve (17) protects the rotor (20) and winch structure from overloads. In the event of pressure in excess of the motor rating, the dual relief valve will open to allow flow from the high pressure to the low pressure side of the circuit, bypassing the motor. This feature is incorporated into the circuit to protect the structural and hydraulic winch components from damage due to line pulls and pressures beyond their rated capabilities.

Two pressure gauges (7A) on the hydraulic power unit indicate the piston pump pressure on the high and low pressure sides of the circuit, and another gauge (7B) indicates the charge pump pressure. A shuttle valve (19) on the winch selects the higher pressure side to be indicated by the gauge (7A) next to the joystick.

A ball valve (18) and hand pump (22) are included to allow manual rotation of the winch without power to the system. The hydraulic line from the joystick is removed from the brake (23) and the line from the hand pump to the brake is connected through the use of the quick-disconnect fittings. The pump can then be used to draw fluid from the reservoir and apply pressure for manual release of the brake. The ball valve can be opened to bypass the piston pump (4), and permit freewheeling of the hydraulic motor (20).

WARNING

CAUTION

FOR NORMAL POWERED OPERATION OF THE WINCH THE BALL VALVE (18) MUST REMAIN FULLY CLOSED, AND THE BRAKE LINE MUST REMAIN CONNECTED TO THE JOYSTICK (5). Extreme caution must be taken to prevent a runaway condition.

4.2 Levelwind Drive

The open loop circuit for the levelwind drive employs a fixed displacement gear pump. Hydraulic oil is drawn from the reservoir through the suction strainer (1B) to the gear pump (6). The pump pressure is monitored by the pressure gauges (7B) on the hydraulic unit and at the levelwind valve. Circuit protection is provided by the relief valve (8).

The flow from the pump is directed to the valve (26) for the levelwind. This is a pressure compensated, four way, three position, directional control valve. The tandem center of the valve blocks the A and B work ports to the levelwind motor (27) when the valve is in the neutral position. When the valve spool is shifted the flow is directed to the motor. The spool is spring centered to return to the neutral position when the handle is released. The exhaust flow from the levelwind circuit returns to the reservoir through the return filter (1C).

A dual relief valve (16) is provided to protect the levelwind motor and structure from overloads. Also, the ball valve (21) can be opened to allow freewheeling of the motor and movement of the levelwind head without hydraulic pressure.

* Orientation of hydraulic power connections have been changed from location 1 to location 2.

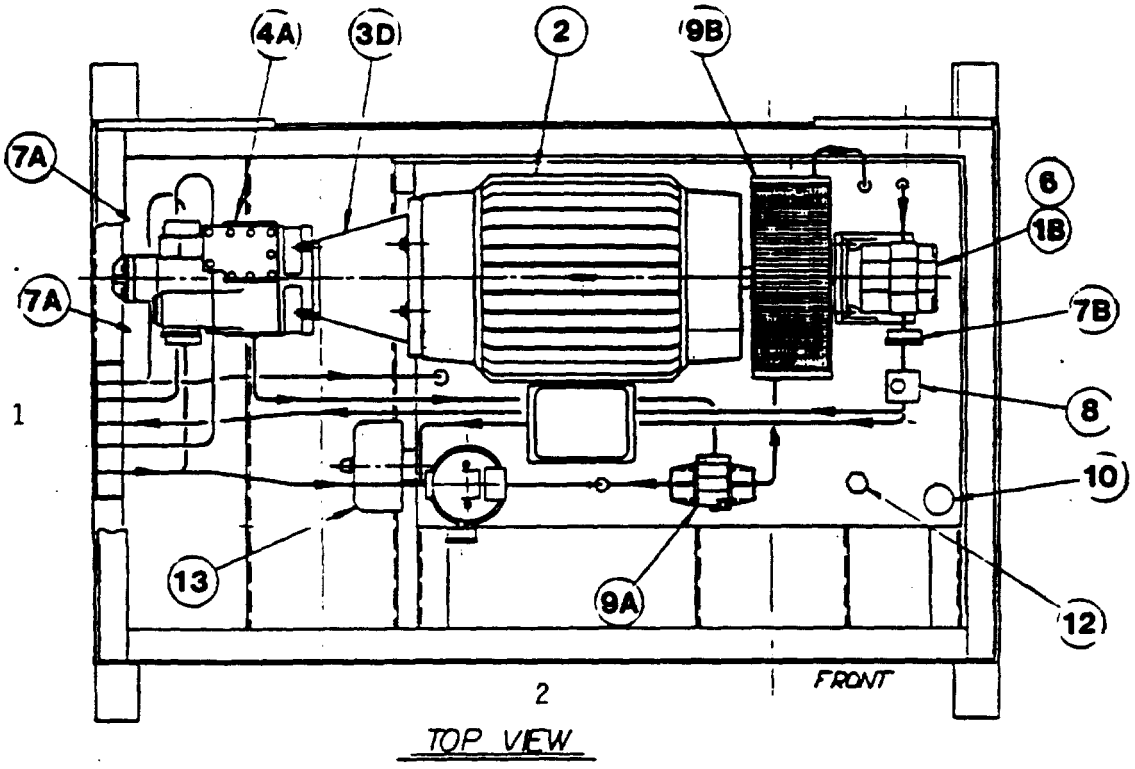


Figure 4-2. Hydraulic Power Package Component Arrangement

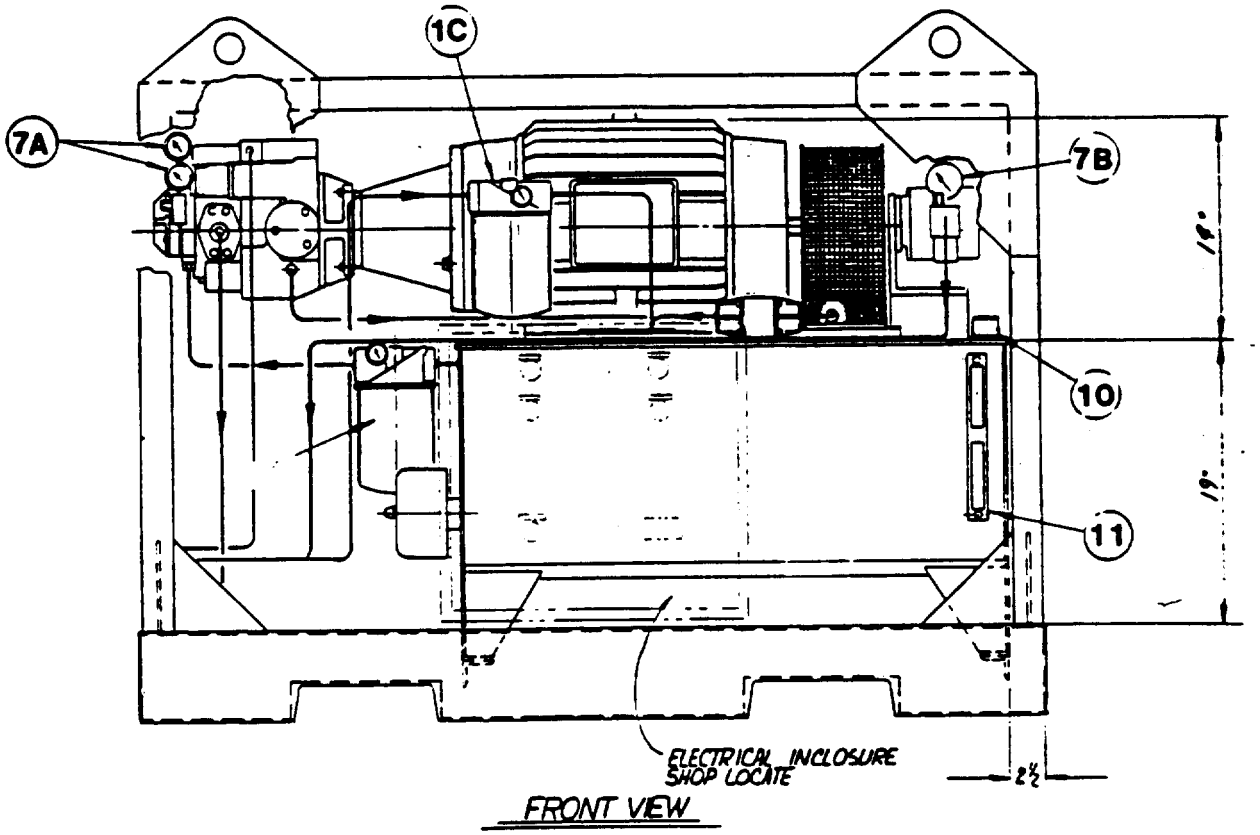


Figure 4-3. Hydraulic Power Package Component Arrangement

5.0 ELECTRICAL SYSTEM

5.1 460 VAC/3-Phase/60 Hz Operation

The NEMA-4X enclosure on the Hydraulic Power Package contains all electrical controls for the Drinking Water Discharge Winch System. The electrical schematic of the system is presented in Figure 5-1 on page 5-3 *. Input power, p 460 VAC/3-phase/60 Hz, is supplied to the contactors for the oil heater and electric motor, and two legs of the input power are tapped through a transformer to provide control power, 120 VAC, single phase. The outside configuration of the NEMA-4X enclosure is presented in Figure 5-2. The immersion oil heater (Item #13) in the reservoir is controlled by the rotary switch on the outside of the enclosure and the automatic control. A red indicator light is illuminated when the heater is in operation. The level/temperature switch (Item #12) in the reservoir is used to shut down the system in the event of excessively high or low oil temperature or low oil level (level sensor is located at the mid elevation of the reservoir). The heater contactor will automatically open if any one of the four conditions exist:

1) - Low oil level (level switch open)
2) - High oil temperature (high temperature switch open above 180° F)
3) - Thermostat open (set for 100° F)
4) - Manual rotary switch turned OFF by operator.

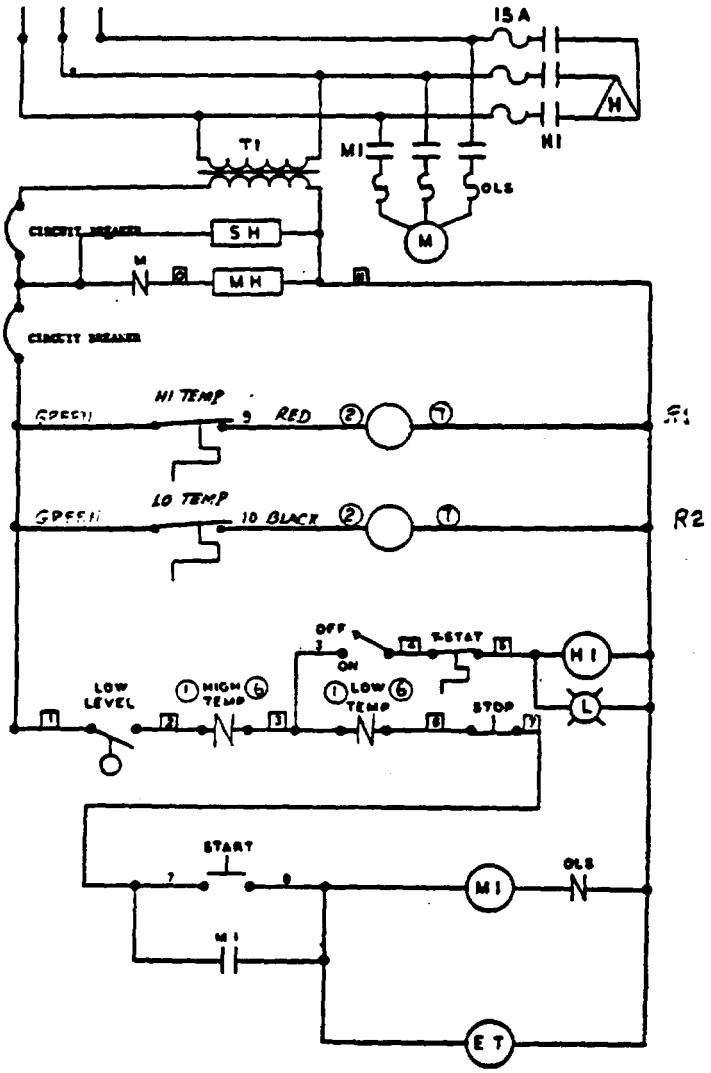
The electric motor can be started and stopped by the operator using the push buttons on the outside of the enclosure. The automatic control will open the motor contactor if any one of five conditions exist:

1) - Low oil level (level switch open)
2) - High oil temperature (high temperature switch open above 180° F)
3) - Low oil temperature (low temperature switch open below 45° F)
4) - Motor overload
5) - Stop button pushed by operator.

WARNING

When connected to input power, the NEMA-4X Enclosure contains exposed 460 VAC connectors. Disconnect power before opening the enclosure.

460 VAC 3 Phase



T1 - TRANSFORMER
SH - SPACE HEATER 120 VAC
MH - MOTOR HEATER 120 VAC
L - HEATER "ON" LIGHT
M - MOTOR 30 HP @ 460 VAC 3 PHASE
H - IMMERSION HEATER 460 VAC 3 PHASE
ET - ELAPSE TIME CLOCK
Hl - HEATER CONTACTOR
Ml - MOTOR STARTER
☐ - REMOTE TERMINAL NUMBERS

Figure 5-1. Winch System Electrical Schematic

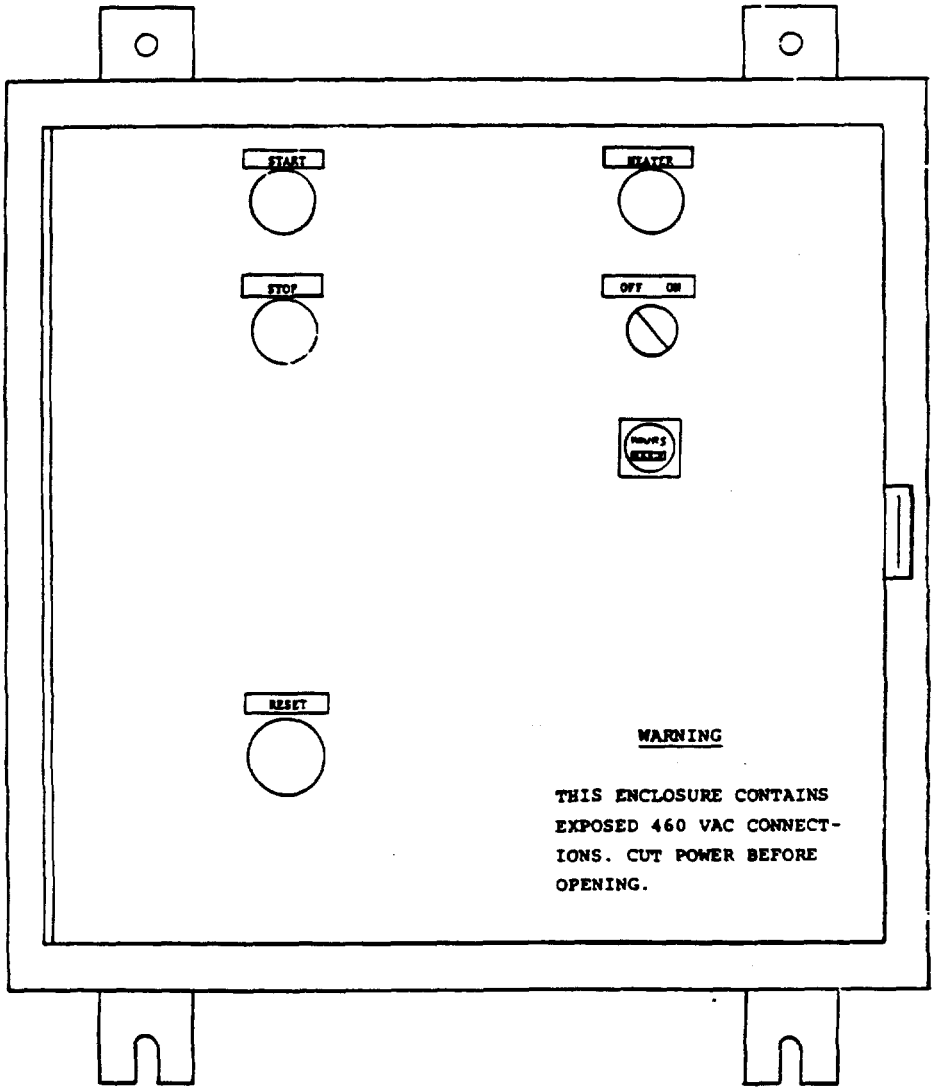


Figure 5-2. Winch System Electrical Enclosure External Configuration

6.0 SYSTEM INSTALLATION

This section describes the detailed methodology for installation of the Drinking Water Discharge Winch System components, namely; winch, levelwind, and hydraulic power package. The mechanical, electrical, and hydraulic installation procedures are discussed.

6.1 Mechanical Installation

6.1.1 Winch

As previously discussed in Section 2.0 System Description and Section 3.0, Structural System, the winch is mounted on a wide flange I-beam base with the basic configuration and dimensions as presented in Figure 6-1.

The base should be positioned on board the vessel so that there is a maximum surface contact between the base and the deck to maintain local load to a minimum. There are six (6) bolt-on weld-down brackets with thirty-two (32) sets of 3/4-10 UNC 2-1/2-inch long bolts with nuts and lock washers supplied with the winch system. The configuration of the brackets are shown in Figure 6-2. The suggested procedure for the winch installation is as follows:

1) Attach bolt-on weld-down brackets (6 pcs) to winch base with 3/4-10 UNC fasteners.

2) Position winch using proper handling techniques (see Section 8.1, Handling Techniques and Limitations)

3) Weld bolt-on weld-down brackets (6 pcs) to deck. Note that the bracket material is ASTM A-36 steel.

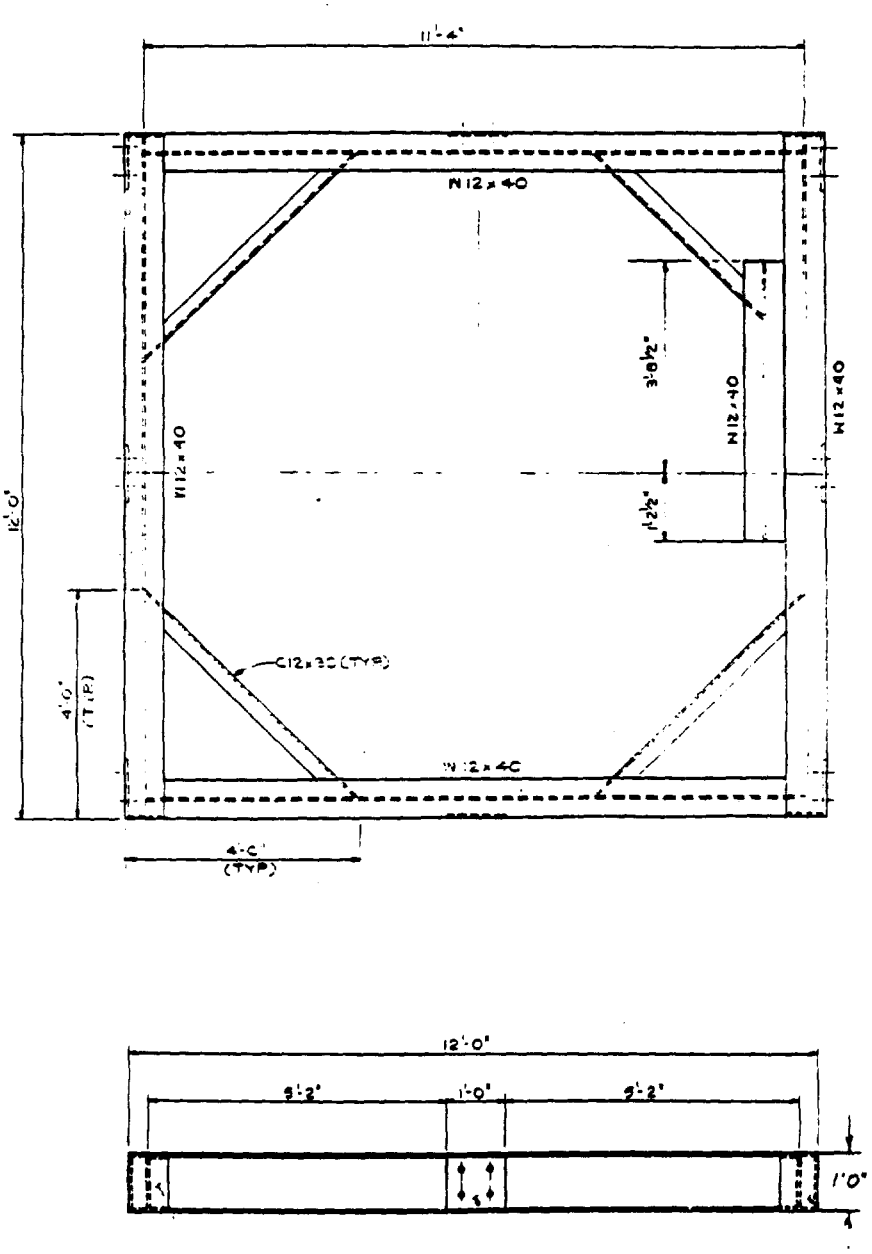
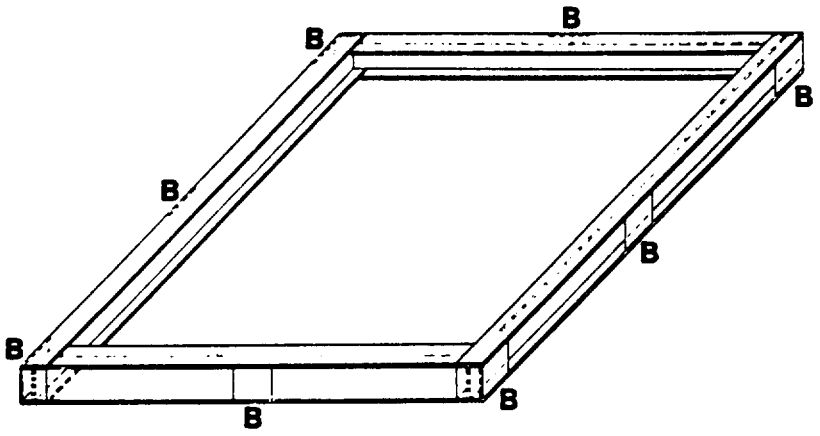
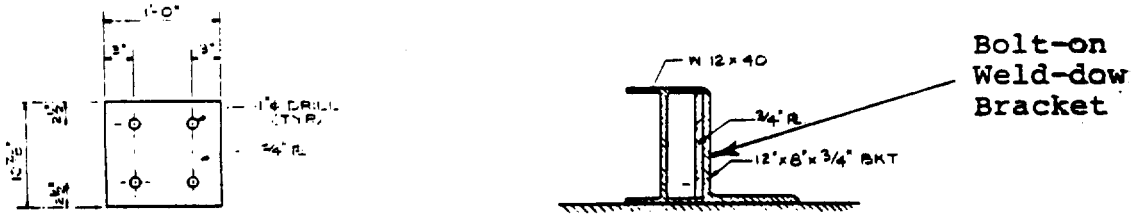


Figure 6-1. Winch Base Configuration and Dimensions



ISOMETRIC VIEW



"B" Indicates Location at brackets

Figure 6-2. BOLT-ON WELD-DOWN BRACKET CONFIGURATION

6.1.2 LEVELWIND

The levelwind is used to evenly wrap the hose onto the winch drum. Due to the traveler head (unit with 4 vertical and one horizontal rollers) motion limitations, it is extremely critical that the levelwind track base be accurately positioned relative to the winch base.

The plan and elevation views of the Levelwind are presented in Figure 6-3. The relative position of the Levelwind foundation to the winch foundation is presented in Figure 6-4. Note that the critical positioning dimensions are denoted with an "*", The suggested procedures for the Levelwind installation is as follows:

1) Attach bolt-on weld-down brackets (2 pcs.) to the Levelwind track with eight 3/4-10 UNC bolts 2-1/2-inch long with nut and lock washer.

2) Position levelwind track/Foundation relative to winch foundation as shown in Figure 6-4.

Note:

Extreme care should be taken when handling the Levelwind. Weight and CG are not evenly distributed.

3) Weld bolt-on weld-down brackets (2 pcs) to deck. Note that the bracket material is ASTM A-36 steel.

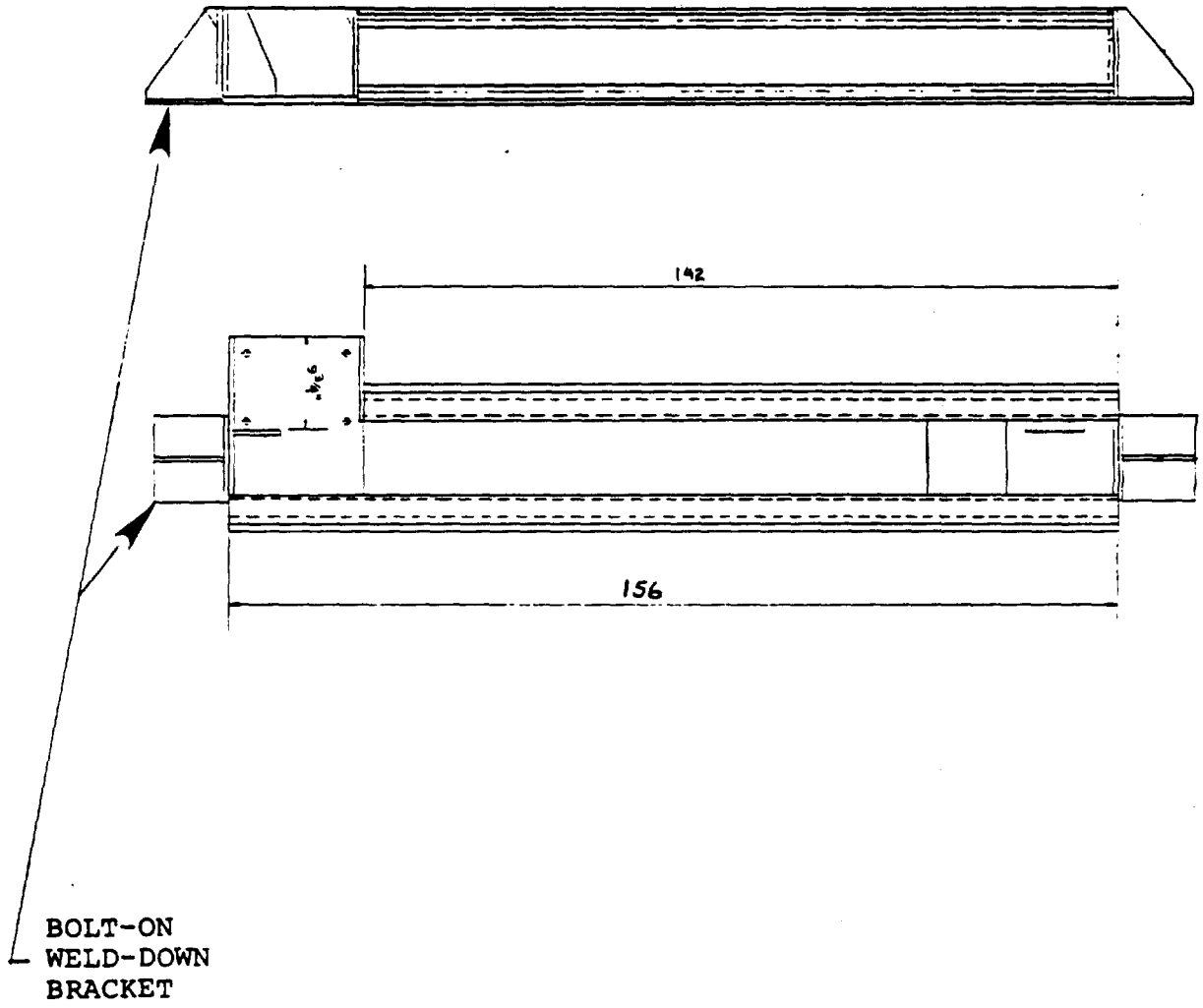
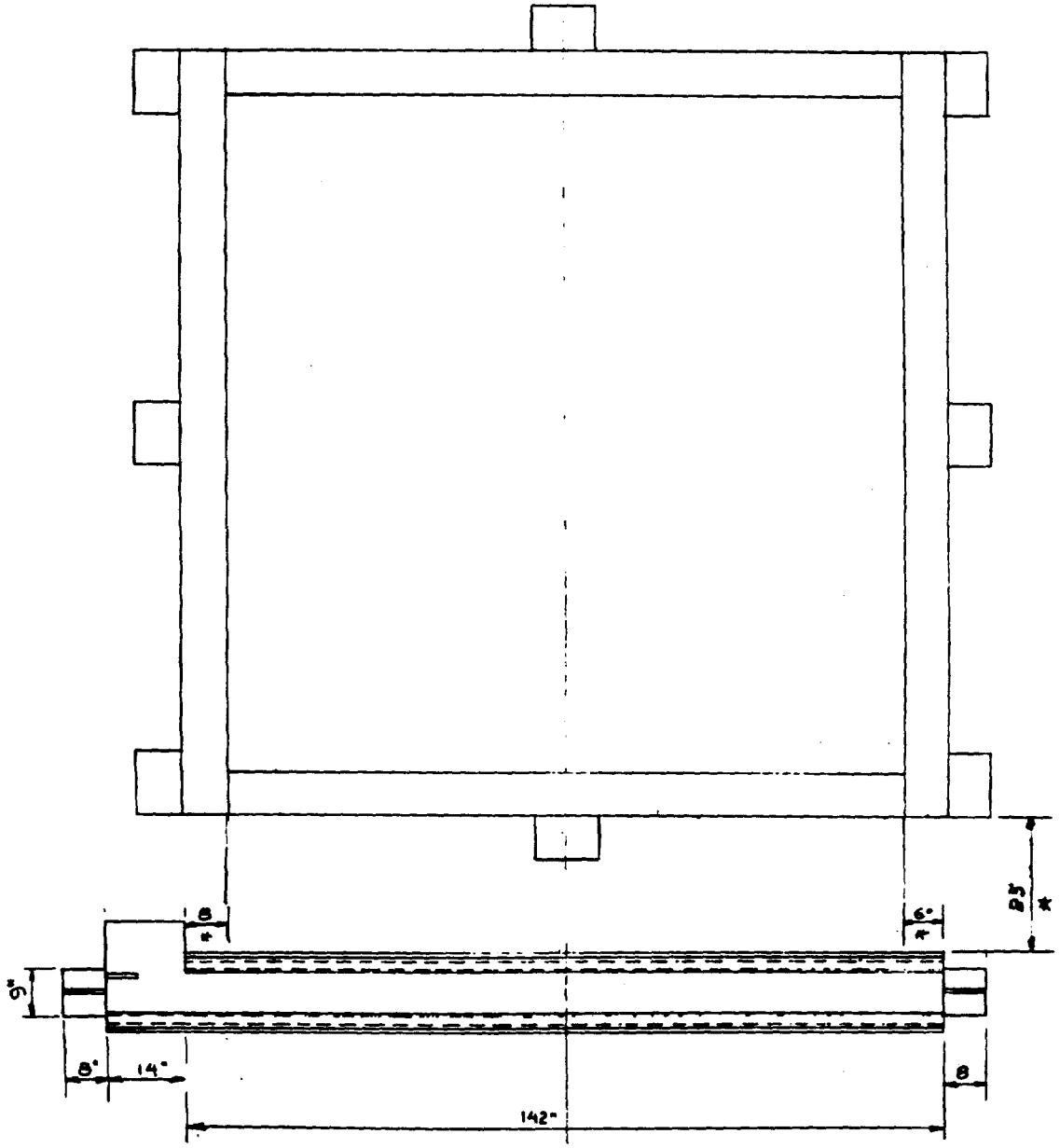


Figure 6-3. LEVELWIND TRACK

Plan and Elevation Views



*** Denotes critical positioning dimensions**

Figure 6-4. Relative Position Levelwind Track/Foundation to Winch Foundation

6.1.3 Water Hose Line

The water hose line end termination as depicted in Figure 6-5 must be rigidly attached to the winch hub. The winch hub incorporates a chute for the water hose line end termination to enter the inside of the hub and be clamped using the Bolt-Down clamp depicted in Figure 6-6.

The suggested procedure for attaching the termination to the inside of the winch hub is as follows:

1) Using appropriate overhead handling equipment, position the water hose line termination down the hub chute so that it is resting as shown in Figure 6-7.

Note:

a) Termination will have to be pulled from the <u>inside</u> of the hub.

b) Termination has a 9 inch maximum O. D. and chute maximum width is 9-1/2 inches. Extreme care must be taken because of the minimum clearance.

2) Rigidly attach termination to chute base with Bolt-Down Clamp as depicted in Figure 6-6. All necessary fastener hardware has been provided.

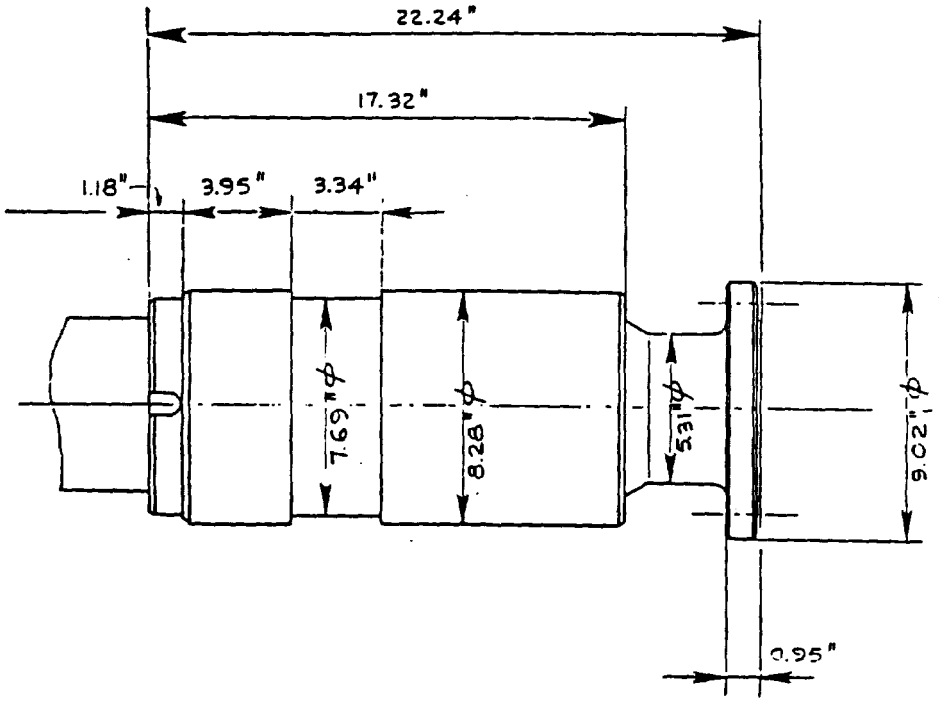


Figure 6-5. 6 Inch O. D. Water Hose Line

End Termination with 4" Flange ANSI B16.5
150 LBS RF

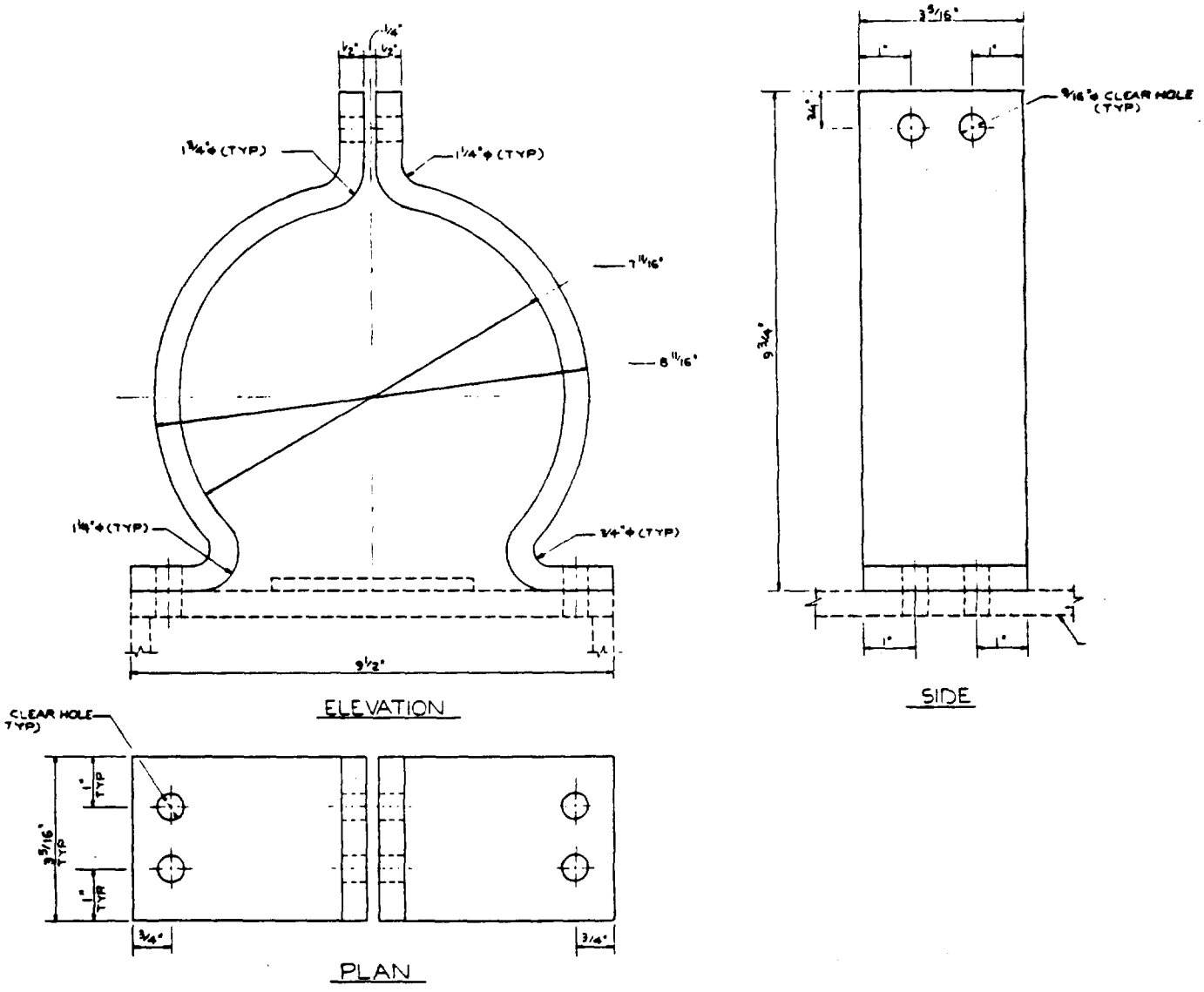


Figure 6-6. 6 Inch Water Hose Line End Termination

Bolt-Down Clamp

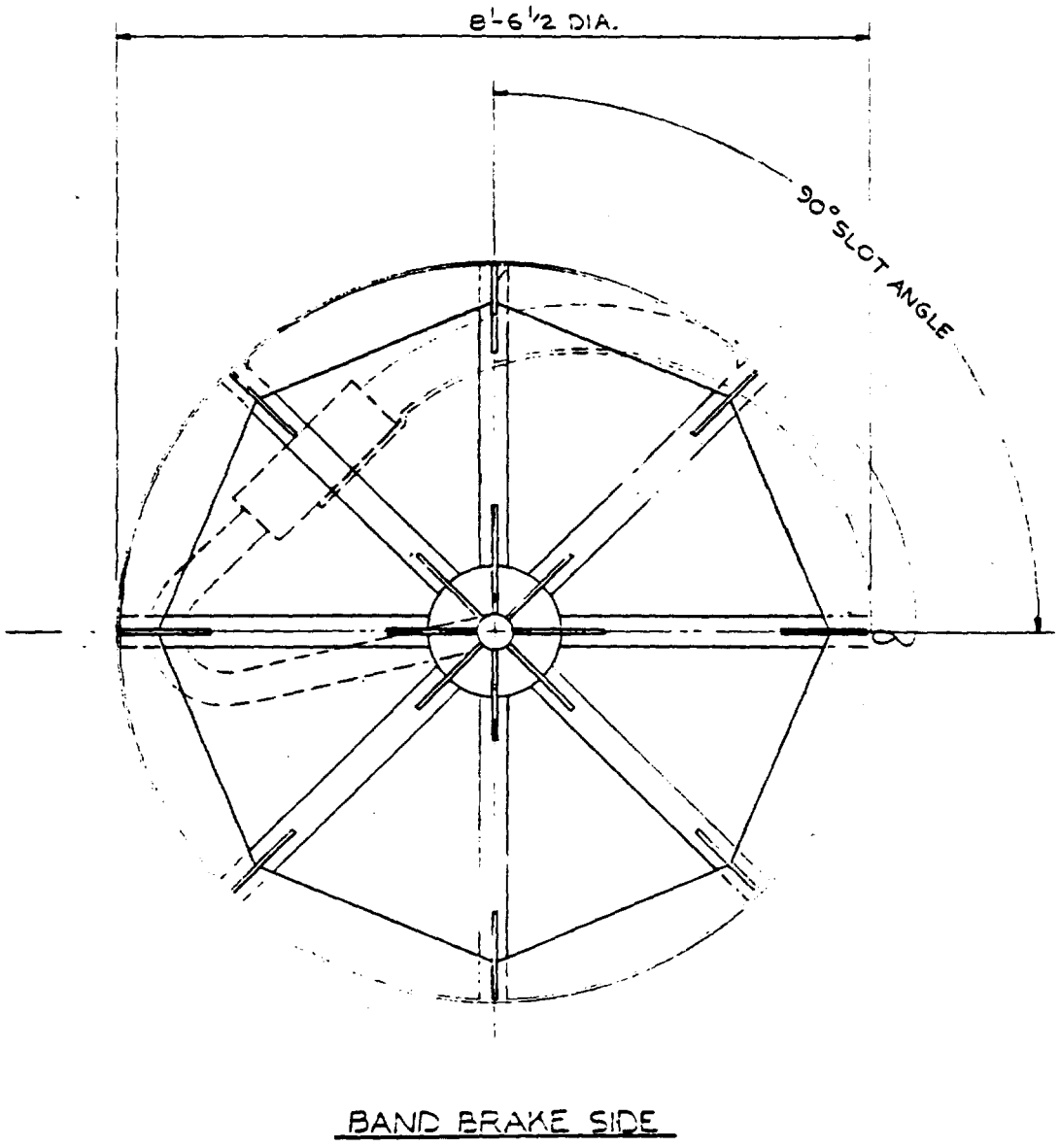


Figure 6-7. Orientation of Water Hose Line with Termination On and Inside Winch Hub

6.1.4 Hydraulic Power Package

The Hydraulic Power Package supplies power to the Winch and the Levelwind. The operator must supply the appropriate piping to interconnect the Hydraulic Power Package with the Winch and the levelwind.

A plan view of the Hydraulic Power Package is presented in Figure 6-8. The suggested procedure for Hydraulic Power Package installation is as follows:

1) Position Hydraulic Power Package relative to Winch as required using proper handling techniques (See Section 8.1, Handling Techniques and Limitations)

2) Weld the four corner brackets (3" X 3-1/2") to the vessel's deck.

CAUTION and WARNING

a) If the Hydraulic Power Package is full of hydraulic oil, extreme care must be taken when welding the brackets down.

b) Care must be taken not to damage any hoses and/or components when welding the brackets down.

* Orientation of hydraulic power connections have been changed from location 1 to location 2.

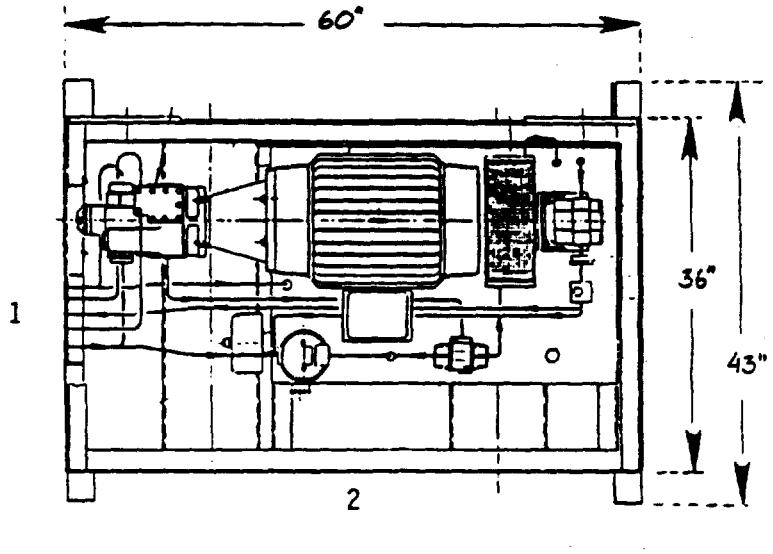


Figure 6-8. Hydraulic Power Package Plan View with Basic Dimensions

6.2 Electrical Installation

The operator must furnish 460 VAC, 3-phase, 60 Hz electric power to the enclosure on the Hydraulic Power Unit. The power supplied must be sufficient to power a 30 HP motor and a 4.5 KW heater. The proper wire size must be selected, taking into consideration the amperage carried and the length of run. See Figure 6-9 for penetration details.

The electrical enclosure does not include a master switch for the high voltage input. It is suggested that a master switch be installed within line-of-sight of the unit. Local electrical codes may require different electrical connections, and it should be verified that the system is in accord with these codes.

WARNING CAUTION

IT IS IMPERATIVE THAT THE PROPER ROTATION OF THE MOTOR AND PUMP BE ESTABLISHED AS INDICATED ON THE MOTOR HOUSING. Serious damage to the pump will occur if it is operated in reverse. The direction of rotation can be checked by "jogging" the motor on and off very quickly. If necessary, any two wires of the 3 phase input can be switched to reverse the direction of rotation.

THESE ELECTRICAL CONNECTIONS SHOULD BE MADE BY QUALIFIED AND KNOWLEDGEABLE PERSONNEL ONLY. After the connections are made close and secure the enclosure. Do not reenter the enclosure until it is positively determined that the power has been disconnected.

Crouse-Hinds

Hubs

Krydon® material hubs for conduit entrances, in sizes 1/2" through 3" are available for factory or field installation in all enclosures made of *Krydon* material. For factory installation, send drawing showing sizes and locations of hubs. Furnished with locknuts and gaskets to assure weathertightness

Standard Materials:▲

- Up to 1 1/2"—*Krydon* material with steel interiors
- 2", 2 1/2", and 3"—*Krydon* material with *Feraloy*® interiors

Standard Finishes:

- Fiber glass reinforced polyester—natural
- Steel—zinc and bleached chromate
- *Feraloy*—zinc electroplate

Conduit Size	Hub Cat. #
1/2	NHUB1
3/4	NHUB2
1	NHUB3
1 1/4	NHUB4
1 1/2	NHUB5
2	NHUB6
2 1/2	NHUB7
3	NHUB8

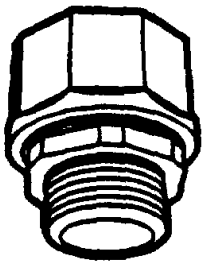


Figure 6-9. Electrical Enclosure Penetration Hub

CROUSE-HINDS #NHUB4 (1 1/4 inch conduit).

6.3 HYDRAULIC INSTALLATION

The only task required to complete the hydraulic installation of the Winch System Components is to connect the hydraulic bulkhead connections on the Hydraulic Power Package with the six connections on the winch and the two connections on the levelwind. The operator only has to match the letters (A thru H) on the bulkhead connections.

WARNING

The following bulkhead connections MUST be piped with material rated for 3,500 psi operations:
A-Winch Motor Port "A"
B-Winch Motor Port "B"
All other connections are rated for 300 psi operation.

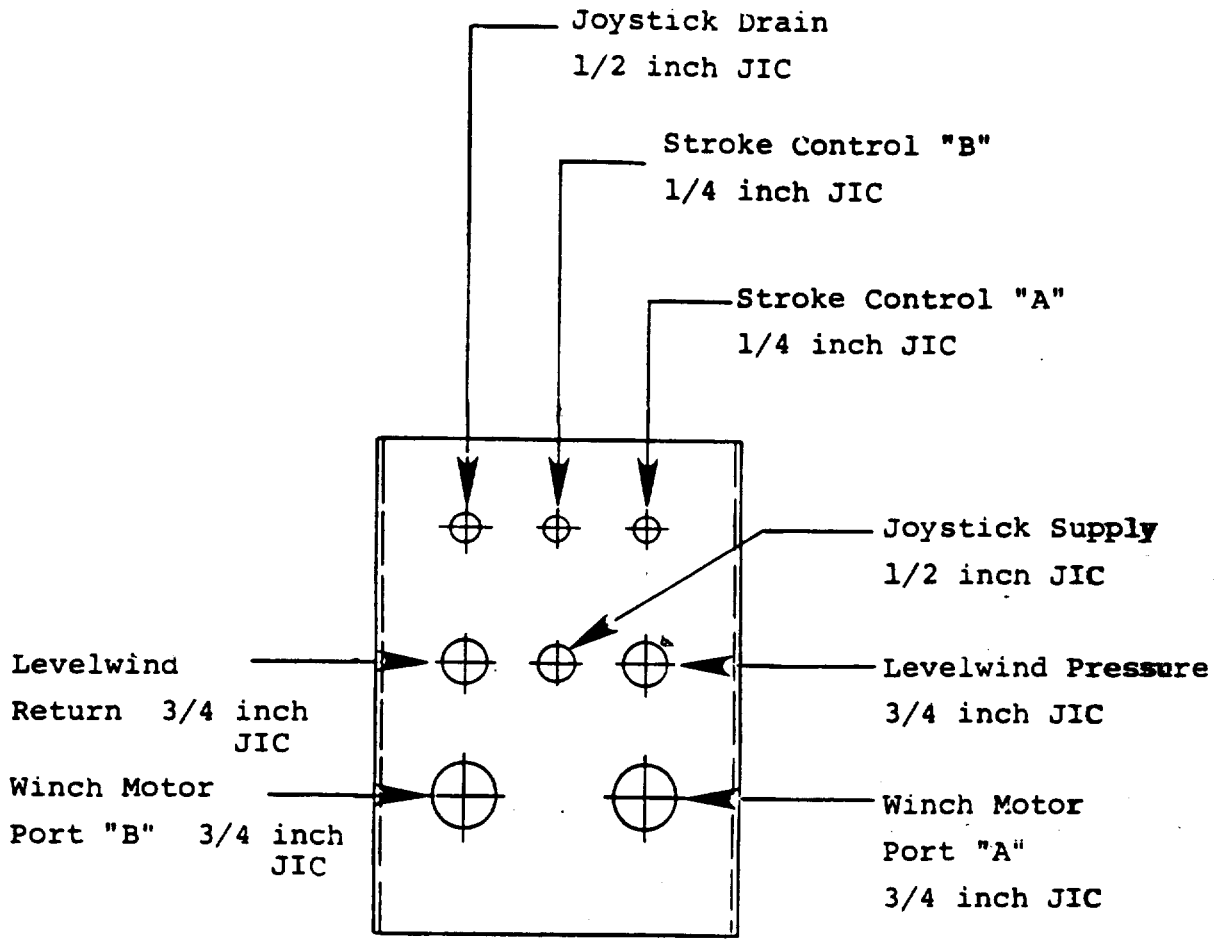


Figure 6-10. Hydraulic Connections Orientation

7.0 SYSTEM OPERATION

The Drinking Water Discharge Winch System can be operated by competent individuals by following the established procedures.

7.1 Start-Up

The following is the start-up procedure for the winch system operation:

(1) Check that the hydraulic hoses are properly connected to the hydraulic power package and to the winch and levelwind, and that the electrical connections are in order. Check the sight gauge on the reservoir to see that it is filled with oil.

(2) Place the valve handles in the neutral position (disc-brake ON, and winch joystick and levelwind control in neutral).

(3) Push the green START button on the electrical enclosure to start the electric motor and pumps. If the motor does not start, one of four conditions may be present:

- Low oil level. Check the sight gauge and fill the reservoir if necessary.
- High oil temperature (above 180°F). Allow the oil to cool down below 180°F.
- Low oil temperature (below 45°F). Turn on the oil heater with the switch on the enclosure. The red indicator will light when the heater is on. Note: The thermostat on the heater should be set for 100°F.

- Motor overload. Check that the control valve handles are in the neutral position.

CAUTION

The automatic control system is designed to protect the equipment from damage. DO NOT ATTEMPT TO BYPASS OR DISABLE THESE CONTROLS.

(4) Check the pump rotation. See the warning in Section 6.2.

(5) Check the charge pump pressure on the hydraulic power package. A minimum pressure of 250 psi is required for proper stroke control and make-up flow for the winch circuit.

(6) If this is the initial start-up, or if the system has not been operated for a period of several days, allow the pumps to run with the valves in the neutral position for approximately five minutes. This will allow the oil to circulate at low pressure and remove entrapped air, etc.

(7) Check the bias setting for the piston pump stroke control. With the joystick in the neutral position, compare the readings of the two gauges on the hydraulic power package indicating the pressures in the two sides of the winch circuit. If the two readings differ, the bias can be zeroed by adjusting the socket-head screw on the end of the stroke control on the piston pump; this will assure that the pump is fully destroyed when the joystick is in the neutral position.

(8) Check for oil leaks and tighten fittings as necessary.

7.2 Operation

7.2.1 Winch Operation

The operation of the winch is controlled by the two joystick handles mounted on the winch frame. To release the disc brake, pull the brake (left) handle to the OFF position. Pressure will be applied to release the brake for rotation. As the brake handle is returned to the ON position, the pressure is released from the disc brake, and the hydraulic motor and winch drum are locked in position.

The winch (right) handle regulates the pilot pressure signal transmitted to the stroke control on the piston pump. This in turn controls the stroke (displacement) of the pump to regulate the direction and rate of flow to the hydraulic motor on the winch. The winch handle is simply pulled toward the operator for winch rotation in the pull-in direction, and is pushed away from the operator for payout rotation.

The winch drive hydraulic circuit is set for a maximum pressure of 3,200 psi. The relief valves are included in the circuit for the protection of the hydraulic components and the overall winch system. THESE RELIEF SETTINGS MUST NOT BE INCREASED ABOVE 3,200 PSI. The relief settings can be checked by the following procedure:

(1) Place the brake handle in the ON position. This will lock the disc brake (23) and prevent winch drum rotation.

(2) Close the ball valve (18).

(3) Shift the winch handle in the payout direction. This will direct the pump flow to the hydraulic motor. Since the ball valve is closed and motor rotation is prevented by the disc brake, the system will be deadheaded.

(4) Observe the system pressure reading. If necessary, adjust the dual relief valve (17) until the pressure is 3,200 psi. This will be the relief setting to protect the hydraulic motor and winch circuit in the payout direction.

(5) Shift the winch handle in the pull-in direction. If necessary, adjust the other side of the dual relief valve until the pressure is 3,200 psi. This will be the relief setting in the pull-in direction.

(6) Return the winch handle to the neutral position.

WARNING CAUTION

FOR NORMAL POWERED OPERATION OF THE WINCH THE BALL VALVE (18) MUST REMAIN FULLY CLOSED, AND THE BRAKE LINE MUST REMAIN CONNECTED TO THE JOYSTICK (5). Extreme caution must by taken to prevent a runaway condition.

7.2.2 Levelwind Operation

For hydraulic operation of the levelwind, a control valve (26) is mounted to the side of the levelwind frame.

The ball valve (21) can be opened to bypass the control valve, and thus allow freewheeling of the levelwind motor. For normal hydraulic operation, the ball must remain closed.

A dual relief valve (16) is provided to protect the levelwind motor and structure from overloads.

WARNING CAUTION

The levelwind hydraulic circuit is set for a minimum pressure of 300 psi. THE RELIEF SETTINGS MUST NOT BE INCREASED ABOVE 300 PSI.

7.2.3 Band Brake Operation

For actuation of the band brake, the valve on the hand pump (31-E) must be positioned for retraction of the band brake cylinder (31-D). Pump up the pressure to retract the piston into the cylinder and tighten the band on the drum. Continued pressure must be applied until the drum has stopped. Observe the pressure gauge (7A), and ensure that the pressure does not exceed 4,000 psi. Move the hand pump valve to the neutral position to lock the cylinder in position.

If a *runaway" drum condition exists, and the band brake begins to smoke, either fresh water or salt water must be sprayed on the band brake to the cool the area. The band brake material, type RBW woven lining at a friction coefficient of 0.4, has the following ratings:

- 7,500 ft/min maximum speed

- 750° F maximum temperature

- 300 psi maximum pressure.

When releasing the band brake, position the valve for extension of the cylinder. Pump the cylinder out until there is a slight clearance between the brake material and the drum. This clearance can be visually observed from the hand pump area.

7.2.4. Disc Brake Manual Release

It may be required to rotate the winch drum when the hydraulic system is shut down and/or no power is available. Provisions have been incorporated into the system to accomplish this task. The following procedure must be used:

(1) Open the ball valve (18) to bypass the piston pump (4A). This will permit freewheeling of the hydraulic motor (20).

(2) At the disc brake, remove the hydraulic line from the joystick (5), and connect the line from the hand pump (22) using the quick-disconnect fittings supplied.

(3) Activate the hand pump with the lever to draw fluid from the reservoir to apply pressure for manual release of the disc brake.

(4) The band brake may be used to control winch drum rotation.

(5) Release the pressure from the brake line with the screw on the hand pump. This will reapply the disc brake.

(6) Close the ball valve.

(7) Connect the brake line from the joystick.

WARNING CAUTION

FOR NORMAL POWERED OPERATION OF THE WINCH, THE BALL VALVE (18) MUST REMAIN FULLY CLOSED, AND BRAKE LINE MUST REMAIN CONNECTED TO THE JOYSTICK (5). Extreme caution must be taken to prevent a runaway condition.

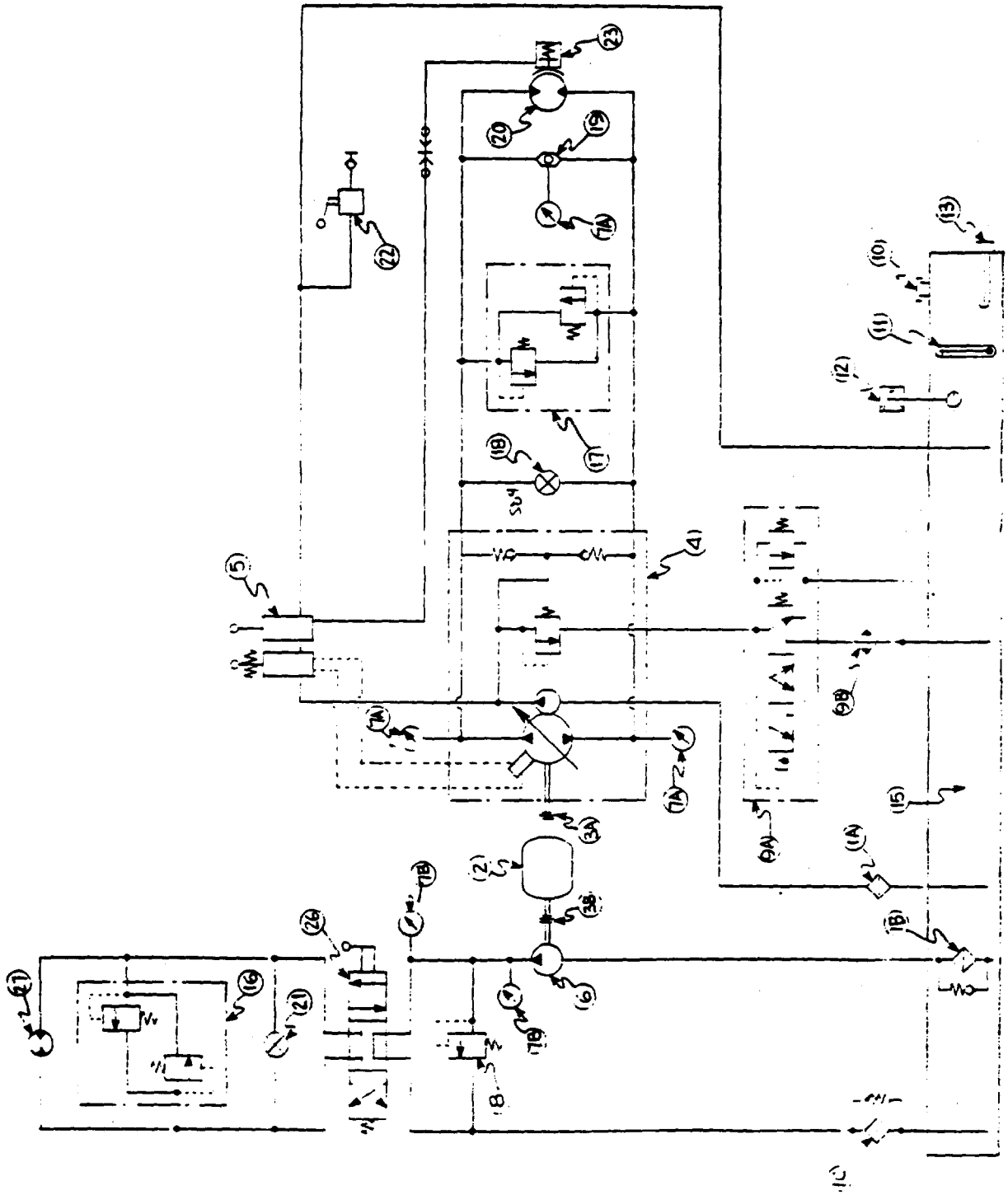


Figure 7-1. Winch System Hydraulics Schematic

8.0. SYSTEM MAINTENANCE

8.1. Handling Techniques and Limitations

Considering the size, weight, and configuration of the Drinking Water Discharge Winch System, there are suggested Methods of handling the individual components. The size and weight estimates are presented in Section 8.2, Shipping Recommendations.

8.1.1. Winch

The winch can only be handled from the two lifting plates on each side of the structure. Details of the lifting plates are presented in Figure 8-1 and 8-2. Note that the plates are not identical in hole spacing.

There are three possible methods to handle the winch. When mobilizing in a shipyard with large crane capability, a four legged sling with sling lengths of 33 feet is recommended. The slings could be reduced to 24 feet long. Shorter sling lengths are not recommended because they would induce high loads to the side of the drum flange. This configuration is presented in Figure 8-3.

To reduce overhead clearance requirements, a spreader bar can be used. Figure 8-4 depicts a one-dimensional spreader bar, and Figure 8-5 depicts a two-dimensional spreader bar.

CAUTION and WARNING

Rigging of the winch should only be undertaken by qualified personnel.

8.1.2. Levelwind

The levelwind is small and light weight. It can be handled by overhead sling or fork-lifts. Note that weight distribution is not even on this component.

8.1.3. Hydraulic Power Package

The Hydraulic Power Package can be handled either from overhead using a four-legged sling or with a fork lift. Basic dimensions of this unit for either modes of lifting are presented in Figure 8-6.

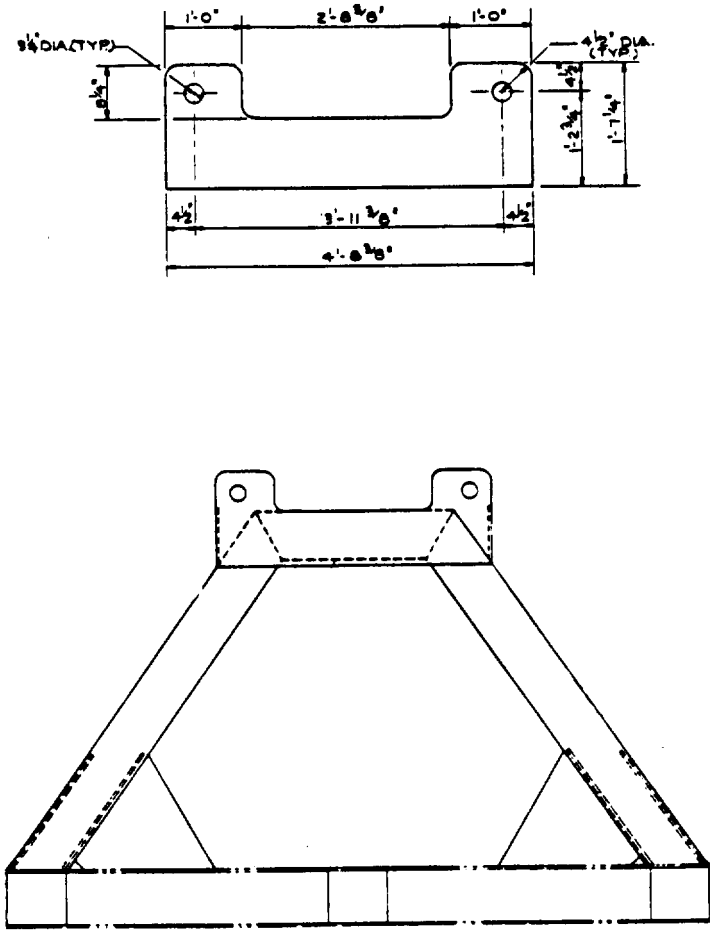


Figure 8-1. Lifting Plate Details, Power Drive Side

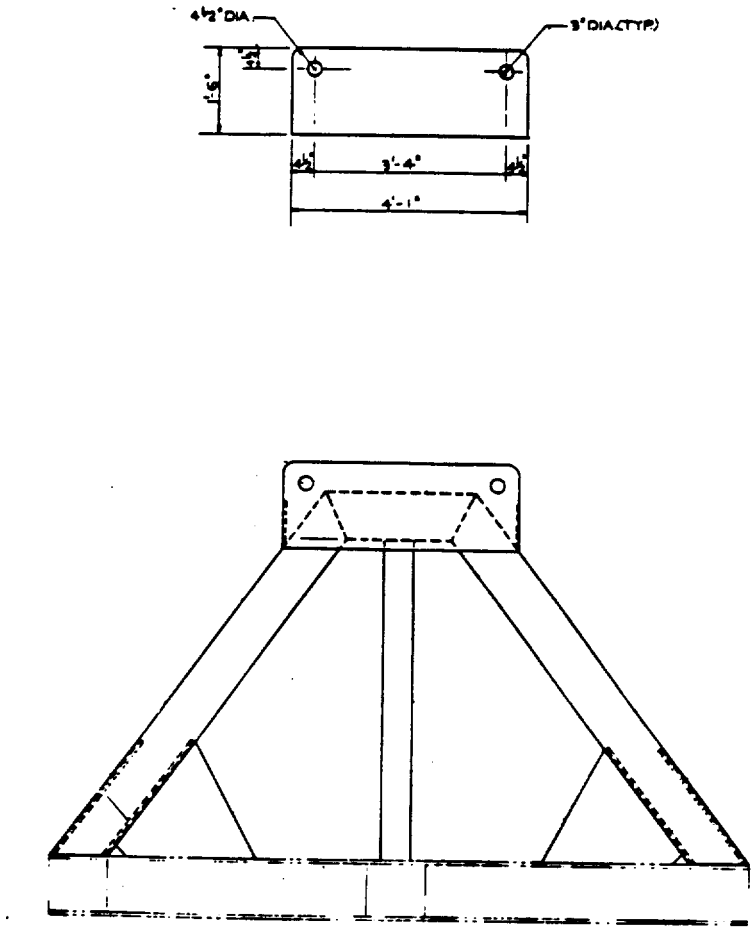
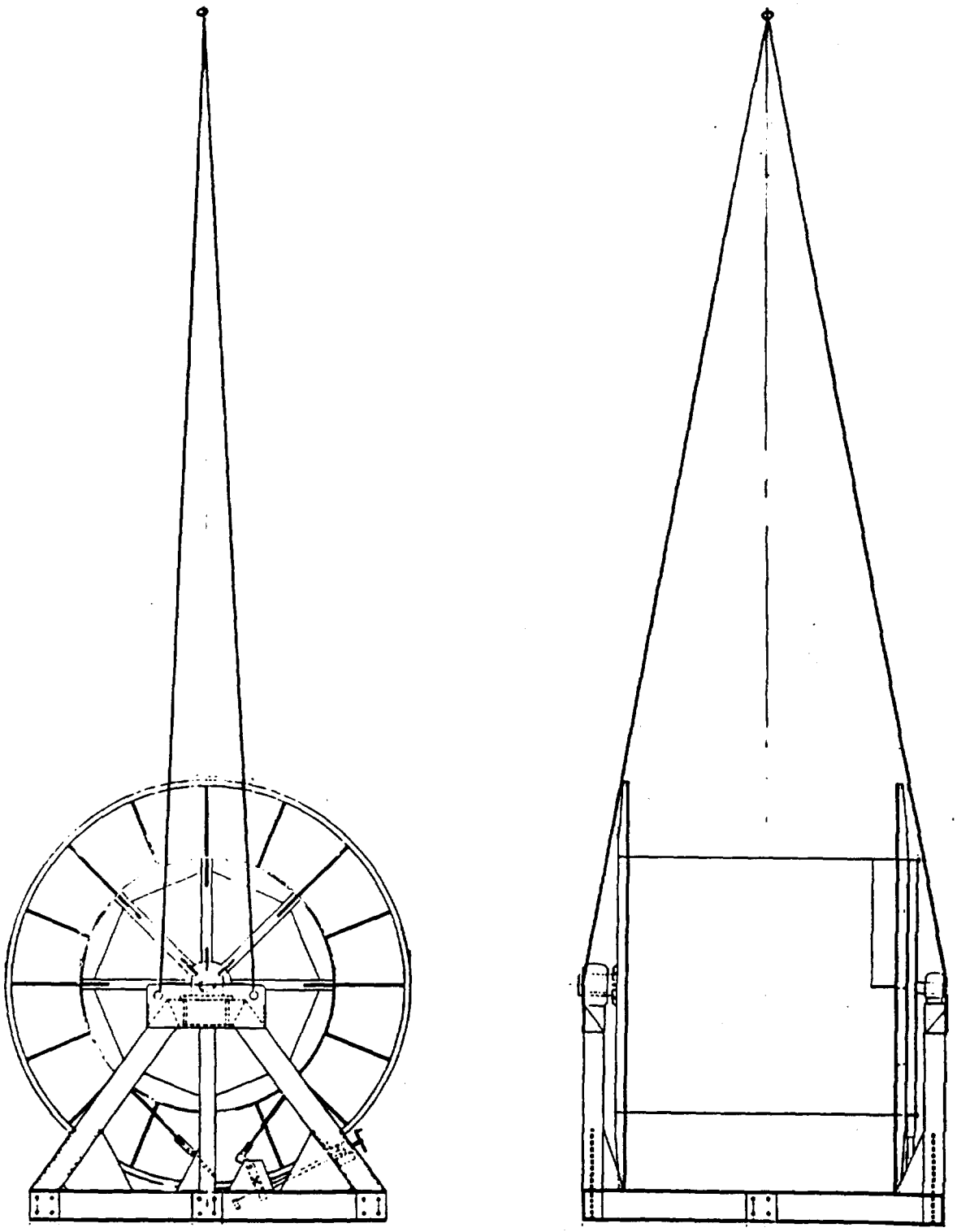


Figure 8-2. Lifting Plate Details: Band Brake Side



Sling Length: Recommended 33 feet
Minimum 24 feet

Figure 8-3. Winch: 4 Legged Sling Lift

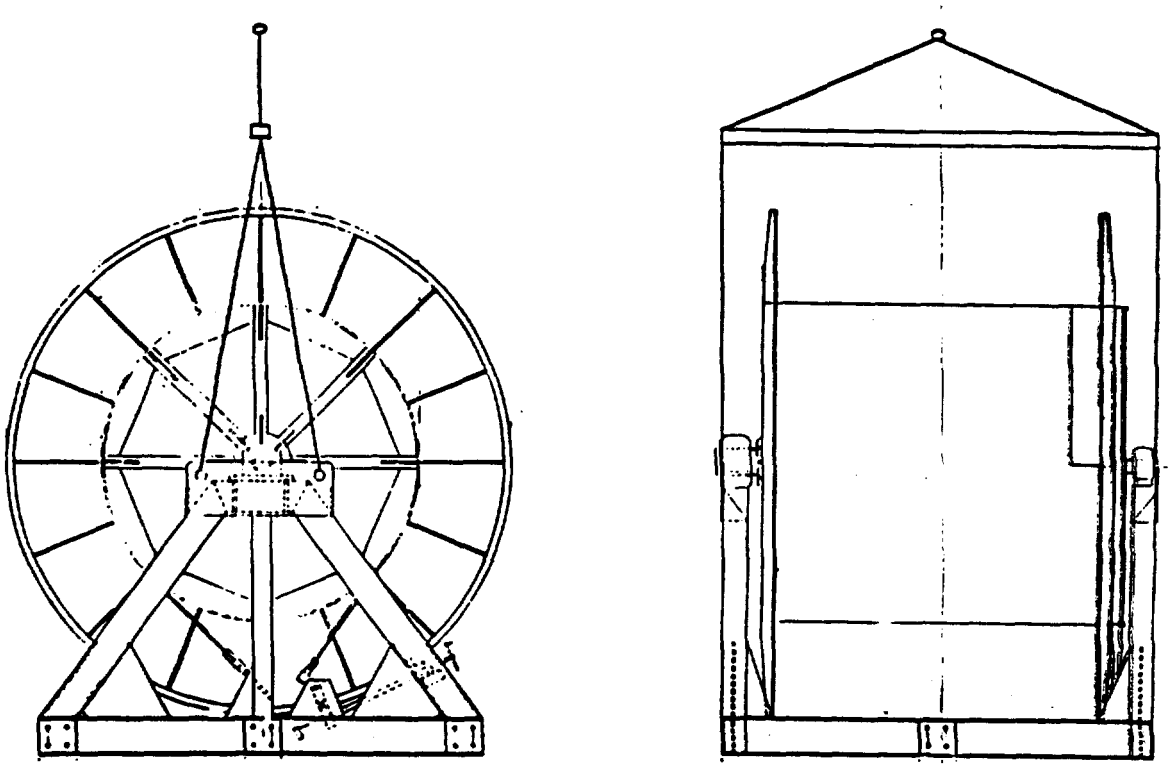


Figure 8-4. Winch: One-Dimensional Lifting Sling Configuration

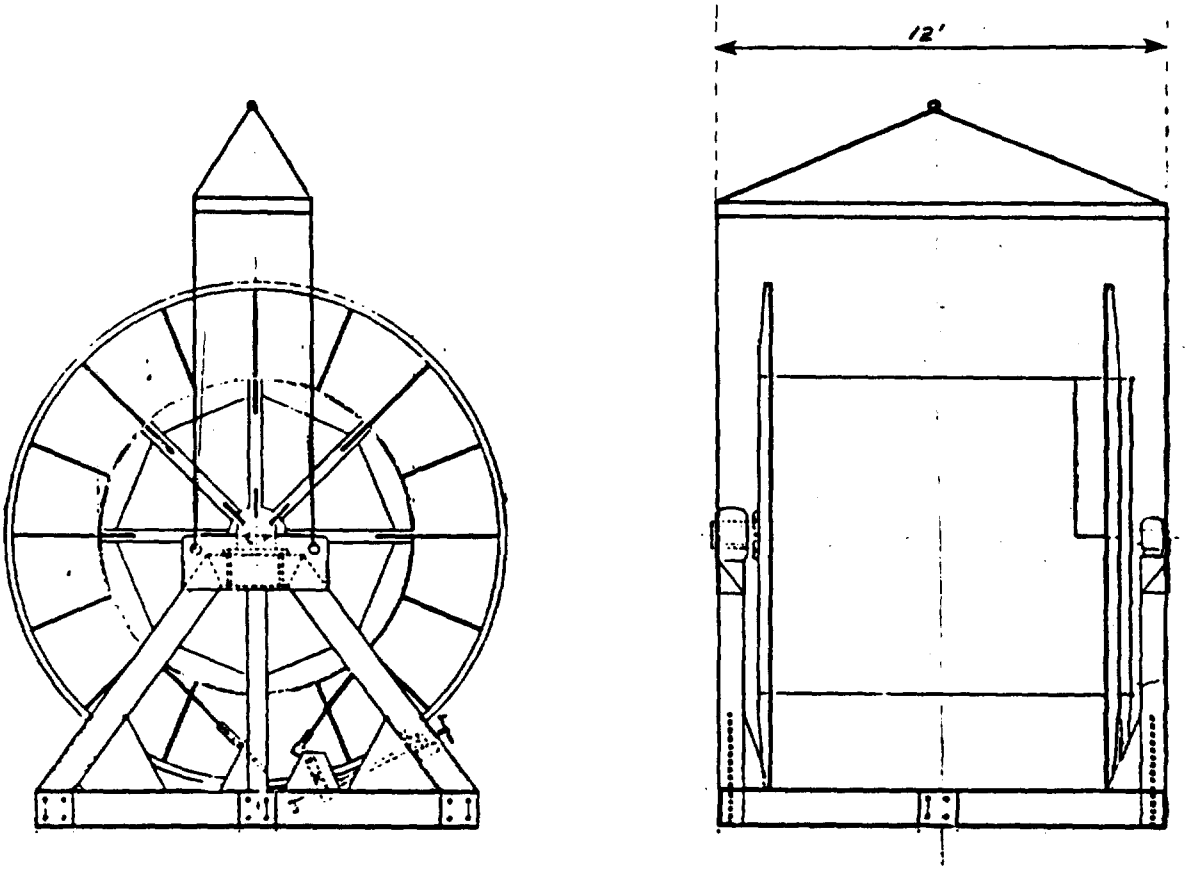
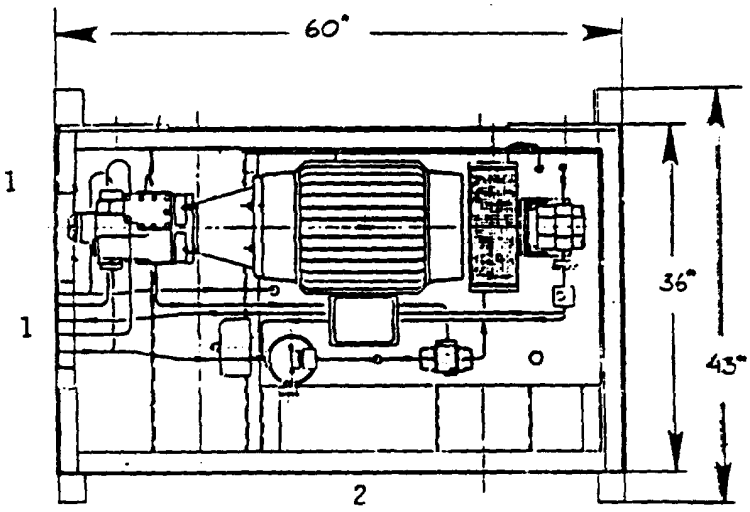


Figure 8-5. Winch: Two-Dimensional Lifting Sling Configuration

* Orientation of hydraulic power connections have been changed from location to location 2.



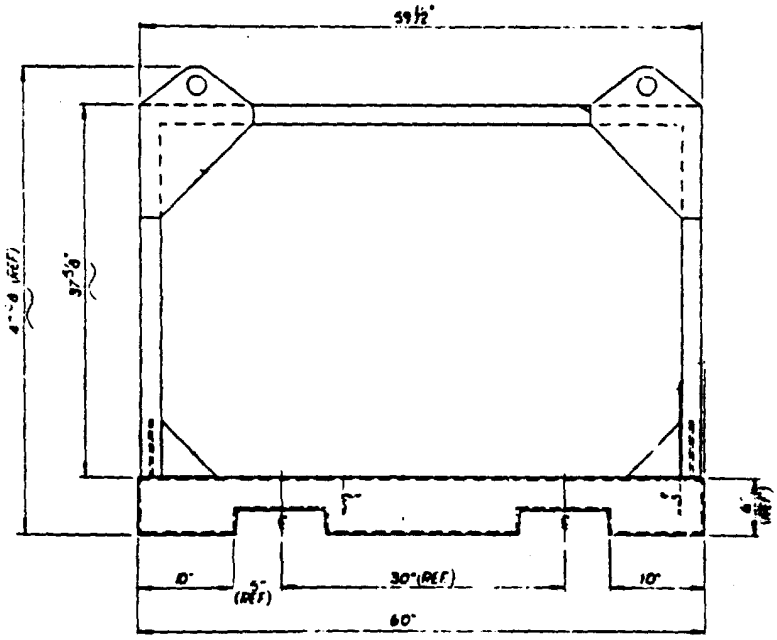


Figure 8-6. Hydraulic Power Package: Basic Handling Dimensions

8.2. Operating Maintenance

To ensure continued satisfactory performance of the Drinking Water Discharge Winch System components the following maintenance tasks should be performed by the operating personnel.

Time Interval	**Task**
Daily	1) Check the hydraulic fluid level before operating. Level should be 80% or more.
	2) Check for hydraulic leaks.
	3) Maintain cleanliness of the hydraulic fluid and components.
Monthly	1) Check fluid levels in the following components. Refill as required. See appendix for level requirements and recommended and equivalent fluids.
	- levelwind reduction gear (Appendix 28)
	- main winch reduction gear (Appendix 24)
	- two winch shaft bearings (Appendix 30A & 30B)

Time Interval	**Task**
Every 3 Months	1) Change oil filters (Items 1A and 1C) on the Hydraulic Power Package. See Table 8-3-I for filter element designation and equivalent replacement. 2) Lubricate the following with a No. 2 bearing grease or equivalent. - ten (10) bearings on levelwind Traveller Head. - ten (10) roller shafts on levelwind Traveller Head rollers. - two (2) thrust bearings on band brake drive shaft. 3) Lubricate 30 H.P. electric Motor (see Appendix 2)
Every 12 months	1) Replace fluids in the following components (see appendix for details) - levelwind reduction gear (Appendix 28) - main winch reduction gear (Appendix 24) - two winch shaft bearings (Appendix 30A and 30B)

Time Interval	**Task**
Every 12 months	2) Replace hydraulic fluid in the reservoir of the Hydraulic Power Package using clean, fresh, uncontaminated hydraulic fluid. It is recommended that Gulf Harmony 46 AW, or equivalent, be used. (See Appendix 15)
As Required	1) Remove rust and paint specifications.

Note:

Depending on the duty cycle of the Winch System Components, the maintenance task intervals may be reduced or increased. See appropriate appendix for manufacturer's recommendations.

8.3. Spares

The final decision on the level of spares to be maintained for the Drinking Water Discharge Winch System is left up to the operator. BDC has compiled a spares list based on operating experience with similar systems. Two a priori conditions were taken into consideration to establish the spares list, namely:

1) The system will be barge/ship mounted; therefore, replacement components are not readily available.

2) Components requiring a high level of expertise will only be spared at the component level.

There are three level of spares that are itemized:

Level I: Consumables
Level II: Repair parts and/or kits
Level III: Replacement components

Table 8-3-I is a detailed list of Level I spares.
Table 8-3-II is a detailed list of Level II spares.
Table 8-3-III is a detailed list of Level III spares.

The spares list presented is considered to be for maximum coverage. For minimum coverage, the suggested level of spares is:

Level I - All items noted in table 8-3-I
Level II - None
Level III - Rotating machinery only:

Piston Pump	-	4A
Gear Pump	-	6
Winch Motor	-	20
Levelwind Motor	-	27

TABLE 8-3-I

LEVEL I Spares: Consumables

Component	Item	Qty	Specification	Ref. Appendix
Suction Filter	Element	6	UC-MX-1591-4-10	1A
Return Filter	Element	6	UC-MX-1591-4-10	1C
Hydraulic Fluid	Oil	40 gals	Gulf Harmony 46AW	15
Reduction Gear-LW	Oil	1 gal	#8-GL32HT	28A/B

NOTE

Equivalent replacement elements for the UC-MX-1591-4-10 Filter element are:

Lenz	CP-1250-10X-30 CP-1250-10X-55
Parker	50 PS-10C
CanFlo	CFRS 55-20-10X
MP	MPS-100-10X

TABLE 8-3-II

Level II Spares: Replacement Parts/Kits

Component	Item	Specification	Qty	Ref. Appendix
Gear Pump Coupling	Insert	#170	1	3B
Levelwind Coupling	Insert	#170	1	3C
Gear Pump	Back-Up Plate	K3010-16	2	6
Gear Pump	O-Rings	R3006-7	1	6
Gear Pump	Seal Kit	X73-37-6	1	6
Gear Pump	Gasket	UB3006-239	2	6
Gear Pump	Gears	BA1007M-07	Set	6
Relief Valve	Cartridge	RAC50-T-50A	1	8
Motor/Heater Control	Main Contact/3 Pole	P/NKMC4	1	14
Motor/Heater Control	Aux. Contact	KAX1A11	1	14
Motor/Heater Control	Overload Relay	OLR-1003	1	14
Motor/Heater Control	Htr Contact Kit	2090EB330	1	14
Motor/Heater Control	Lamp Htr	PB30BLS1	1	14
Motor/Heater Control	Coil Kit	3TY-6505-OAB8	1	14
Winch Motor	Seal Kit	MAB-500-003	1	20
Winch Motor	Rotor Set	MAB-10-7000-A1	1	20
Winch Motor	Coupling Shaft	091399	1	20
Winch Motor	Drive Link	MAB-10-3000	1	20
Hand Pump	Seal Kit	Ref 1000-6	1	22
Disc Brake	O-Ring Set	PK 661	1	23
Disc Brake	Stack Kit	PK 695	1	23
Disc Brake	Bearing Kit	PK 663	1	23
Disc Brake	Gasket Kit	PK 664	1	23
Levelwind Motor	Seal Kit	SK 0000 12	1	27
Levelwind Motor	Rotary Set	MAF-06-7002-A1	1	27
Levelwind Motor	Coupling Shaft	091477	1	27
Levelwind Motor	Drive Link	MAF-01-3000	1	27
Swivel Joint	Seal Kit	4 inch Style 20	1	31A

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TABLE 8-3-III

Level III Spares: Replacement Components

Component	Specification	Qty	Ref. Appendix
Piston Pump	20-2065-HDC	1	4A
Pump Stroke Control	MCV-106A-5001	1	4B
Joystick	HCS-6-BI-BI-H	1	5
Gear Pump	P15H301GEAB5-17	1	6
Pressure Gauge	UC-3920	1	7A
Pressure Gauge	UC-1616	1	7B
Thermal Bypass Valve	65655	1	9A
Level Temp. Switch	TTL-008-180-45F	I	12
Dual Relief Valve	DWV-10-A-3000	1	17
Shuttle Valve	MH-04-P	1	19
Winch Motor	MAB-10-0-02-A1	1	20
Levelwind Valve	A0755-T4-LSR	1	26
Levelwind Reducer	FAF-70A1669.31	1	28
Levelwind Chain	ANSI#60	1	29A
Levelwind Roller Brg.	AELPL-205-100	2	30D
Hydraulic Hose	See Separate List	-	31C

8.4. Long Term Storage

Whenever the Drinking Water Discharge Winch System is to be placed into storage for any length of time, certain maintenance tasks should be performed to extend the operating life of the system.

8.4.1. System Preparation INTO Storage

The following are the preparation for storage tasks that should be performed on the Winch System Components, namely winch, levelwind, and hydraulic power package.

1) Wash all components with soap and/or detergent to remove any salt and/or dirt deposits.

2) Remove rust and recoat with primer.

3) Assure that hoses and electrical cables are properly stowed so they cannot be damaged.

8.4.2. System Preparation FROM Storage

The following are the preparation from storage tasks that should be performed on the Winch System Components, namely: winch, levelwind, and hydraulic power package:

1) Wash all components with soap and/or detergent to remove any salt and/or dirt deposits.

2) Recoat where required (see Table 8.5 for painting specifications)

3) Hydraulic System

a) Check reservoir for water deposits. Drain water if it exists.

b) Check hydraulic fluid level. Replenish oil as required (see Appendix 15 for oil specifications.

c) Run complete system at no load condition for approximately 1/2 hour. Then run system at light load condition for 1/2 hour. This will circulate the oil throughout the system and remove any foreign particles via the filters and strainers.

d) Install new filter elements (see Appendix 1A for Suction Filter and Appendix 1C for Return Filter Element)

e) Check for leaks and tighten and/or repair as required.

8.5. System Coating Specifications

The specifications for the original painting of the Drinking Water Discharge Winch System are contained in Table 8-5. These specifications should be followed as closely as possible for any touch-up or repainting of the system.

TABLE 8.5

PROTECTIVE COATING SPECIFICATIONS
PAINTING PROCEDURE

1.0. Inspection

1.1 Prior to the beginning of any abrasive blasting, all surfaces will be inspected by Brancart Development personnel as to its acceptability for proper coating. Should any areas be deemed unsatisfactory, they shall be identified, marked. and held for action determined by the owner or his designated representative.

2.0. External Surfaces

2.1. Surface Preparation

2.1.1 Prior to abrasive blasting, the steel shall be examined for the presence of any oils or greases. Should any be present, it shall be removed by use of a volatile non-oily solvent and clean rags-

2.1.2 Surfaces not to be blasted will be protected by appropriate masking.

2.1.3 All surfaces shall be abrasive blasted to a near-white metal finish (SSPC-SP10-63T or NACE 2).

2.1.4 All blasted surfaces shall be primed the same day.

2.2 Protective Coating Application - Abrasive Blasted Surfaces

2.2.1 Apply one coat of Inorganic Zinc to a dry film thickness of 2½ - 4 mils DFT.

2.2.2 Apply one coat of Polyamide Epoxy Intermediate coating to a dry film thickness of 4-6 mils DFT.

2.2.3 Apply one coat of Polyurethane Top Coat to a dry film thickness of 1l-2 mils DFT.

2.3 Protective Coating Application - Previously Painted Surfaces

2.3.1 This section deals with items such as pumps, filter housings, motors, etc., that have a "standard shop enamel" coating applied to them.

2.3.2 Apply one coat of Universal Primer to a dry film thickness of 1-2 mils DFT.

2.3.3 Apply one coat of Polyurethane Top Coat to a dry film thickness of 1h-2 mils DFT.

3.0 Internal Closed Surfaces

3.1 Unless covered by another specification, no internal surfaces shall be abrasive blasted or coated.

4.0 Approved Sources

4.1 The following coating systems are listed for reference only. These materials, or approved equals, may be used per this specification.

Supplier	Inorganic Zinc	Polyamide Epoxy	Polyurethane	Universal Primer
Matcote	1-289	1-8442 Series	2-500 Series	3-355
Mobil Chemical	#7	89 Series	40 Series	Alumapoxy
Carboline	#11	190HB Series	134 Series	GP Series

5.0 Colors

5.1 The final top coat color shall be Haze Grey.

6.0 References

6.1 All coatings shall be applied in accordance with the manufacturer's recommendations included in their product literature.

8.6. Shipping Recommendations

Due to the physical size and weight of the Drinking Water Discharge Winch System, shipping recommendations will be limited to barge/ship and/or trucks. If, per chance, the system is to be air shipped, the major requirement would be to remove all hydraulic fluid from the system.

8.6.1. Winch

The basic envelope dimensions of the winch are:

Length: 13'8" inches
Width : 12'0" inches
Height: 14'8" inches
Weight: 26,000 lbs, w/o hose and connectors

The foot-print of the winch is 144 inches X 144 inches and the bearing surface is 4,352 square inches. Whenever the winch is being transported, the following procedure should be followed:

a) Investigate bearing load area relative to shipping mode. Area load could be decreased by using doubler (spreader) plates.

b) Handle winch as per suggestions presented in Section 8.1: Handling Techniques and Limitation.

c) Secure load to transport surface. Preferred method is to weld the bolt-down brackets to the transport surface. Alternate method would be to secure the base from side motion and secure tie-down lines from the four lifting points.

d) Even though the winch has a sprig loaded disc brake ("ON" when hydraulic system is OFF) and a band brake, the drum should be secured with the chain and shackles supplied as shown in Figure 8-6. This method of tie-down will prevent the drum from moving due to motion-induced vibrations.

8.6.2. Levelwind

The basic envelope dimensions of the winch levelwind are:

Length: 172 inches
Width : 21 inches
Height: 72 inches
Weight: 2250 lbs

This unit should be stowed in the normal operating position and secured via the end bolt-on brackets are appropriate tie-downs. The traveller head should also be secured to the levelwind track to eliminate motion-induced vibrations. The levelwind hoses should be secured and protected from potential damage.

8.6.3. Hydraulic Power Package

The basic envelope dimensions of the winch hydraulic power package are:

Length: 60 inches
Width: 36 inches
Height: 47 inches
Weight: 1850 lbs

DECKMASTER

This unit should be secured to the transport platform via the four upper lifting eyes and the based "blocked" so it will not move. The hydraulic hoses and electrical cable can be coiled and secured within the envelope of the hydraulic power package. Care must be taken so that motion-induced vibration will not chaff the hose and/or electrical cable. Depending on local transport regulations, the hydraulic fluid in the system (primarily the 40 gallons in the reservoir) may have to be removed.

8.7. Record Keeping

Brancart Development Corporation (BDC) strongly suggest that an Operations and a Maintenance Log be maintained for the Drinking Water Discharge Winch System. A copy of the suggested logs are presented following this section and separate log books are supplied with the winch.

The logs will present historical data on the operation of the system. If feasible, BDC requests that copies of the logs be sent to:

Brancart Development Corporation
17150 Butte Creek Road
Suite 219
Houston, Texas 77090
Attn: Mr. C. P. Brancart

This information will assist BDC to monitor system performance.

Drinking Water Discharge
Winch System

Operations
Log

Operations Log

Drinking Water Discharge Winch System

Event No	Exercise and Date(s)	Operating Time				Remarks this Event
		ON Time	OFF Time	Elapse Time	Total Hrs To Date	

Remove After Entr

Remov
Afte
Ent

Drinking Water Discharge Winch System Maintenance Log

Date	Exercise	Maintenance Tasks Accomplished and Remarks

9.0. COMPONENT TECHNICAL DESCRIPTION

Appendices number 1 through 31 contain vendor supplied technical information on all components purchased for the Drinking Water Discharge Winch System. Table 9-1 summarizes all the hydraulic and support components used on the system. For quick reference, a hydraulic schematic is presented in Figure 9-1. The component technical description presented includes quantity, part number, physical and operating description, service manuals where applicable, and source of the component. Note that the parent source is given. Suggestion is made to obtain parts from a local distributor.

TABLE 9.1

Drinking Water Discharge Winch System Components

ITEM	DESCRIPTION	MANUFACTURER	PART NUMBER
1-A	Suction Filter	UCC	UC-MX-1591-105
*1-B	Suction Strainer	UCC	UC-SE-5113
1-C	Return Filter	UCC	UC-MX-1591-101
2	Electric Motor	Toshiba	Special
3-A	Motor/Pump Coupling	Falk	50-T-10-CGA
3-B	Gear Pump Coupling	Magnaloy	100-lBxl/4-3/4B x3/16K-170
3-C	Levelwind Coupling	Magnaloy	100-1Bx3/16K-5/8B x3/16K-170
3-D	Motor/Pump Mount	MacMillin	F3-C
4-A	Piston Pump	Sunstrand	20-2065-HDC
4-B	Pump Stroke Control	Sundstrand	MCV-106A-5001
5	Joystick	Gresen	HCS-6-Bl-B1-H
*6	Gear Pump	Commercial Shearing	P15H301GEAB5-17
7-A	Pressure Gauge	UCC	UC-392o
7-B	Pressure Gauge	UCC	UC-1616
*8	Relief Valve	Brand	RL-50
9-A	Thermal Bypass Valve	Thermal Transfer	65655
9-B	Oil Cooler	Thermal Transfer	L-71772
10	Filler/Breather Cap	UCC	UC-AB-1163-40
11	Oil Level Sight Gauge	UCC	UC-FLT-31322
12	Level/Temperature Switch	Approved Purification	TTL-008S-180S-45 F
*13	Oil Heater	Gaumer	A2Z3N25M4-LT
*14	Motor/Heater Control	Electro-Quip	Special
15	Hydraulic Fluid	Gulf Oil	Harmony 46AW
*16	Dual Relief Valve	Gresen	DXV-75-300
17	Dual Relief Valve	Gresen	DWV-10-A-3000
18	Ball Valve	Cooper	HP-3/4 4150-SE
19	Shuttle Valve	Racine	MH-04-P
20	Winch Motor	TRW Ross	MAB-10-0-02-A1

TABLE 9.1

Drinking Water Discharge Winch System Components

ITEM	DESCRIPTION	MANUFACTURER	PART NUMBER
*21	Bail Valve	Cooper	3/4-4150-SE
22	Hand Pump	Terpleton-Kenley	1000-6
23	Disc Brake	Ausco	31u25
24	Winch Gearbox	Fairfield	S6A1-33-32
25	Winch Gear Set	American Gear	Special
26	Levelwind Valve	Brand	A0755-T4-LSR
27	Levelwind Motor	TRW Ross	MAF-06-0-06-A1
*28	Levelwind Reducer	Eurodrive	FAF 70A1669.31
29-A	Levelwind Chain	Browning	# 60
29-B	Levelwind Drive Sprocket	Martin	Sprocket:60BTL28 Bushing: 2012x1 5/8
*29-C	Levelwind Idler Sprocket	Browning	60B17x1
*29-D	Levelwind Drive Tightener	Hub City	3T200BC, TU25x1
30-A	Small Shaft Bearing	NTN	SAF-22528
30-B	Large Shaft Bearing	Miether	SAF 048K x 7 3/16 x 10 1/2, N048 P48
30-C	Deleted		
30-D	Levelwind Roller Bearing	NTN	AELPL-205-100
*30-E	Winch Roller Shaft Bearing	NTN	UCP-207-107T
31-A	Swivel Joint	Parker Hannifin	4-inch Style 20 flg x flg
31-B	Fasteners	-	See List
31-C	Hydraulic Hose	-	See List

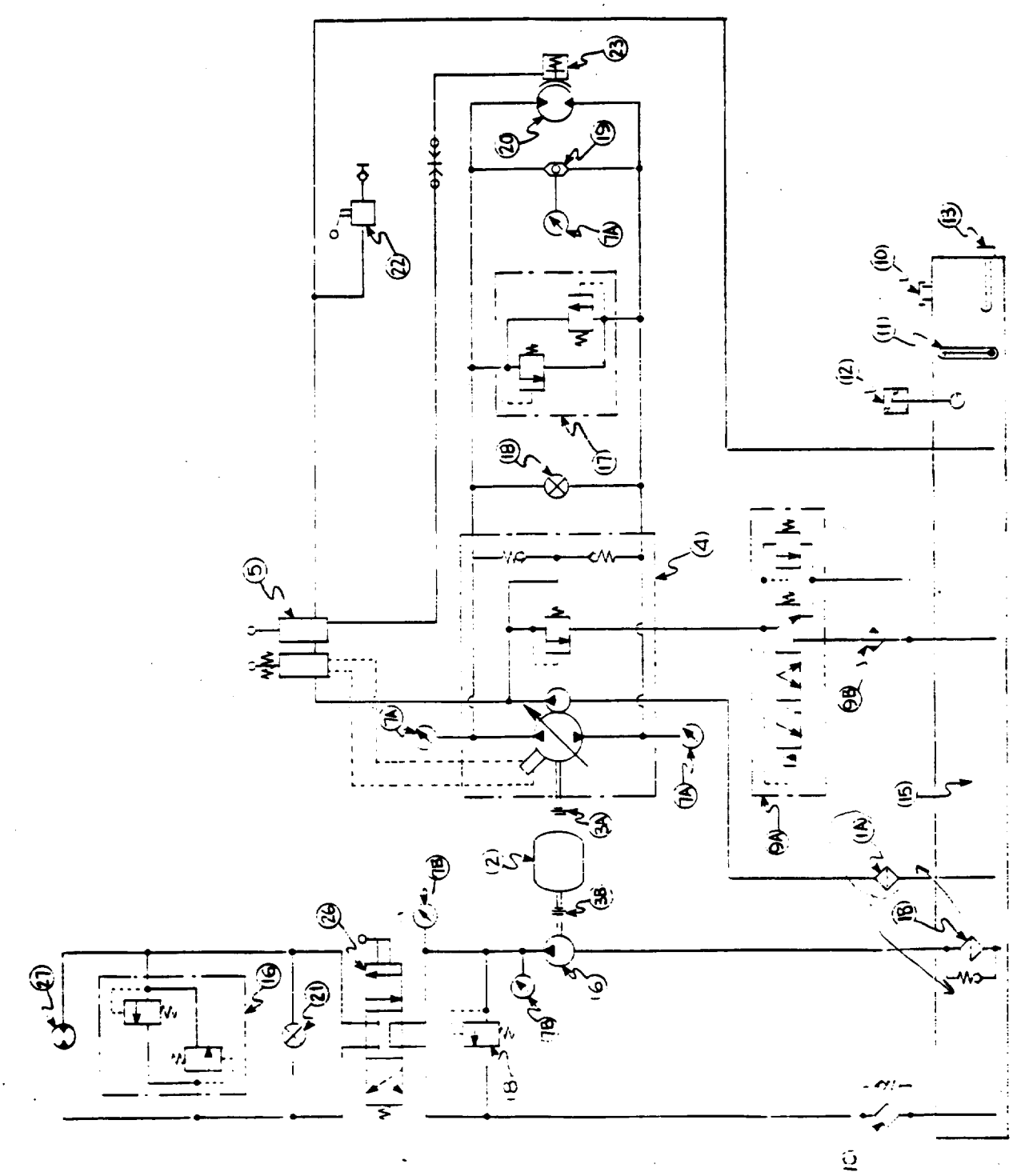


Figure 9-1. Winch System Hydraulic Schematic

DECKMASTER
WINCH MODEL NO. WHR-102-12?25
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

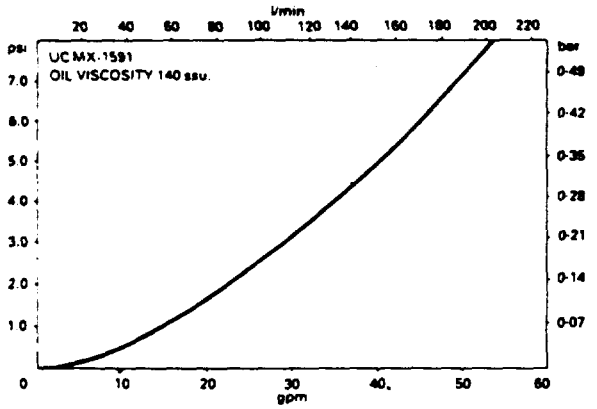
COMPONENT DESCRIPTION

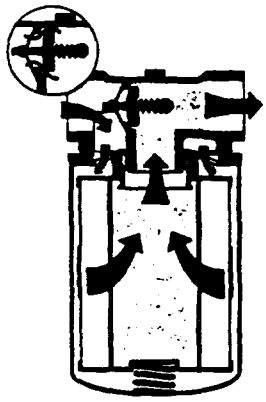
Reference Item No.:	1-A
Quantity Required:	One
Description:	Suction Filter
Manufacturer:	UCC
Part Number:	UC-MX-1591-105
Source:	NL Rucker Products NL Industries, Inc. 15401 W. Vantage Parkway Suite 120 Houston, Texas 77032

Tele #: 1-713-987-2117

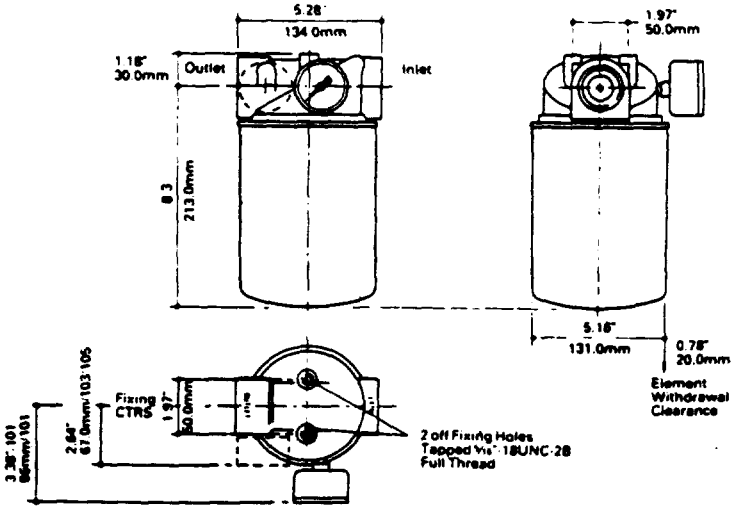
Suction Line Filters
Use these graphs to establish pressure drop (sub atmospheric). It is important to ensure that the total pressure loss due to filter and pipes etc, does not create a depression at the pump inlet exceeding the pump manufacturers recommendations. High viscosity conditions such as might occur during cold start conditions must be taken into account. For further data consult UCC. Suction Filters can be supplied fitted with a by-pass valve set to crack at 2.5 psi (0.17 bar) or with no by-pass.

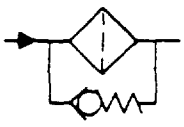
Part Number	Suction Application
UC-MX-*-103	With By Pass - With Indicator
UC-MX-*-104	With By Pass - No Indicator
UC-MX-*-105	No By Pass - With Indicator
UC-MX-*-106	No By Pass - No Indicator





Part Number	Flow gpm	Flow l/min	Ports NPT	Micron Rating	Indicator	By-Pass	Weight lb (kg)	Replacement Element
UC-MX-1591-101	48	180	1¼	10	With	With	5.43 (2.47)	UC-MX-1591-4-10
UC-MX-1591-102					Without	With	5.17 (2.36)	





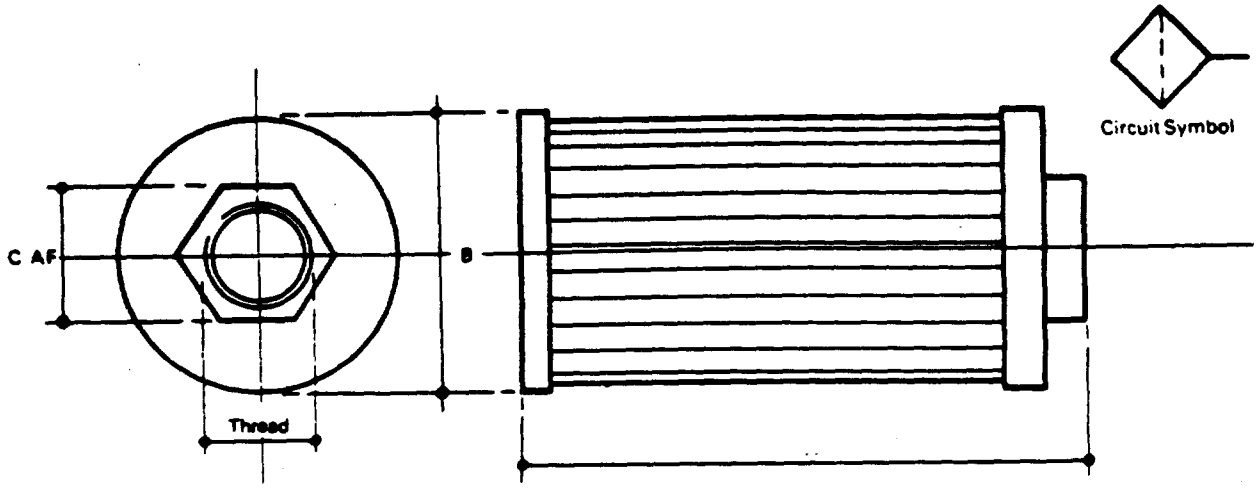
DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	1-B
Quantity Required:	One
Description:	Suction Strainer
Manufacturer:	UCC
Part Number:	UC-SE-5113
Source:	NL Rucker Products NL Industries, Inc. 15401 W. Vantage Parkway Suite 120 Houston, Texas 77072

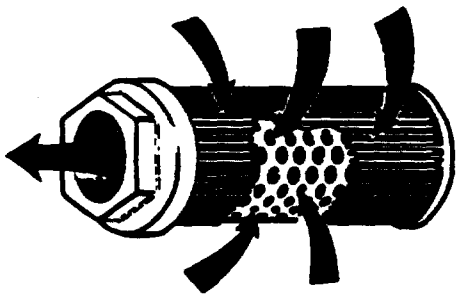
Tele #:(713) 987-2117

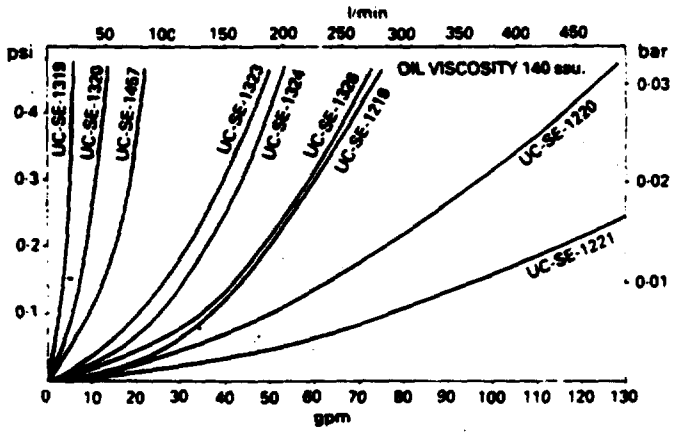
Suction Elements



Suction Elements with 3 PSI By-pass Valve

UC-SE-5110	4.0	15	1/2	125
UC-SE-5110	6.6	25	3/4	125
UC-SE-5112	13.2	50	1	
UC-SE-5113	25.0	90	1 1/2	125
UC-SE-5114	34.3	130	1 1/2	
UC-SE-5115	47.5	180	2	125
UC-SE-5117	92.46	350	2 1/2	
UC-SE-5118	132.0	500	3	125





DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	1-C
Quantity Required:	One
Description:	Return Filter
Manufacturer:	UCC
Part Number:	UC-MX-1591-101
Source:	NL Rucker Products NL Industries, Inc. 15401 W. Vantage Parkway Suite 120 Houston, Texas 77032

Tele #: 1-713-987-2117

The UCC range of full flow Maxi – flow Filters fitted with disposable spin-on type elements are available for flows up to 105 gpm (400 l/min) and have a nominal filtration retention of 10 microns. They are designed for use with mineral and petroleum based fluids. Three basic models are available, suitable for return or low pressure use at flow rates of nominally 15 gpm (60 l/min), 48 gpm (180 l/min) and 105 gpm (400 l/min). These figures are based on pressure drop/flow data and suitability for flow rates in excess of these figures should be established after consideration of this data and individual system conditions. Maximum Working Pressure is 100 psi (7 bar). The Filters are equally suitable for Suction Line applications but care must be taken to ensure that the pressure drop across the Filter together with other system losses does not create an excessive sub-atmospheric condition at the pump inlet. For further details consult UCC or their Distributors.

Replacement Element

The disposable spin-on type element provides a quick and easy replacement facility giving minimum system downtime. The possibility of depositing contamination into the system when changing the more conventional type of element is eliminated with the disposable element design. Maxiflow spin-on elements are identified by their yellow colour with black characters.

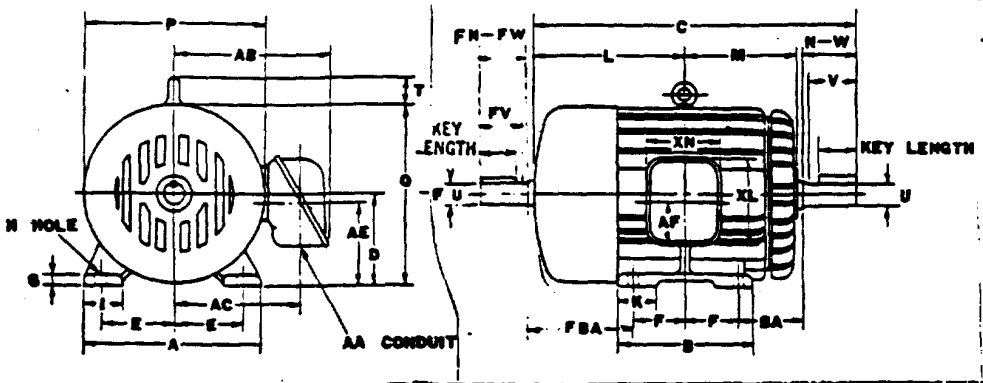
DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	2
Quantity Required:	ONE
Description:	Electric Motor
Manufacturer:	TOSHIBA
Part Number:	30HP/208/230/460 - 3 Phase TEFC Double Shaft, 286T Frame, Heater
Source:	TOSHIBA INTERNATIONAL CORP. Industrial Equipment Division 1313 W. Little York Road Houston, Texas 77040

Tele #: 1-713-466-0277

TOSHIBA TOTALLY-ENCLOSED FAN-COOLED DIMENSIONS



Three phase Squirrel
Horizontal Foot-mounted
NEMA Design B
Frame 284-365

FRAME NO.	MOUNTING E	F	H	BA	FBA	A	B	C	DD	G	J	K	L	M	O	P	T	Drive End (Rear End) KEY WAY WIDTH	DEPTH	KEY LENGTH
284T	5½	4¾	11/32	4¾	7¾	12¾	11⅛	28⅝	7	1⅛	3⅝	3⅛	12	9⅝	14⅝	16¼	2⅝	½	¼	3¼
284TS	5½	4¾	11/32	4¾	7¾	12¾	11⅛	28⅝	7	1⅛	3⅝	3⅛	12	9⅝	14⅝	16¼	2⅝	⅜	⅜	1⅜
286T	5½	5½	11/32	4¾	7¾	12¾	13⅜	27⅝	7	1⅛	3⅝	3⅛	13⅝	10⅛	14⅝	16¼	2⅝	½	¼	3¼
286TS	5½	5½	11/32	4¾	7¾	12¾	13⅜	28⅝	7	1⅛	3⅝	3⅛	13⅝	10⅛	14⅝	16¼	2⅝	⅜	⅜	1⅜
324T	6¼	5¼	11/32	5¼	9	15	13⅜	29⅝	8	⅞	3⅝	3⅛	13⅝	10⅛	15⅝	18¼	2⅝	½	¼	3⅛
324TS	6¼	5¼	11/32	5¼	9	15	13⅜	27⅝	8	⅞	3⅝	3⅛	13⅝	10⅛	15⅝	18¼	2⅝	½	¼	2
326T	6¼	6	11/32	5¼	9	15	15⅜	29⅝	8	⅞	3⅝	3⅛	14⅝	11⅛	15⅝	18¼	2⅝	½	¼	3⅛
326TS	6¼	6	11/32	5¼	9	15	15⅜	29⅝	8	⅞	3⅝	3⅛	14⅝	11⅛	15⅝	18¼	2⅝	½	¼	2
364T	7	5⅝	11/32	5⅞	10	16⅜	14⅜	32¼	9	⅞	3⅝	3⅛	14⅝	11⅝	16⅝	17¼	3⅛	⅝	⅜	4¼
364TS	7	5⅝	11/32	5⅞	10	16⅜	14⅜	30¼	9	⅞	3⅝	3⅛	14⅝	11⅝	16⅝	17¼	3⅛	½	¼	2
365T	7	6⅛	11/32	5⅞	10	16⅜	15⅜	32¼	9	⅞	3⅝	3⅛	15⅝	11⅝	16⅝	17¼	3⅛	⅝	⅜	4¼
365TS	7	6⅛	11/32	5⅞	10	16⅜	15⅜	31¼	9	⅞	3⅝	3⅛	15⅝	11⅝	16⅝	17¼	3⅛	½	¼	2

FRAME NO.	CONDUIT BOX④ AA	AB	AC	AE	AF	XL	XN	SHAFT EXTENSION Drive End (Rear End) N-W	U②	V③	SHAFT EXTENSION End Opposite Drive End FN-FW	FU②	FV③	KEY WAY WIDTH	DEPTH	KEY LENGTH	BEARINGS DRIVE END	OPP. END	APPROX. WEIGHT
284T	1½	12	10¼	7	3½	6¼	5⅝	4⅝	1⅞	4⅜	4	1⅜	3⅜	⅜	⅜	2⅞	6310	6310	320
284TS	1½	12	10¼	7	3½	6¼	5⅝	3¼	1⅜	3	3¼	1⅜	3	⅜	⅜	1⅜	6310	6310	330
286T	1½	12	10¼	7	3½	6¼	5⅝	4⅝	1⅞	4⅜	4	1	3⅜	¼	⅛	2⅞	6310	6310	370
286TS	1½	12	10¼	7	3½	6¼	5⅝	3¼	1⅜	3	3¼	1⅜	3	⅜	⅜	1⅜	6310	6310	380
324T	2	13¾	11⅞	8	5½	8⅛	6⅞	5¼	2⅛	5	4⅝	1⅞	4¾	½	¼	3¼	6312	6312	470
324TS	2	13¾	11⅞	8	5½	8⅛	6⅞	3¾	1⅞	3½	3¾	1⅞	3½	½	¼	2	6312	6312	470
326T	2	13¾	11⅞	8	5½	8⅛	6⅞	5¼	2⅛	5	4⅝	1⅞	4¾	½	¼	3¼	6312	6312	530
326TS	2	13¾	11⅞	8	5½	8⅛	6⅞	3¾	1⅞	3½	3¾	1⅞	3½	½	¼	2	6312	6312	520
364T	3	14⅝	12⅝	9	5½	8⅛	6⅞	5⅛	2⅜	5⅝	4⅝	1⅞	4¾	½	¼	3¼	6314	6312	750
364TS	3	14⅝	12⅝	9	5½	8⅛	6⅞	3¾	1⅞	3½	3¾	1⅞	3½	½	¼	2	6312	6312	730
365T	3	14⅝	12⅝	9	5½	8⅛	6⅞	5⅛	2¾	5⅝	4⅝	1½	4¾	½	¼	3¼	6314	6312	770
365TS	3	14⅝	12⅝	9	5½	8⅛	6⅞	3¾	1⅞	3½	3¾	1⅞	3½	½	¼	2	6312	6312	770

NOTE: ① Tolerance on dimension D +0.00 inch. −1/32 inch 284—326
+0.00 inch. −1/16 inch 364—365

② Tolerance on shaft diameter U +0.000 inch. −0.001 inch

③ Dimension V represents length of straight part of shaft.

④ Conduit box will be mounted on opposite side upon request. Providing mounting conditions permit, conduit box may be turned so that entrance can be made upward, downward, or from either side.

ALL DATA SUBJECT TO CHANGE WITHOUT NOTICE.
FOR CONSTRUCTION USE ONLY CERTIFIED DATA.

CERTIFIED

For BRANCART DEVELOPMENT

Your Order No. _____

Toshiba Order No. _____

Frame 286TC, HP 30, RPM (F.L.) 1800

Amp. (F.L.) _____, Volts 208/230/460, Hz. 60, Ph. 3

Model No. _____, Type TEFC, Form _____

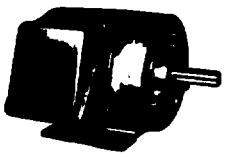
Remarks: _____

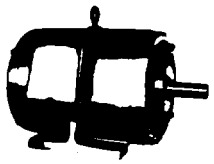
Per _____, Date _____

DRAWING NO.
D-70027

TOSHIBA INTERNATIONAL CORPORATION

TOSHIBA
A Quality Product for World Energy


Dripproof, Frames 143T-145T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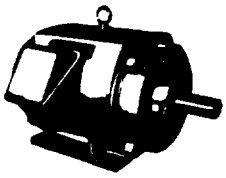
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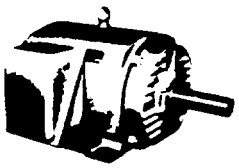
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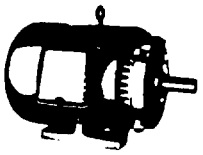
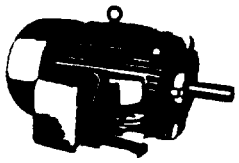

TEFC, Frames 143T-256T


TEFC, Frames 284T-587UZ


XP, Frames 143T-256T


XP, Frames 284T-447TZ

INSTRUCTIONS:

Installation and Maintenance

Toshiba World Energy Motors

Polyphase motors

- Frames 143T through 507UZ Dripproof
- Frames 143T through 587UZ Totally-Enclosed Fan-Cooled
- Frames 143T through 447TZ Explosion-Proof

TOSHIBA/HOUSTON
INTERNATIONAL CORPORATION

READ CAREFULLY BEFORE INSTALLING AND STARTING MOTOR

RECEIVING

(1) Check nameplate data.
(2) Check whether any damage has occurred during transportation.
(3) Turn shaft by hand to check that it turns freely.

LOCATION

(1) Dripproof Motors are designed for installation in a well ventilated place where the atmosphere is reasonably free of dirt and moisture.
(2) Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
(3) Explosion Proof motors are designed and built for hazardous duty. Listed by U L for Class 1, Group D; and Class II, Groups E, F and G.

MOUNTING

(1) Mount motor securely on a firm, flat base. All ball bearing normal thrust motors may be mounted in any position.
(2) Align motor accurately, using a flexible coupling if possible. For drive recommendations consult with drive or equipment manufacturer, or Toshiba.
(3) V-belt Sheave Pitch Diameters should not be less than the following Table 1. values (NEMA recommended values).
(4) Tighten belts only enough to prevent slippage. Belt speed should not exceed 5000 ft. per min.

POWER SUPPLY & CONNECTIONS

(1) Nameplate voltage and frequency should agree with power supply. Motor will operate satisfactorily on line voltage within 10% of nameplate value; or frequency within 5%; combined variation not to exceed 10%. 230 Volt motors can be used on 208-volt network systems, but with slightly modified performance characteristics.
(2) Dual voltage and single voltage motors can be connected for the desired voltage by following connection diagram (**labeled on the inner side of terminal cover, also shown on the nameplate**) For voltages shown on nameplate

(3) All Explosion Proof motors have Temperature Limiting Devices in the motor enclosure to prevent excessive external surface temperature of the motor in accordance with U/L standards. Terminals of thermal protectors (P1, P2) should be connected to the motor control equipment.

(4) Wiring of motor and control, overload protection and grounding should be in accordance with National Electrical Code and local building codes.

Fig. 1 SHAFT EXTENSION LOADS DUE TO TRANSMISSION OF POWER

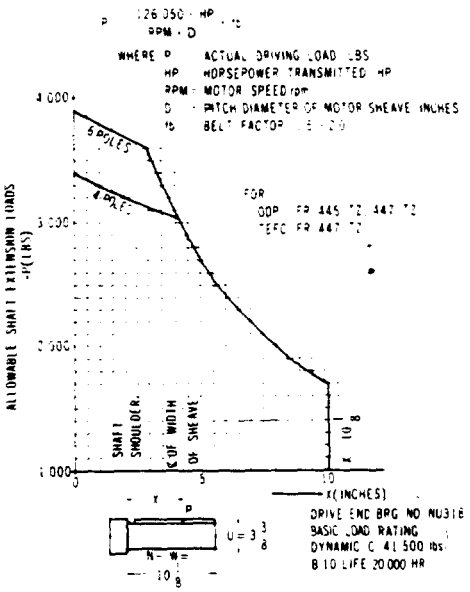


Fig. 2 SHAFT EXTENSION LOADS DUE TO TRANSMISSION OF POWER

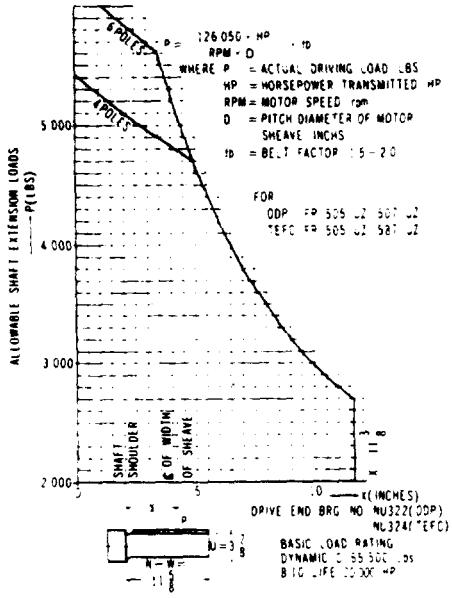


Table 1. V-belt Sheave Pitch Diameters (MG1-14.42)

Frame No.	Horsepower at Sync. Speed RPM			V-belt Sheave (Inches)			
				Conventional		Narrow	
				A, B, C, D and E		3V, 5V and 8V	
	3600	1800	1200	Min. Pitch Diameter	*Max. Width	Min. Outside Diameter	**Max. Width
143T	1½	1	¾	2.2	4¼	2.2	2¼
145T	2-3	1½-2	1	2.4	4¼	2.4	2¼
182T	3	3	1½	2.4	5¼	2.4	2¾
182T	5	—	—	2.6	5¼	2.4	2¾
184T	—	—	2	2.4	5¼	2.4	2¾
184T	5	—	—	2.6	5¼	2.4	2¾
184T	7½	5	—	3.0	5¼	3.0	2¾
213T	7½-10	7½	3	3.0	6½	3.0	3⅜
215T	10	—	5	3.0	6½	3.0	3⅜
215T	15	10	—	3.8	6½	3.8	3¾
254T	15	—	7½	3.8	7¾	3.8	4
254T	20	15	—	4.4	7¾	4.4	4
256T	20-25	—	10	4.4	7¾	4.4	4
256T	—	20	—	4.6	7¾	4.4	4
284T	—	—	15	4.6	9	4.4	4¾
284T	—	25	—	5.0	9	4.4	4¾
286T	—	30	20	5.4	9	5.2	4¾
324T	—	40	25	6.0	10½	6.0	5¼
326T	—	50	30	6.8	10½	6.8	5¼
364T	—	—	40	6.8	11½	6.8	5¼
364T	—	60	—	7.4	11½	7.4	5¼
365T	—	—	50	8.2	11½	8.2	5¼
365T	—	75	—	9.0	11½	8.6	5¼
404T	—	—	60	9.0	14¼	8.0	7¼
404T	—	100	—	10.0	14¼	8.6	7¼
405T	—	—	75	10.0	14¼	10.0	7¼
405T	—	100	—	10.0	14¼	8.6	7¼
405T	—	125	—	11.5	14¼	10.5	7¼
444T	—	—	100	11.0	16¾	10.0	8½
444T	—	125	—	11.0	16¾	9.5	8½
444T	—	150	—	—	—	10.5	8½
445T	—	—	125	12.5	16¾	12.0	8½
445T	—	150	—	—	—	10.5	8½
445T	—	200	—	—	—	13.2	8½

* Max. sheave width = 2 (N-W)-¼". ** Max. sheave width = N-W.

Sheave ratios greater than 8 : 1 and center-to-center distance less than the diameter of the large sheave should be reffered to the company.

A. Wye-connected Dual Voltage (9 Leads)

	ODP	TEFC. XP
2P	1½HP – 3HP	1½HP – 5HP
4P	1 HP – 5HP	1 HP – 5HP
6P	½HP – 5HP	½HP – 5HP

Across the Line Starting

LOW VOLTAGE	HIGH VOLTAGE
T4 T5–T6	T4 T5 T6
T7 T8 T9	T7 T8 T9
T1 T2 T3	T1 T2 T3
LINE	LINE

B. Delta-connected Dual Voltage (9 Leads)

	ODP
2P	5HP 7½HP

Across the Line Starting

LOW VOLTAGE	HIGH VOLTAGE
T4 T9 T6	T4 T9–T6
T8 T5 T7	T8–T5 T7
T2 T3 T1	T2 T3 T1
LINE	LINE

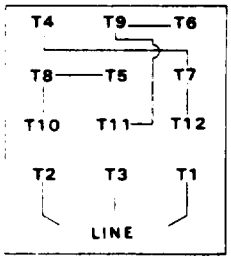
C. Delta-connected Dual Voltage (12 Leads)

	ODP		TEFC. XP	
2P	10HP	250HP	7½HP – 150HP	
4P	7½HP – 200HP		7½HP – 150HP	
6P	7½HP	125HP	7½HP – 125HP	

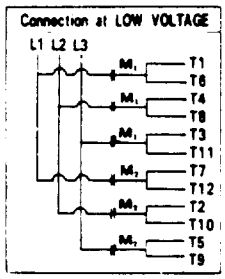
C-1 Across the Line Starting

LOW VOLTAGE	HIGH VOLTAGE
T4 T9 T6	T4 T9– T6
T8 T5 T7	T8–T5 T7
T10 T11 T12	T10 T11 T12
T2 T3 T1	T2 T3 T1
LINE	LINE

C-2 575 Volt Connection



C-4 Part Winding Starting



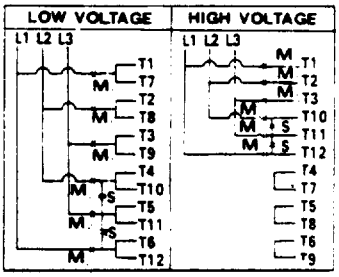
	Start	Run
M1	Close	Close
M2	Open	Close

M2 should be energized within 2 seconds after M1 is energized.

NOTES:

1. Motors can be used on 575 Volt network in accordance with C-2 connection. Not available for XP motors.
2. 4 poles and 6 poles motors are satisfactory for Part Winding starting at low voltage.

C-3 Wye Start Delta Run

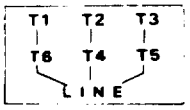


	Start	Run
M	Close	Close
M	Open	Close
S	Close	Open

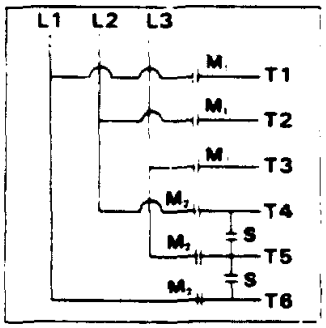
D. Delta-connected Single Voltage (6 Leads)

	ODP		TEFC. XP	
2P	300HP	400HP	200HP	350HP

D-1 Across the Line Starting



D-2 Wye Start Delta Run

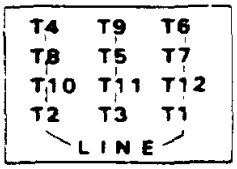


	Start	Run
M	Close	Close
M	Open	Close
S	Close	Open

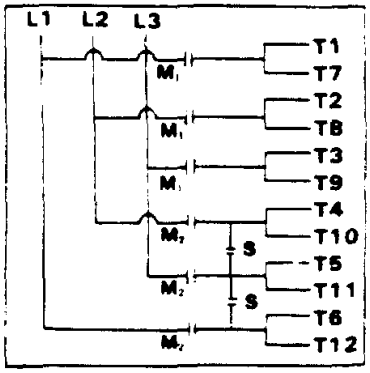
E. Delta-connected Single Voltage (12 Leads)

	ODP	TEFC XP
4 P	250HP 400HP	200HP 400HP
6 P	150HP 350HP	150HP - 350HP
8 P	125HP - 250HP	125HP 300HP

E-1 Across the Line Starting

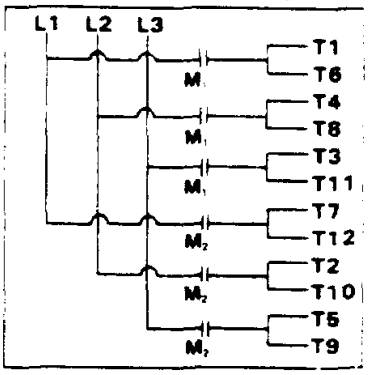


E-2 Wye Start Delta Run



	Start	Run
M1	Close	Close
M2	Open	Close
S	Close	Open

E-3 Part Winding Starting



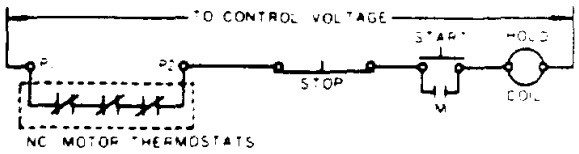
	Start	Run
M1	Close	Close
M2	Open	Close

M_2 should be energized within 2 seconds after M is energized

WARNING FOR EXPLOSION-PROOF MOTOR

Disconnect power before working on motor driven equipment. This motor is equipped with an automatic temperature-limiting device. The National Electrical Code and Underwriter's Laboratories requires connection of leads P1 and P2 into the control circuit of a manual reset starter per following diagram

KLIXON TYPE	AC VOLT	VOLT AMP RATING
9700L	120 600V	125 VA
9700K	120 600V	720 VA

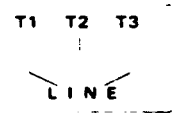


NOTE:

Frame 256T and smaller has two thermostats

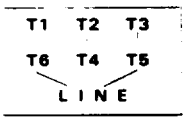
F.575 Volt Motors 5HP and Smaller (3 Leads)

Across the Line Starting

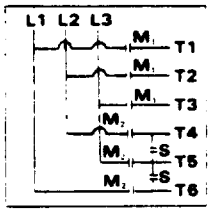


G.575 Volt Motors 7 ½HP and Larger (6 Leads)

G-1 Across the Line Starting



G-2 Wye Start Delta Run



	Start	Run
M	Close	Close
M	Open	Close
S	Close	Open

MAINTENANCE

1. INSPECTION

Inspect motor at regular intervals. Keep motor clean and vent openings clear.

2. LUBRICATION

a. **Frame 143T-256T:** Double sealed ball-bearing motors without grease fittings.
TOSHIBA prelubricated seal bearings don't need relubrication. These bearings are designed for average 30,000 hrs. operation under standard conditions. (see table 2)

b. **Frame 284T-587 UZ:** Motors having pipe plugs or grease fittings in bearing brackets.
Motors are shipped with sufficient grease for long operation (see table below). It is necessary to relubricate anti-friction bearing motors periodically, depending on size and type of service.

Table 2. Frequency of Relubrication

SYNC RPM RANGE	FRAME RANGE	TYPE OF SERVICE	
		STANDARD (8Hr day operation)	(24Hr day operation)
3600	143T-256T	* 5 years	* 2 years
	284TS-286TS	210 days	70 days
	324TS-587USS	150 days	50 days
1800	143T-256T	* 7 years	* 3 years
	284T-326T	4 years	1.5 years
	364T-365T	390 days	130 days
	404T-447TZ	270 days	90 days
	505US-587UZ	210 days	70 days
1200	143T-256T	* 7 years	* 3 years
	284T-326T	4 years	1.5 years
	364T-447TZ	390 days	130 days
	505US-587UZ	270 days	90 days

NOTES :

1. **Remark *: We recommend changing bearing after these operations, but if not changeable, you can relubricate by removing the seal, cleaning and refilling the bearing and the cavity with recommended grease.**
2. **For easy service (1 Hr/day operation) multiply tabled value by 2.**
3. **For very severe service (High vibration, shock) 1/3 of tabled value.**

3. INSTRUCTIONS FOR LUBRICATING

Replace one pipe plug on each end shield with grease fitting. Remove the other plug for grease relief. Be sure fittings are clean and free from dirt. Using a low-pressure grease gun, pump in the recommended grease until new grease appears at grease relief hole. Relubrication intervals is specified on page 7, table 2. After relubricating, allow motor to run for 10 minutes before replacing relief plugs.

4. RECOMMENDED GREASE

Use the following greases or some equivalent lithium based greases unless a special grease is specified on the nameplate.

MOBILUX #2	MOBIL OIL CO.	BEACON 325	EXXON
ALVANIA #2	SHELL OIL CO.	CHEVRON SRI NO.2	STD. OIL CO. OF CALIF.

WARRANTY

Generally, TOSHIBA will correct by repair or replacement any defect in material and workmanship when properly used for a period of one year after installation or 18 months after shipment whichever comes first. TOSHIBA is not responsible for apparatus returned without proper authorization and identification, improper handling or storage, misapplication of the motor or the driven equipment, defects in the driven equipment or device.

RENEWAL PARTS

(1) Use only genuine TOSHIBA renewal parts.
(2) When ordering, specify complete information (at least Model Number and Serial Number) of the motor. Specify quantity and describe part.
(3) For information and service refer to the nearest TOSHIBA INTERNATIONAL CORPORATION office.

WARNING

EXPLOSION-PROOF MOTORS are constructed to comply with the U/L Label Service Procedure Manual. Repairs of EXPLOSION-PROOF MOTORS must be made by the manufacturer or U L listed servicecenter to maintain the U L Listing.

FOR FURTHER INFORMATION CONTACT
TOSHIBA INTERNATIONAL CORPORATION
Industrial Equipment Division
13131 W. LITTLE YORK Rd. P.O. BOX 40906 HOUSTON, TEXAS 77040

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	3-A
Quantity Required:	One
Description:	Motor/Pump Coupling
Manufacturer:	FALK
Part Number:	50-T-10-CGA
Source:	NL Rucker Products NL Industries, Inc. 15401 W. Vantage Parkway Suite 120 Houston, Texas 77032

Tele #: 1-713-987-2117

OTHER FALK STEELFLEX FEATURES

Steelflex couplings are always available from stock with popular straight bores; with taper bores for taper bushings, or with rough stock bores. We also give prompt attention and quick delivery to your special or custom bore requirements.

(1) **TAPERED GRID** . . Made of high strength, chrome-vanadium alloy steel, quenched and tempered to spring hardness. So designed that the stresses developed in the grid by the transmitted load are well below the point at which the fatigue of the metal takes place.

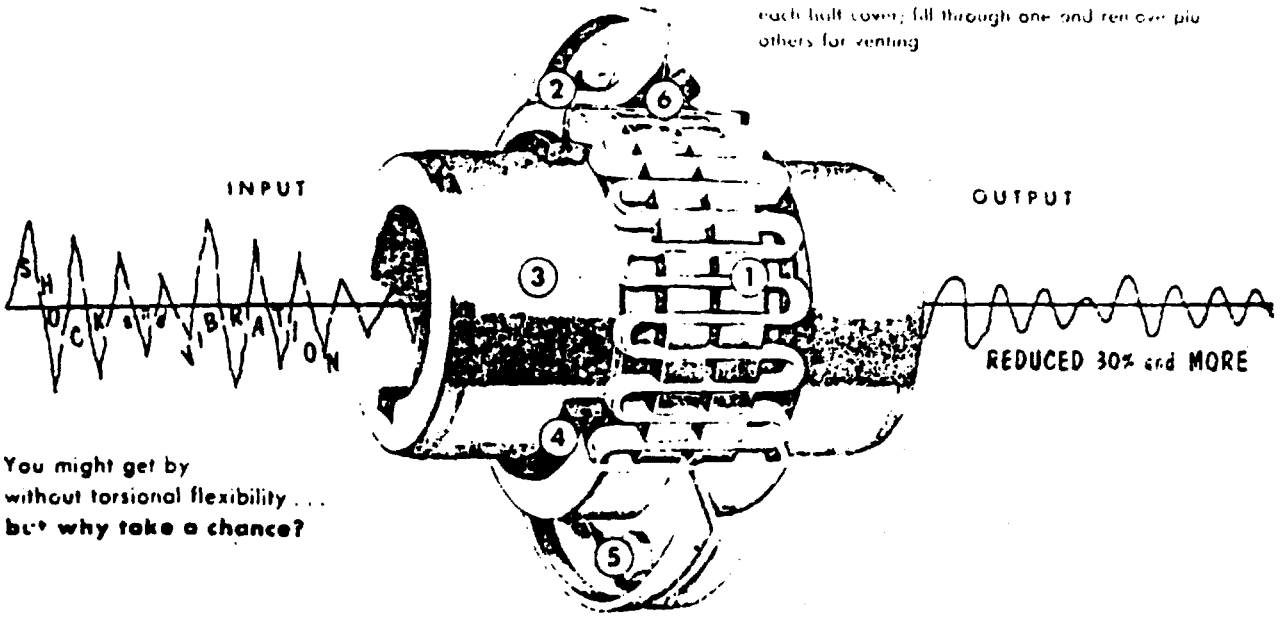
(2) **COVERS** . . Two designs are available. The Type T10 is a horizontal split, alloy aluminum, easily assembled cover especially suited to reversing service. The Type T20 is a vertical split, heavy duty steel cover with a wide flange for easy assembly.

(3) **HUBS** . . Made of steel, accurately machined to permit utilization of any hub surface for measurement of shaft alignment.

(4) **SEALS** . . Made of durable synthetic material and designed to prevent loss of lubricant and entrance of water, dust, or other foreign materials.

(5) **COVER BOLTS** . . Grades 5 and 8, hardened cap screws and either hexagon lock nuts or standard nuts and lock washers are used throughout.

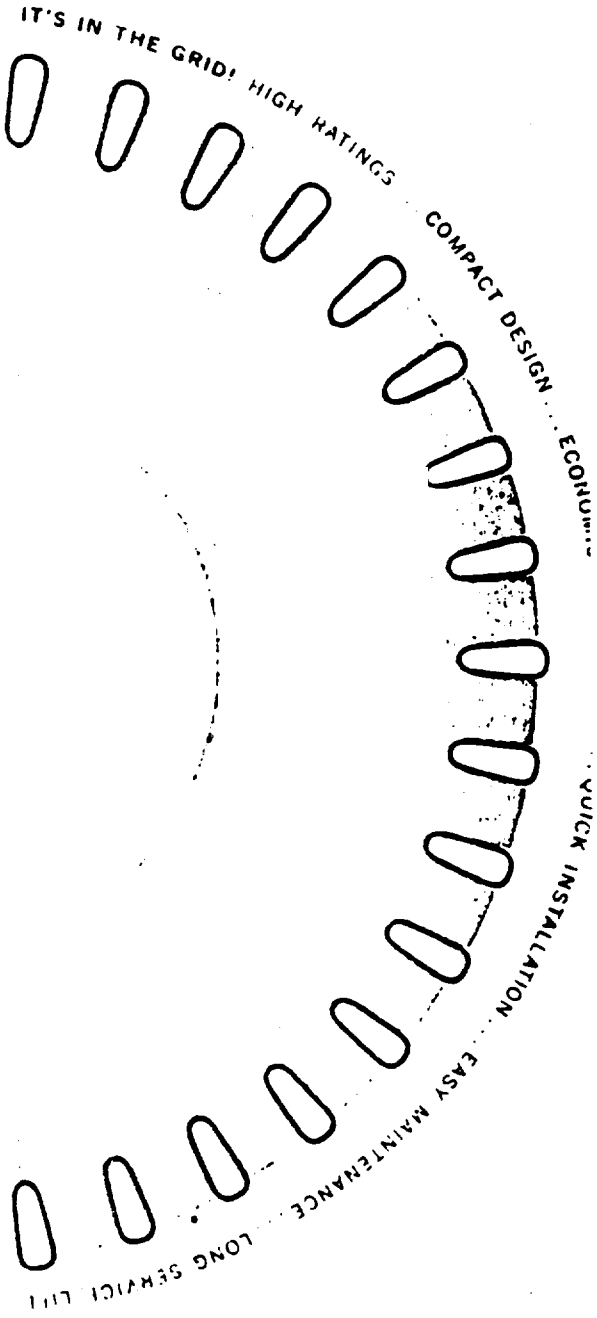
(6) **LUBRICATION FITTINGS** . . Both cover types accept any pressure type lube fitting with a standard ⅛" or ¼" pipe thread depending on coupling size. For ease of lubrication, covers have one or more lube holes in each bolt cover; fill through one and remove plug in others for venting.



You might get by without torsional flexibility . . . **but why take a chance?**

The Company warrants that, for a period of one year from date of shipment, the equipment to be manufactured and delivered hereunder will deliver successfully its rated capacity as indicated in this Bulletin, provided it is properly installed and maintained, correctly lubricated, and operated in the environment and within the limits of speed, torque or other load conditions for which it was sold. Such equipment is expressly NOT warranted against failure or unsatisfactory operation resulting from dynamic vibrations of any form imposed upon it by the drive system in which it is installed, no matter how induced, unless the nature of such vibrations has been fully defined and expressly accepted in writing by the Company as a condition of operation.

Why TAPERED GRID Steelflex couplings?



HIGH RATINGS

Falk Steelflex couplings, using the grid and tooth principle of transmitting power, have been successfully applied for over 50 years. The grid incorporates a tapered cross-section which offers high capacities, yet remains torsionally flexible to smother shock and vibration while compensating for shaft misalignment. These high capacities, together with optimum maximum bore increments, result in low unit cost for the majority of applications.

VERSATILE DESIGN

Interchangeable covers in the popular sizes; choose either Type T10 or T20, whichever best suits your application . . . use the same stock coupling horizontally or vertically without modification . . . any one coupling offers a wide range of "finished bores" . . . maximum bore increments assure economical selections.

EASY ASSEMBLY

Single layer tapered grids slide into place easily, on many applications by hand pressure alone . . . cover assembly accomplished with standard wrenches.

ASY MAINTENANCE

Use any standard grease gun with common, pressure type lube fitting.

LONGER SERVICE LIFE

Millions of Steelflex couplings have gone into service on every conceivable type of industrial application. This experience, combined with extensive laboratory and field tests, is the background for the development of the tapered grid coupling. The result . . . sound basic ratings . . . accurate selection procedures . . . a final, engineered product to provide years of trouble free service.

ALWAYS AVAILABLE FROM OFF THE SHELF

Steelflex couplings and service parts in all the popular sizes and types are available from Factory and service center stocks, or from our more than 300 distributors in all principal cities around the country . . . the largest rough bore, finish straight or taper bore stocks of any shaft coupling on the market.

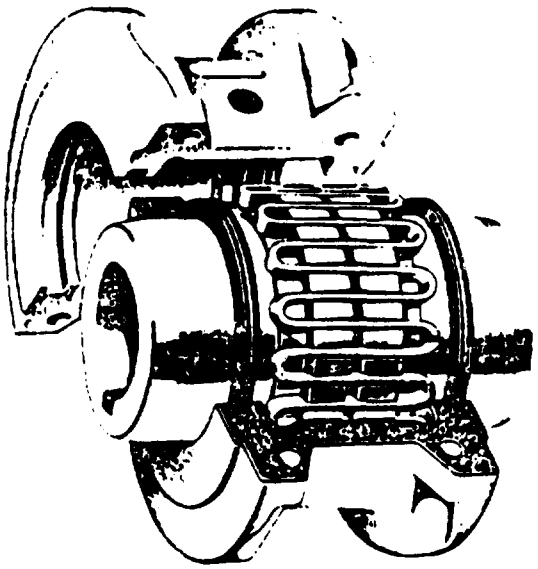
A PRODUCT OF ENGINEERING RESEARCH

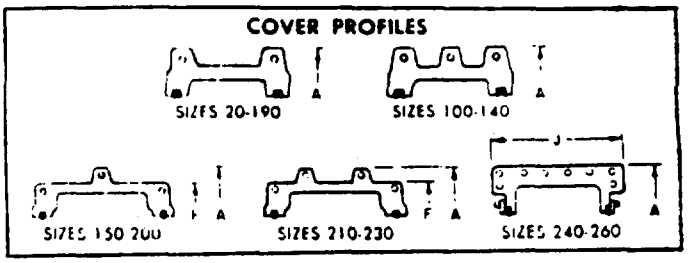
Falk's Type T Tapered Grid Couplings offer positive evidence of leadership in the field of flexible coupling design. The result of extensive testing on specially designed testing machines . . . confirmed by actual field application . . . backed by 50 years successful experience in the design and manufacture of Steelflex couplings, The Falk Corporation expresses confidence that this coupling offers the best protection available for your connected machinery.

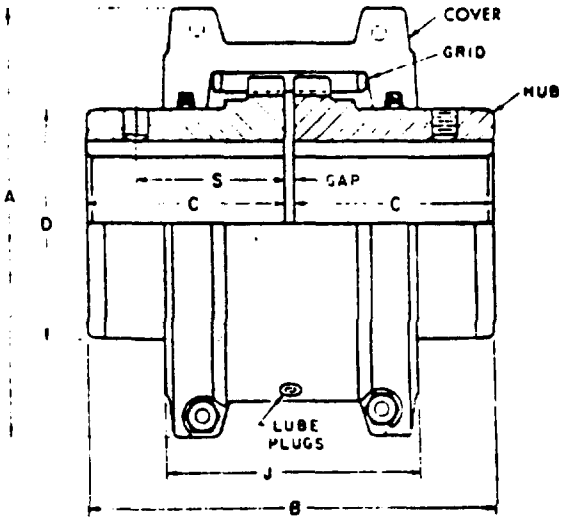
CAUTION: Consult applicable local and national safety codes for proper guarding of rotating shafts and couplings. These products must be installed as explained in Falk Service Manuals. Copies available upon request.

Type T10

WITH HORIZONTAL SPLIT COVER
SIZES 20T10 THRU 260T10

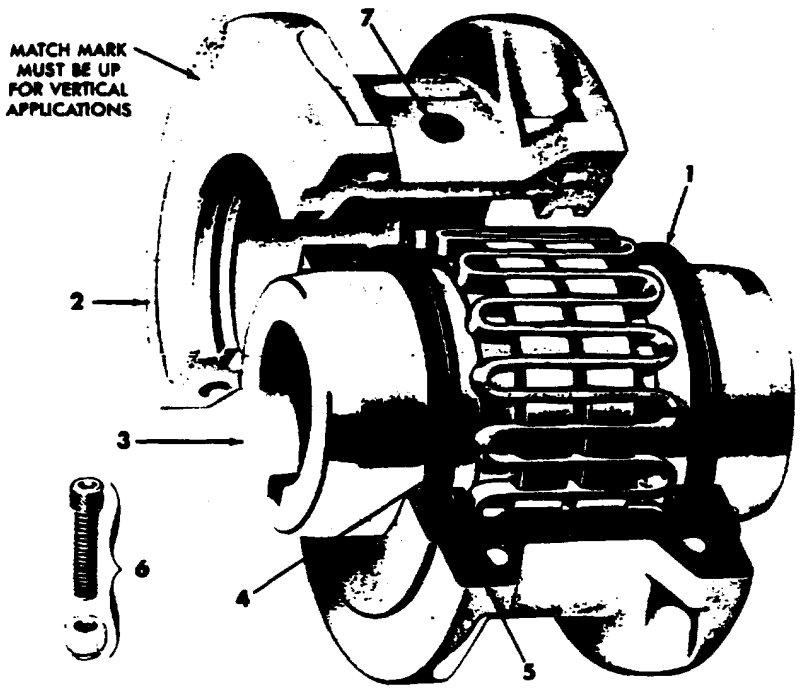






SIZE	Basic Rating	Max Speed rpm	Max* Bore	Min Bore†	Ctlg Wt With No Bore — lb	Lube Wt lb	DIMENSIONS — INCHES							GAP●			SIZE
							A†	B●	C	D	F	J	S	Min	Nor mal	Max	
20TD★	35	4500	1⅛★	½	4	⅛	4	3⅜	1⅞	1⅝		2⅜	▲	⅛	⅛	⅛	20TD★
20T	45	4500	1⅛	½	4½	⅛	4	3⅜	1⅞	1⅝		2⅜	1 23/64	⅛	⅛	⅛	20T
30T	1 17	4500	1⅜	½	5½	⅛	4⅜	3⅞	1⅞	1 49/64		2 17/64	1 33/64	⅛	⅛	⅛	30T
40T	1 96	4500	1⅝	½	7½	⅛	4⅜	4⅛	2	2¼		2¾	1 33/64	⅛	⅛	⅛	40T
50T	3.24	4500	1⅞	⅝	12	⅛	5 5/16	4⅞	2⅜	2⅝		3⅛	1 49/64	⅛	⅛	⅛	50T
60T	5 5	4350	2⅛	¾	16	⅛	5 13/16	5⅛	2½	2		3⅜	2⅛	⅛	⅛	⅛	60T
70T	8 16	4125	2½	¾	23	⅛	6⅜	6⅛	3	3 1/16		3⅜	2⅛	⅛	⅛	⅛	70T
80T	14 3	3600	3	1 5/16	40	⅜	7⅜	7⅛	3½	4⅛		4 9/16	2 13/32	⅛	⅛	¼	80T
90T	22 8	3600	3½	1 5/16	57	⅜	8⅜	7⅞	3⅞	4⅞		4 13/16	2 13/16	⅛	⅛	¼	90T
100T	43 4	2440	4	1⅝	96	⅜	9⅞	9 11/16	4⅜	5 19/32		5⅛		⅛	⅜	⅜	100T

TYPE T10 STEELFLEX COUPLING PARTS



PART NUMBERS

1. Seal (T10)
2. Cover (T10)
3. Hub (Specify bore and keyway)
4. Grid
5. Gasket (T10)
6. Fasteners (T10)
7. Lube Plug

WHEN ORDERING SPARE PARTS, SPECIFY COUPLING **SIZE** AND **TYPE** AS SHOWN ON COUPLING COVER

INTRODUCTION— This manual applies to Sizes 20 thru 140 T10 Falk Steelflex Tapered Grid Couplings. They are designed to operate in either the horizontal or vertical position without modification. However, for vertical applications, the match mark shown above, must be up. The performance and life of the couplings depend largely upon how you install and service them. Carefully follow the instructions in this manual for optimum performance and trouble free service.

PARTS IDENTIFICATION — All coupling parts have identifying part numbers as shown above. Parts 3 and 4 (Hubs and Grids), are the same for both T10 and T20 couplings; all other coupling parts are NOT INTERCHANGEABLE. Therefore, when ordering parts, always SPECIFY SIZE and TYPE shown on the COVER. Sizes 80 thru 140T10 covers have been manufactured with two and three ribs; DO NOT mix these cover halves.

LUBE FITTINGS — Cover halves have ⅛ NPT lube holes. Use a standard grease gun and lube fitting as instructed in Step 6 on Page 2.

LIMITED END FLOAT — When electric motors, generators, engines, compressors and other machines are fitted with sleeve or straight roller bearings, limited axial end float kits are recommended for protecting the bearings. Falk Steelflex couplings are easily modified to limit end float; refer to Manual 428-820 for instructions.

LUBRICATION — Adequate lubrication is essential for proper operation of the coupling. Refer to Table 1 on Page 2 for the amount of lubricant required. It is recommended that the coupling be checked once a year and lubricant added if required. For extreme or unusual operating conditions, check more frequently.

CAUTION: Consult applicable local and national safety codes for proper guarding of rotating members.

LUBRICANT SPECIFICATIONS — Refer to Manual 428-010 for recommended lubricants. The following specifications apply to lubricants for Falk couplings which are lubricated annually and operate within ambient temperatures of 0° to 150°F (−18° to +66°C). For temperatures beyond this range, consult the Factory.

Dropping Point — 300°F (149°C) or higher.

Consistency — NLGI No. 2 with worked penetration value in the range of 250 to 300.

Separation and Resistance — Low oil separation rate and high resistance to separation from centrifuging.

Liquid Constituent — To possess good lubrication properties . . . equivalent to a high quality, well refined petroleum oil.

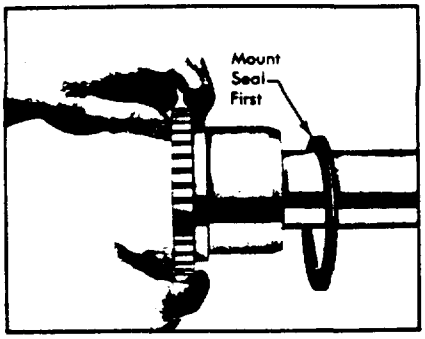
Inactive — Must not corrode steel or cause swelling or deterioration of synthetic seals.

Clean — Free from foreign inclusions.

SEMI-PERMANENT LUBRICATION — Refer to Service Manual 428-012 for details.

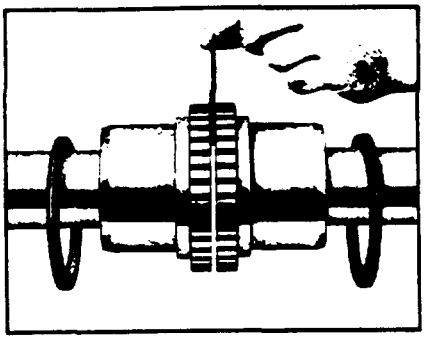
INSTALLATION — Only standard mechanics tools, wrenches, a straight edge and feeler gauges are required to install Falk Steelflex couplings. Coupling Sizes 20 thru 90 are generally furnished for CLEARANCE FIT with set screws. Sizes 100 and larger are furnished for an INTERFERENCE FIT without set screws. Heat hubs with interference fit in an oil bath to a maximum of 275°F (135°C) to mount. The oil flashpoint must be 350°F (177°C) or higher. Refer to Page 2 for detailed mounting instructions.

INSTALLATION OF TYPE T10 STEELFLEX TAPERED GRID COUPLINGS



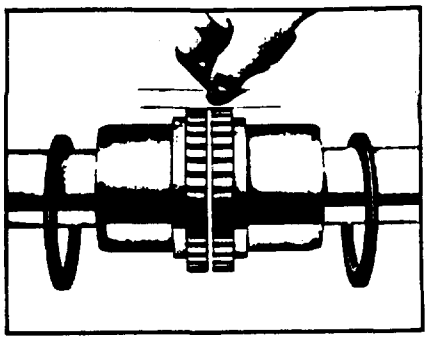
1 MOUNT SEALS AND HUBS

Lock out starting switch of prime mover. Clean all metal parts using a non-flammable solvent. Lightly coat seals with grease and place on *shafts BEFORE mounting hubs. Mount hubs on* their respective shafts so the hub face is flush with the end of its shaft. Tighten set screws when furnished. Heat interference fit hubs as instructed on Page 1.



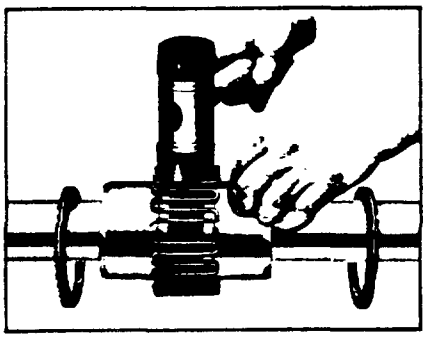
2 GAP & ANGULAR ALIGNMENT

Use a spacer bar equal in thickness to the gap specified in Table 1. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR limit specified in Table 1.



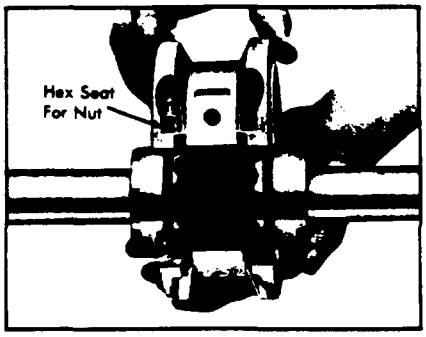
3 OFFSET ALIGNMENT

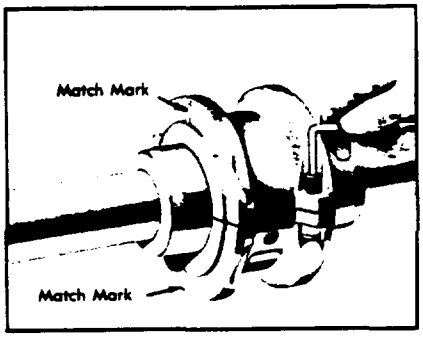
Align so that a straight edge rests squarely (or within the limits specified in Table 1) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the OFFSET limit specified in Table 1. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. NOTE: Use a dial indicator for more accurate alignment.



4 INSERT GRID

Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction; this will permit cover installation. Spread the grid slightly to pass it over the coupling teeth and seat with a soft mallet.





5 PACK WITH GREASE AND ASSEMBLE COVERS

Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark UP, or on the high side. Secure cover halves with fasteners and tighten to torque specified in Table 1. (Note that Sizes 20 thru 70 have a self-locking feature for the stop nuts.) CAUTION: Make certain lube plugs are installed before operating.

VERTICAL COUPLINGS

TABLE 1 INSTALLATION DATA* (Dimensions-Inches)

SIZE	Gap	Operating* Alignment Limits		Cover Bolt Torque (lb-in)	Max Speed (rpm)	Lube Wt (lb)
		Offset (Max)	Angular (Max)			
20T	.125	.005	.005	100	4500	.06
30T	.125	.005	.005	100	4500	.06
40T	.125	.005	.005	100	4500	.12
50T	.125	.005	.005	200	4500	.12
60T	.125	.010	.010	200	4350	.19
70T	.125	.010	.010	200	4125	.19
80T	.125	.010	.010	200	3600	.38
90T	.125	.012	.012	200	3600	.56
100T	.188	.012	.012	260	2440	.94
110T	.188	.012	.012	260	2250	1.1
120T	.250	.012	.012	650	2025	1.6
130T	.250	.012	.012	650	1800	2
140T	.250	.015	.015	650	1650	2.5

* Refer to Bulletin 421-110 for maximum bores and Engineering 427-108 for reboring instructions.

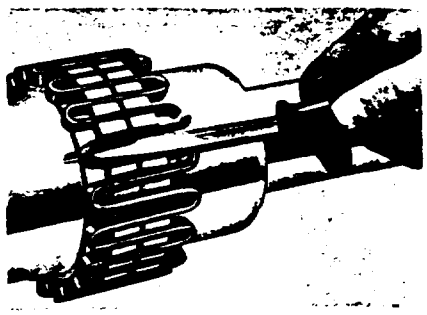
* Align couplings within "Operating Alignment Limits" specified above. Exceeding these limits reduces coupling life.

6 PERIODIC LUBRICATION

— Remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. CAUTION: Make certain all plugs have been inserted after lubricating.

COUPLING DISASSEMBLY AND GRID REMOVAL

Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screw driver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screw driver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.



DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	3-C
Quantity Required:	One
Description:	Gear Pump Coupling
Manufacturer:	MAGNALOY
Part Number:	100-1BX1/4K-3/4BX3/16K-170
Source:	MAGNALOY Coupling Company Division of Douville-Johnston Corp. P. O. Box 295 Alpena, Michigan 49707

Tele #: 1-517-356-2187

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.: 3-C

Quantity Required:	One
Description:	Levelwind Coupling
Manufacturer:	MAGNALOY
Part Number:	100-1BX1/4 K-5/8BX3/16K-170
Source:	MAGNALOY Coupling Company Division of Douville-Johnston Corp. P. O. Box 295 Alpena, Michigan 49707

Tele #: 1-517-356-2187

Light Weight Magnesium Construction (24% weight of cast iron - - 64% weight of aluminum) provides many important benefits, such as a largely reduced flywheel effect and low starting and stopping inertia; reduced load on bearings extends life of pump, motor and/or machine: easier handling for installation; and rust proof and corrosion resistance.

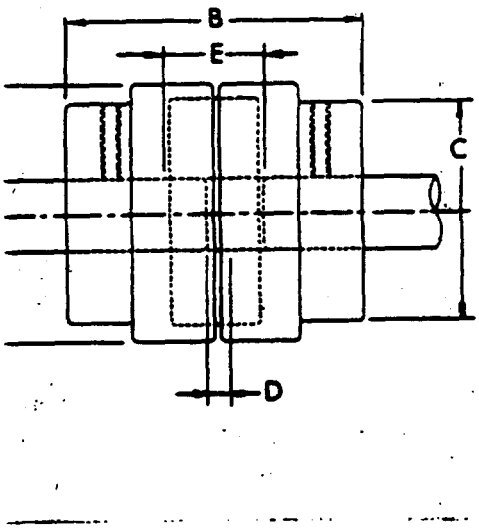
Visual Alignment - Accurately machined, flat exterior surface permits easy alignment by using a simple straight edge or scale - no special tools or templates are needed (see back cover for installation instructions).

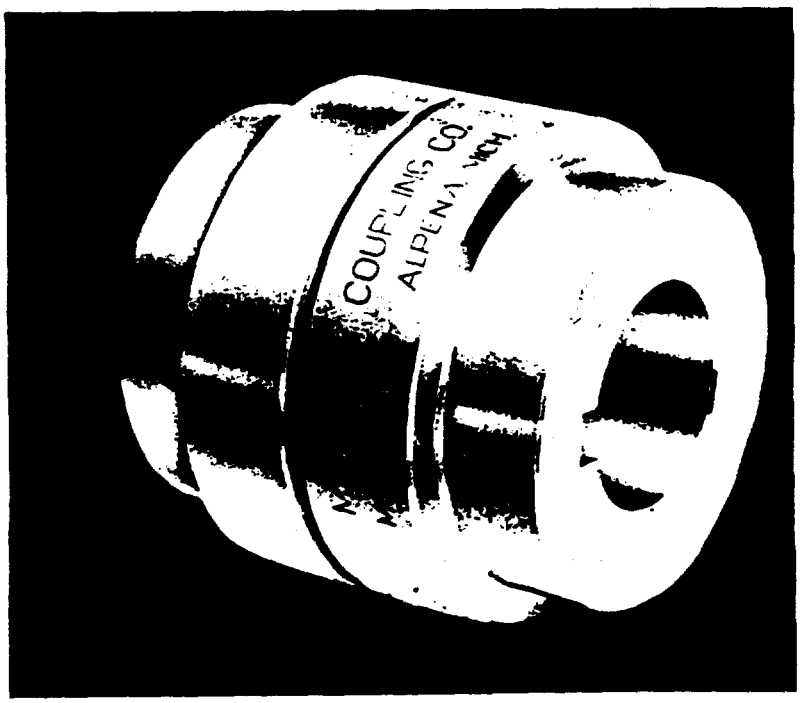
Maximum Torsional Strength - Solid magnesium alloy sand castings are heat treated and offer the highest strength-to-weight ratio available. Design includes reinforced drive lugs, and a capsulated insert to prevent insert extrusion and disintegration at high speeds, or high loads.

Precision Machining - All Magnaloy couplings are machined to .002" T.I.R. between center line of bore and large O.D. Machining tolerances of ±.010" with critical dimensions ±.001". This extreme manufacturing precision assures vibration-free (balanced) operation even at very high RPMs, and permits matched parts replacement.

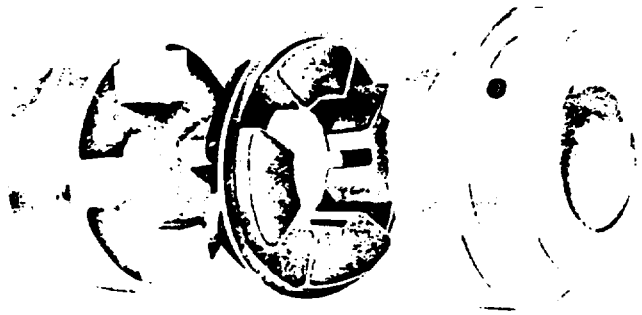
magnaloy flexible-drive cou

STANDARD KEYED BORES
(dimensional drawing)





Magnaloy Coupling's full range of flexible inserts permit custom designed performance for a wide range of applications. All insert materials offer complete electrical insulation, as Magnaloy's design eliminates all metal-to-metal contact.



Specify desired insert by using model insert number (R H column of table below) followed by material symbol and the durometer (hardness) divided by ten.

Insert Material Symbols
Neoprene — N
Urethane — U
Viton — V
EPDM — E
Rubber — R
Buna-N — B
Hytrel — H

Example
570-N7

Recommended Coupling Insert Materials

NEOPRENE —— Standard insert (70 durometer) for use under normal conditions. Other durometers available (50, 80, and 90) to facilitate matching coupling to specific needs. As the durometer number increases, the torsional stiffness and compression set resistance of the coupling also increases.

URETHANE -- Recommended for use where extreme and cyclic loading conditions exist. It has very good compression set and abrasion resistance characteristics.

VITON -- Extremely good resistance to a broad range of chemicals. It is recommended that a chemical resistance chart be consulted before specifying.

EPDM and NATURAL RUBBER -- Recommended for use where resistance to extremely low temperatures is needed.

NEW! HYTREL ... Exceeds the loading capabilities of urethane while offering high temperature resistance (300°F).

Additional insert materials and pricing is available upon request from factory.

COUPLING SPECIFICATIONS

Coupling Model	Basic Insert Number	Maximum Bore*		Rated Torque Capacity		HP Rating Per 100 RPM		Wr^2 LB.-Ft.^{2}	Torsional Rigidity LB.-IN./Deg.	Approx. Weight		Dimensions Inches			D Distance Betw Shaft Ends Inches	E	No. of Drive Lugs	Stands Set-Scr Size
		IN.	MM	LB.-IN.	N-M	HP	HP (metric)			LB.	Kg	A	B	C	Min.	Max. Full Brg.		
~~100~~	~~170~~	1	25	1141	129	1.81	1.84	.0046	218	3/4	.3	2.60	2.6	2.00	1/16	3/4	3	1/4–
200	270	1 1/4	31	1474	167	2.34	2.37	.0068	204	1	.5	2.90	3.1	2.25	1/16	7/8	3	5/16–
300	370	1 1/2	38	2821	319	4.48	4.54	.022	261	2	.9	3.45	3.6	2.90	1/16	7/8	3	5/16–
400	470	1 3/4	44	4085	462	6.48	6.57	.031	312	3	1.4	4.00	4.3	3.05	1/16	1 1/8	3	3/8–
500	570	2 1/4	57	8247	932	13.40	13.59	.071	1125	4	1.8	4.80	4.7	4.00	1/16	1 1/4	4	3/8–
600	670	2 5/8	66	11,596	1310	18.40	18.66	.16	2030	7	3.2	5.97	6.0	4.50	1/16	1 3/8	6	3/8–
700	770	2 7/8	73	16,659	1882	26.43	26.80	.34	3100	12	5.4	6.90	7.1	5.19	1/16	1 7/8	6	1/2–
800	870	3 7/8	98	26,999	3050	42.83	43.43	.95	---	18	8.2	8.60	8.0	7.00	1/16	2	6	1/2–
900	970	4 3/4	120	62,008	7007	98.38	99.76	4.20	---	38	17.2	11.40	9.9	8.30	1/16	2 1/2	6	3/4–

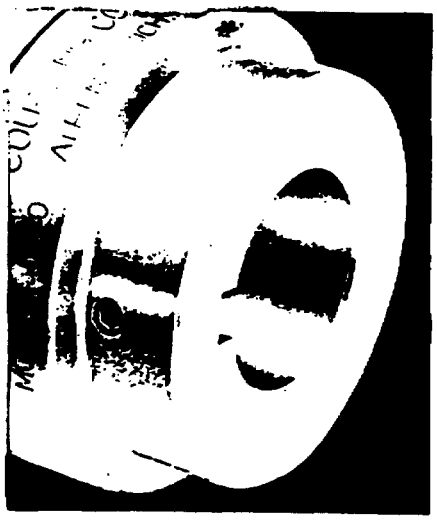
**For Keyways Larger Than Standard (opposite page), Consult Factory.*

NOTE: Above Torque and H.P. Ratings are Based on Laboratory Tests Conducted by the Mechanical Engineering Department, University of Michigan, Ann Arbor, Michigan, 1977.

"Standard" bores and keyways are available from warehouse stock for immediate delivery. "Semi-standard", "in-plant" splined, and other special sizes are available with minimum delay.

Bore Tolerances

OVER	INCLUD	TOLERANCE
–	1	+.0005/+.000
1	2	+.0008/+.000
2	3	+.0012/+.0002
3	4	+.0015/+.0005
4	5	+.002/+.001



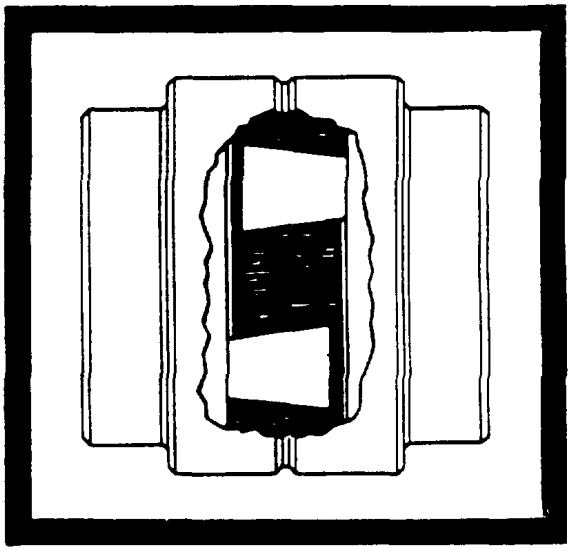
Magnaloy "Standard" Bore & Key Combinations

	Model No.							
BORE KEY	1	2	3	4	5	6	7	8
3/8 x 3/32	•	•						
7/16 x 3/32	•	•						
7/16 x 1/8	•	•						
1/2 x 1/8	•	•	•					
9/16 x 1/8	•	•	•					
5/8 x 5/32	•	•	•					
5/8 x 3/16	•	•	•	•				
11/16 x 3/16	•	•	•	•				
3/4 x 1/8	•	•	•					
[redacted]		•	•	•	•	•		
7/8 x 3/16	•	•	•	•	•	•		
7/8 x 1/4	•	•	•	•	•	•		
15/16 x 1/4		•	•					
1 x 3/16	•	•	•	•	•	•		
1 x 1/4	•	•	•	•	•	•		
1- 1/8 x 1/4		•	•	•	•	•		
1- 3/16 x 1/4			•		•			
1- 1/4 x 1/4		•	•	•	•	•		
1- 1/4 x 5/16		•	•	•	•	•	•	•
1- 3/8 x 5/16			•	•	•	•	•	•
1- 3/8 x 3/8			•					
1- 7/16 x 3/8			•	•	•			
1- 1/2 x 5/16			•	•	•			
1- 1/2 x 3/8			•	•	•	•	•	•
1- 5/8 x 3/8				•	•	•	•	•
1- 3/4 x 3/8				•	•	•	•	•

BORE KEY	Model No. 4	5	6	7	8	9
1- 3/4 x 7/16	•	•	•	•	•	
1- 7/8 x 1/2		•	•	•	•	•
1-15/16 x 1/2		•	•			
2 x 1/2		•	•	•	•	•
2- 1/8 x 1/2		•	•	•	•	•
2- 1/4 x 1/2		•	•	•	•	•
2- 3/8 x 5/8			•	•	•	•
2- 1/2 x 5/8			•	•	•	•
2- 5/8 x 5/8			•	•	•	•
2- 3/4 x 5/8				•	•	•
2- 7/8 x 3/4				•	•	•
3 x 3/4					•	•
3- 1/4 x 3/4					•	•
3- 3/8 x 7/8					•	•
3- 1/2 x 7/8					•	•
3- 5/8 x 7/8					•	•
3- 3/4 x 7/8					•	•
3- 7/8 x 1					•	•
4- x 1						•
4- 1/8 x 1						•
4- 1/4 x 1						•
4- 3/8 x 1						•
4- 1/2 x 1						•
4- 1/2 x 1-1/4						•
4- 5/8 x 1-1/4						•
4- 3/4 x 1-1/4						•

Keyway Tolerances: Width –.000 + .0015
Depth –.000 + .005

"Load-Lock" Design is simple and effective. The drive-lug configuration is reduced from face to base, as is the mating lug of the other half of the coupling. This forms an interlocking inverted "V" with the insert when under load. This load-lock design protects bearings by eliminating all end thrust in both directions, and it requires only one set screw in each coupling half.



Selection Method

1. Several specifics must be considered to make the best choice of couplings:
   A. Type of prime mover and load characteristics (see table below).
   B. Shaft diameter and key size or spline configuration (no. of teeth, pitch ratio, pressure angle.)
   C. Horsepower rating of loads to be transmitted.
   D. Maximum operating speed (rpm).
   E. Maximum operating misalignment.
   F. Clearance limitations.
2. Calculate effective hp/100 rpm by use of table below and select the minimum size coupling recommended.
3. VERIFY YOUR SELECTION:
   A. Check for maximum bore size.
   B. Check dimensions for adequate clearance.
   C. Indicate any special insert specification and/or coupling coating for environmental protection, if required.

Horsepower Service Factors for Selection of Magnaloy Couplings
(Equation: hp (effective)/100 rpm = hp (actual) x S.F. x 100/rpm)

LOAD CHARACTERISTICS	TYPE OF PRIME MOVER			
	MOTOR (Std. Torque) OR TURBINE	MOTOR (High Torque)	I.C. ENG. (More than 6 cylinder)	I.C. ENG. (Less than 6 cylinder)
LIGHT . Even Load . Non-Reversing . Low Torque	1.0	1.25	1.5	1.75
MEDIUM . Uneven Load . Moderate Shock . Infreq. Revers. . Medium Torque	1.5	1.75	2.0	2.5*
HEAVY . Uneven Load . Heavy Shock . Freq. Reversing . High Torque	2.0*	2.25*	2.75*	3.0*

NOTE: Above service factors are intended for use as a general guide only.

***Recommend use of Urethane Insert.**

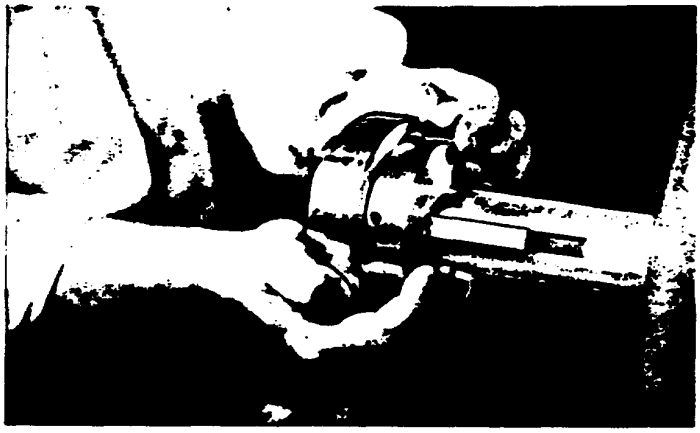
DECKMASTER

Magnaloy Couplings offer four-way flexibility (parallel, angular, axial and torsional) and require no lubrication. They are easily installed and properly aligned without use of special equipment which is important because poor alignment produces excess stress on bearings and coupling. Magnaloy's insert reduces noise and vibration, permits needed flexibility, and serves as a prime safety feature, as the insert accepts all misalignment strain. The worst that will happen is that misalignment will cause excess insert wear; however, the insert is Inexpensive and easy to replace. Under normal conditions the insert seldom requires replacement.

installation instructions

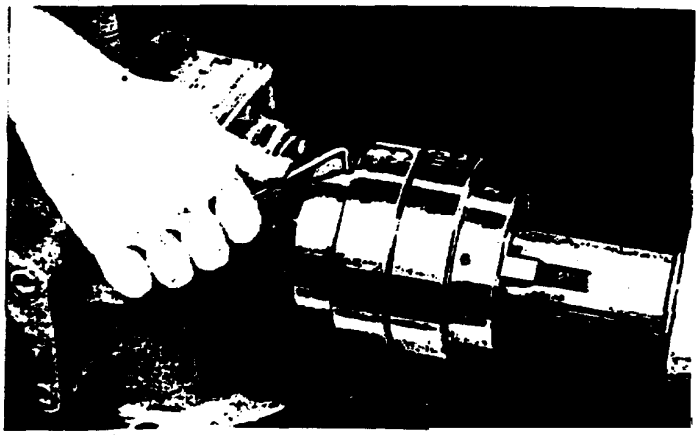
Magnaloy Couplings are bored to standard "push-fit" dimensions. If fit is too tight, check shaft for burrs.

Shaft Spacing should not be closer than the web around the outside of the insert, nor farther apart than the insert's thickest dimension.



Alignment - Place scale at top and side of coupling. Use a .005" feeler gauge under scale for final inspection. This will indicate amply accurate parallel and angular alignment. Magnaloy's precisely tooled outside surface permits this simple, but accurate method.

Before Tightening Set Screws, run coupling to see if it separates or tends to "creep". Recheck for angular alignment, then tighten two set screws.



DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

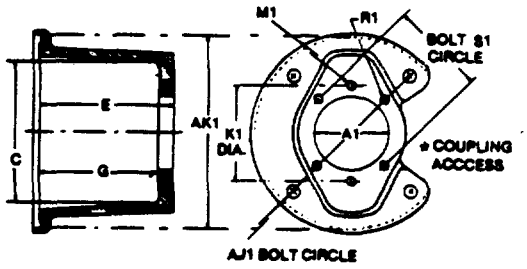
COMPONENT DESCRIPTION

Reference Item No.:	3-D
Quantity Required:	One
Description:	Pump/Motor Mount
Manufacturer:	MacMillin
Part Number:	F3-C
Source:	MacMillin Hydraulic Engineering Corp. 7355 North Lawndale Avenue Skokie, Illinois 60076

Tele #:	1-312-676-2910
TELEX #:	28-3508

TABLE 5 — TYPE F3 MOUNTS

For NEMA Frames 284TC/TSC thru 286TC/TSC



F3-A †	SAE A 2-Bolt and 4-Bolt	3.251	5.50	6.87	6.62	4.188	2-3/8-16	4-3/8-16	4.125	4-17/32 on 9" B.C.	10.502 10.505	13.0
F3L-A †				8.68	8.43							17.5
F3-B †	SAE B 2-Bolt and 4-Bolt	4.001		6.87	6.49	5.75	2-1/2-13	4-1/2-13	5.00			13.0
F3L-B †				8.68	8.30							17.0
F3-C †	SAE C 2-Bolt and 4-Bolt	5.001		6.87	6.37	7.125	2-5/8-11	4-1/2-13	6.375			13.0
F3L-C †				8.68	8.18							16.5

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	4-A
Quantity Required:	One
Description:	Piston Pump
Manufacturer:	Sundstrand
Part Number:	20-2065-HDC
Source:	Sundstrand Hydro-Transmission 2800 East 13th Street Ames, Iowa 50010

Tele #: 1-515-232-3370

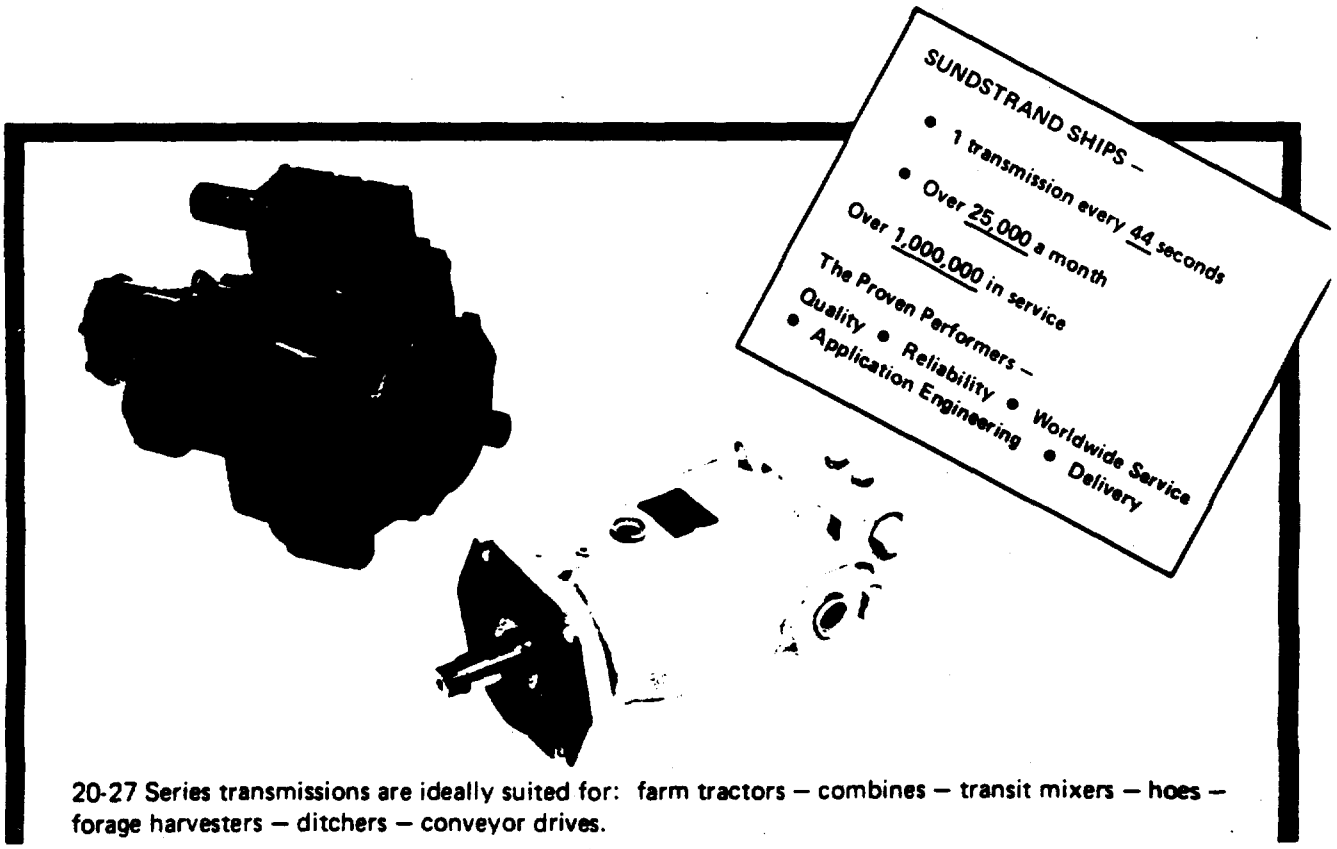
DECKMASTER

SUNDSTRAND 20-27 Series TRANSMISSION

Sundstrand Heavy-Duty 20-27 Series transmissions provide a high quality, high performance means of transmitting power. The components-variable displacement pump, fixed displacement motor, and variable displacement motor-are available in eight standard sizes and provide the ultimate in simplicity for controlling speed, direction, and power levels to 465 max. horsepower.

Numerous control systems are available, including displacement pressure override, swing, elected-servo, etc., to provide the best drive suited to the application.

Sundstrand hydrostatic transmissions have been field proven on over 825,000 applications (650 million operating hours). National Sundstrand sales and service representatives located throughout the country provide experienced application assistance and prompt delivery of transmissions to meet your requirements.



20-27 Series transmissions are ideally suited for: farm tractors – combines – transit mixers – hoes – forage harvesters – ditchers – conveyor drives.

20-27 Series

DESIGN PARAMETERS

Continuous working pressure at rated speed ..... 3000 psi
Heavy-duty capability. Normal relief valve setting ..... 5000 psi
Shock load capability. Proof pressure rating ..... 10,000 psi
Safety limit (actual test) ..... 20,000 psi

SERIES AND SPECIFICATIONS

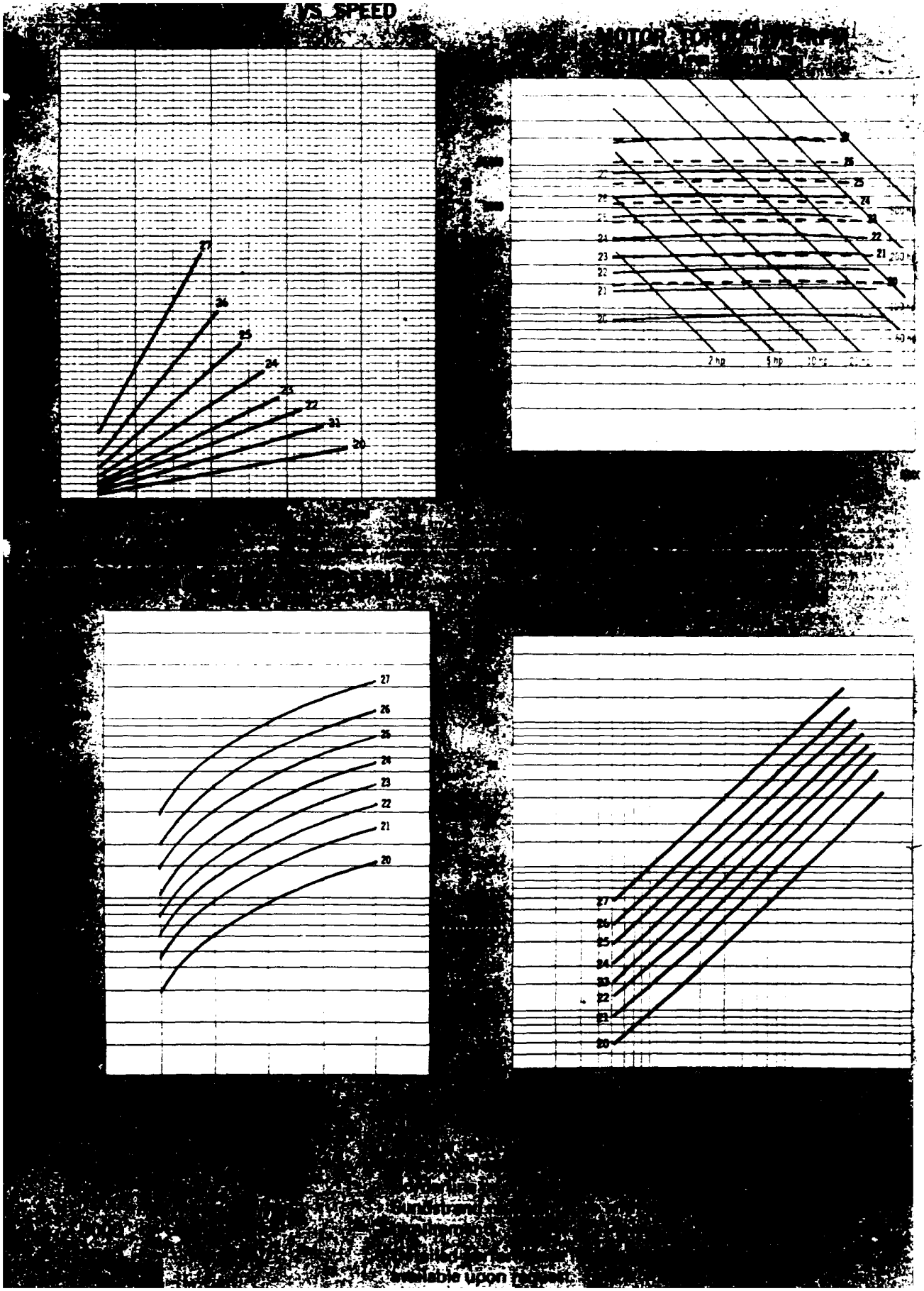
SERIES	MAX. DISP. IN.³	TORQUE PER* 1000 PSI FT.-LB.	HP PER 1000 PSI* @ 1800 RPM	HP PER 1000 PSI* @ 1200 RPM	MAX. SHAFT SPEED RPM
20	2.03	27.0	9.21	6.14	3800
21	3.15	41.8	14.30	9.53	3500
22	4.26	56.6	19.35	12.90	3200
23	5.43	72.0	24.67	16.45	2900
24	7.24	96.0	32.90	21.90	2700
25	10.12	134.5	46.00	30.70	2400
26	13.87	184.0	63.00	42.00	2100
27	20.36	270.0	92.50	61.67	1900

*Theoretical Values

VARIABLE DISPLACEMENT PUMP, VARIABLE DISPLACEMENT MOTOR DIMENSIONS (APPROX.)

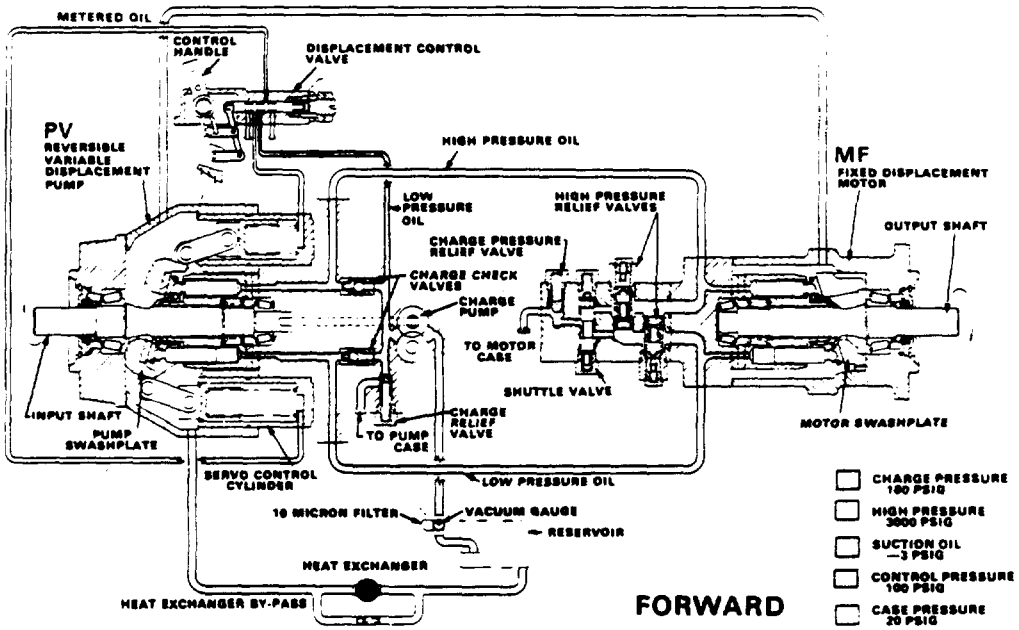
SERIES	LENGTH*	WIDTH*	HEIGHT*	MOUNTING FLANGE SAE SIZE	DRIVESHAFT	(APPROXIMATE) P. V. WT.-LBS.	(APPROXIMATE) M. V. WT.-LBS.
20	14	8¾	10⅞	C	14T-12/24 Pitch**	97	109
21	14 1⅛	10	11¼	C	14T-12/24 Pitch**	118	129
22	15⅜	10½	11½	C	14T-12/24 Pitch**	135	146
23	15⅝	11⅞	12⅜	C	14T-12/24 Pitch**	173	184
24	19 1¾	13⅜	13⅜	D	13T- 8/16 Pitch**	273	266
25	22⅛	14¼	15	E	13T- 8/16 Pitch**	359	370
26	23⅞	14¼	16⅜	E	13T- 8/16 Pitch**	515	539
27	24⅞	16⅜	17½	F	15T- 8/16 Pitch**	592	602

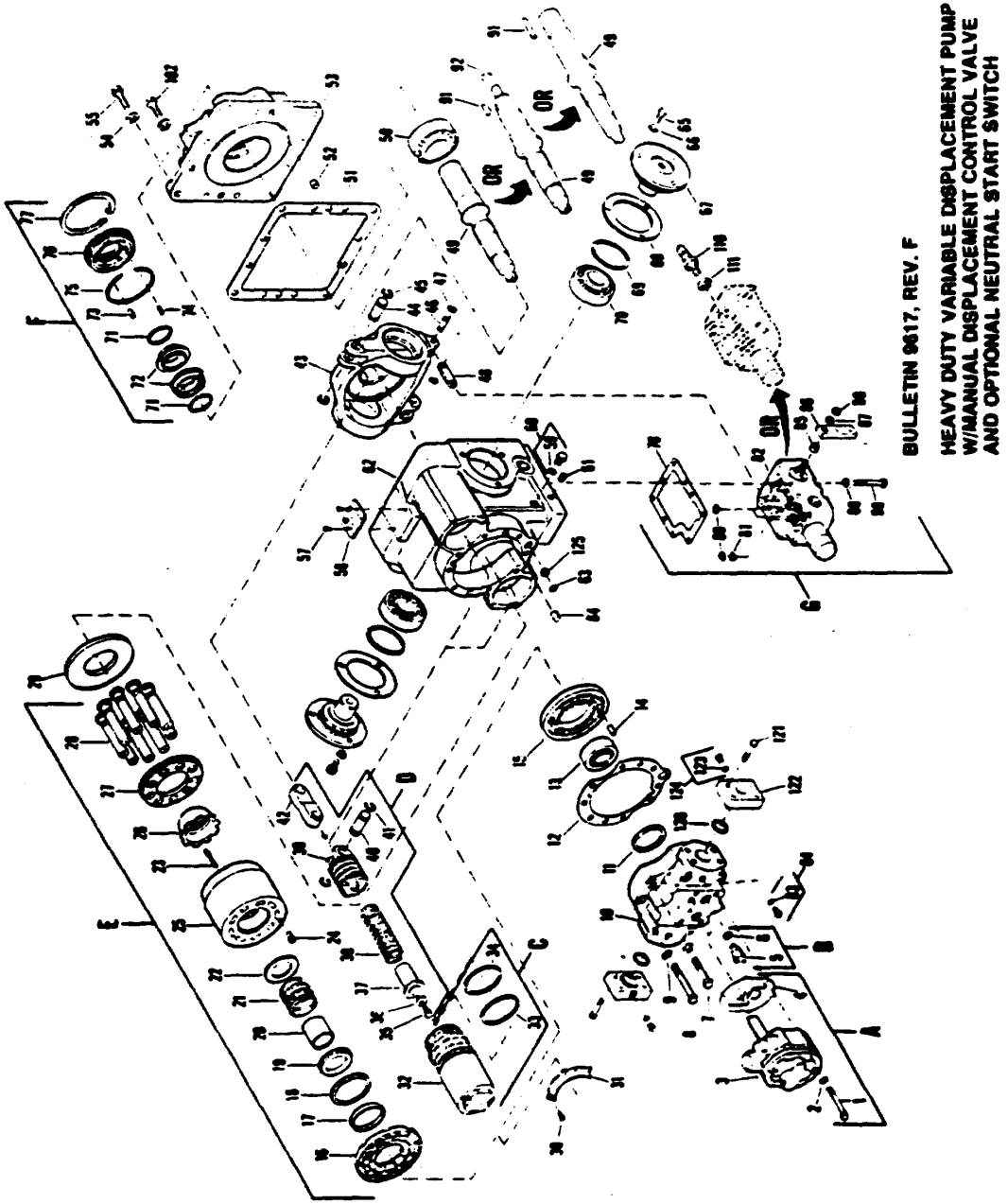
*Maximum Dimensions In Inches **SAE Taper And Other Shafts Available


VS. SPEED
MOTOR
27
26
25
24
23
22
21
20
2 hp
5 hp

OPERATION SCHEMATICS

PV-MF
VARIABLE PUMP – FIXED MOTOR





BULLETIN 9617, REV. F

HEAVY DUTY VARIABLE DISPLACEMENT PUMP
W/MANUAL DISPLACEMENT CONTROL VALVE
AND OPTIONAL NEUTRAL START SWITCH

MODEL NO. - 20-2065 DESCRIPTION - PUMP VAR REVISION DATE - 00-00-00 REVISION NO. --
FOR PART REFERENCE IDENTIFICATION SEE BULLETIN 9617

KIT REF	KIT NUMBER	KIT NUMBER DESCRIPTION	QTY/ MODEL	PART REF	PART NUMBER	NOTE ID	PART NUMBER DESCRIPTION		QTY/ MODEL	SUPERCEDED PART NUMBER	REV NO
				069	9004100-2160		O RING		2		
				065	9004101-0140		O RING		1		
				059	9004201-2500		O RING		1		
				014	9004800-2510		PIN	ST HDLS	1		
				052	9004800-3708		PIN	ST HDLS	2		
				064	9004800-3708		PIN	ST HDLS	2		
				044	9004830-0001		PIN		2		
				046	9004030-2501		PIN		1		
				061	9005001-1200		PLUG	PIPE	1		
				060	9005100-4400		PLUG	ST THD	1		
				045	9006300-0050		RING	RETG	4		
				047	9006375-0026		RING	RETG	2		
				065	9007200-3112		SCREW	HEX HD	6		
				055	9007200-3722		SCREW	HEX HD	11		
				007	9007200-3728		SCREW	HEX HD	3		
				008	9007200-3736		SCREW	HEX HD	4		
				030	9007276-0011		SCREW	TORX	4		
				057	9007600-1103		SCREW	DRIVE	2		
				066	9009610-3459		WASHER	PLN	6		
				004	9009610-4069		WASHER	PLN	8		
				054	9009610-4069		WASHER	PLN	12		
				067	9200018		TRUNNION		2		
				053	9200075		COVER	FRT	1		
				051	9200076		GASKET	FRT COV	1		
				031	9200087		RETAINER	SLEEVE	2		
				012	9200088		GASKET	END CAP	1		
				029	9200159		PLATE	TRUS	1		
				062	9200168		HOUSING	VAR	1		
				043	9200201		SWPLATE	VAR	1		
				049	9200289		SHAFT PMP		1		
				015	9200429		PLATE	VAL LH	1		
				010	9200432		END CAP	PUMP	1		
D	9200490	PISTON SERVO	2	040	9004830-0001		PIN		2		

MODEL NO. - 20-2065 DESCRIPTION - PUMP VAR REVISION DATE - 00-00-00 REVISION NO. --
FOR PART REFERENCE IDENTIFICATION SEE BULLETIN 9617

KIT REF	KIT NUMBER	KIT NUMBER DESCRIPTION	QTY/ MODEL	PART REF	PART NUMBER	NOTE ID	PART NUMBER DESCRIPTION		QTY/ MODEL	SUPERCEDED PART NUMBER	REV NO
				041	9006300-0050		RING	RETG	4		
				035	9007575-0005		SCREW	12PT HD	2	9007575-0005	
				036	9009625-2604		WASHER	SPECIAL	2		
				042	9200467		LINK	SERVO P	2		
				039	9200488		PISTON	SERVO	2		
				037	9210046		GUIDE	SPRING	2		
				038	9210529		SPRING	SERVO	2		
E	9200546	CYL BLK KIT	1	018	9006200-0175		RING	RETG	1		
				022	9200013		SEAT	SPRING	1		
				020	9200015		GUIDE	SPRING	1		
				026	9200124		GUIDE	SLP RET	1		
				027	9200158		RETAINER	SLP	1		
				017	9200179		PILOT	BRG PLT	1		
				016	9200216		PLATE	BRG	1		
				024	9200228		PIN		1		
				019	9200336		RETAINER	SPRING	1		
				028	9200499		PISTON	ASSY	9		
				021	9200503		SPRING	CYL BLK	1		
				025	9200544		CYL BLK		1		
				023	9200545		SPRING	S RET G	6		
				058	9220355		NAMEPLATE		1		
F	9510189	KIT SEAL	1	075	9004100-2340		O RING		1		
				071	9004104-1290		O RING		2		
				077	9006201-0334		RING	RETG	1		
				072	9210329		SEAL	KIT	1		
				074	9220242		SPRING	SEAL	6		
				076	9510441		SEAL RETAINER		1		
				000	9593		BULLETIN		1		

MODEL NO. -20-2065 **DESCRIPTION-PUMP VAR** **REVISION DATE- 00-00-00** **REVISION NO. _**

FOR PART REFERENCE IDENTIFICATION SEE BULLETIN 9617

KIT REF	KIT NUMBER	KIT NUMBER DESCRIPTION	QTY/ MODEL	PART REF	PART NUMBER	NOTE ID	PART NUMBER DESCRIPTION	QTY/ MODEL	SUPERCEDED PART NUMBER	REV NO.
C	9510206	KIT SERVL SL	2	034	9004100-1360		O RING	2		
				033	9004100-1390		O RING	2		
				032	9200528		SLEEVE SERVO	2		
				013	9510250		BEARING-REAR	1		
				050	9510251		BEARING-FRONT	1		
				070	9510252		BEARING-TRUNNIO	2		
A	9510365-0001	KIT CHG PUMP	1	003	N/A		N/A	1		
				001	9007200-2540		SCREW HEX HD	4		
				002	9009610-2850		WASHER PLN	4		
				000	9592		BULLETIN	1		
				004	9801235		GASKET CHO PMP	1		
G	9510368-2001	KIT CONT VA	1	082	N/A		N/A	1		
				088	9003560-2500		NUT HEX	1		
				080	9004101-0140		O RING	3		
				090	9007200-2530		SCREW HEX HD	9		
				089	9009610-2850		WASHER PLN	9		
				087	9009660-2500		WASHER TOOTHLK	1		
				086	9800916		HANDLE CONT S	1		
				085	9800917		SPACER CONT H	1		
				078	9802472		GASKET	1	9801240	
				068	9510422-0001		KIT TRUN SHIM	1	9200019	
				011	9510423-0001		KIT SHIM	1	9200343	
B	9800648	VALVE CK	2	006	9004101-0150		O RING	2		
				048	9800905		LINK	1		
				081	9801094		PLUG CONT V	1		

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

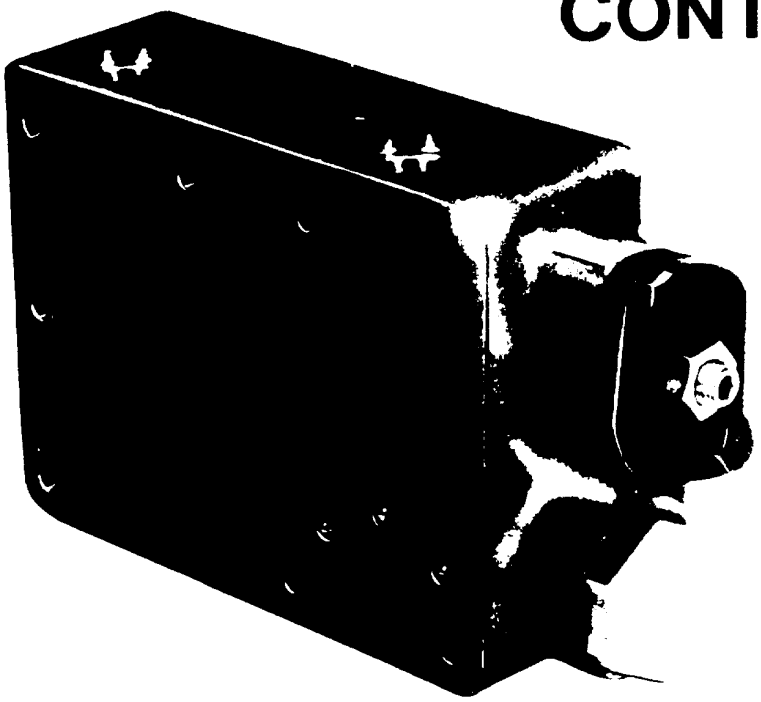
COMPONENT DESCRIPTION

Reference Item No.:	4-B
Quantity Required:	One
Description:	Pump Stroke Control
Manufacturer:	Sundstrand
Part Number:	MCV-106A -5001
Source:	Sundstrand Mobile Controls 3900 Annapolis Lane North Minneapolis, Minnesota 55441

Tele #: 1-612-559-2121

SUNDSTRAND Mobile Controls

MCV106AXXXX
HYDRAULIC DISPLACEMENT CONTROL-PV



SUNDSTRAND

0241

JUNE 1983
BULLETIN 95-8972

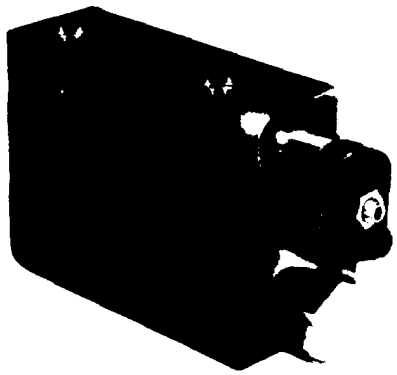
MCV106AXXXX Hydraulic Displacement Control-PV

BULLETIN 95-8972

APPLICATION

The MCV106A Hydraulic Displacement Control (HDC) is a cost-effective hydraulic pump stroke control which uses mechanical feedback to establish closed-loop control of the swashplate angle of Sundstrand Series 2X and Series 3X pumps.

The HDC accepts a differential hydraulic pressure signal from a control handle or servovalve and uses the differential pressure to drive its double spool arrangement and port oil to the pump servocylinders. The spool configuration allows a null deadband for machine safety in the pump's output while maintaining optimum dynamic response to control commands.



FEATURES

- Servo control deadband independent of signal null deadband: offers safety combined with accurate and responsive control
- Resistant to the environment: shock, vibration and humidity tested
- High porting spool force resists chip plugging
- Swashplate movement can be visually detected at the feedback shaft
- Low cost

SPECIFICATIONS

HYDRAULIC

OIL VISCOSITY
40-6000 SSU

OIL TEMPERATURE
-40° to 121° C (-40° to 250° F) operating range
21° to 82° C(70° to 180° F) rated performance range—2X Series
21° to 104° C (70° to 220° F) rated performance range—3X Series

MINIMUM SYSTEM FILTRATION
10 Micron

ENVIRONMENTAL

SHOCK
50 g for 11 milliseconds. Three shocks in both directions of the three mutually perpendicular axes for a total of 18 shocks.

VIBRATION
Withstands a vibration test designed for mobile equipment controls consisting of two parts:

1. Cycling from 5 to 2000 Hz in each of the three axes.
2. Resonance dwell for one million cycles for each resonance point in each of the three axes.

Subject to acceleration levels of 1 g to 46 g. Acceleration level varies with frequency.

PERFORMANCE

MODULATING RANGE
148 psid (MCV106AXX01)
430 psid (MCV106AXX02)
218 psid (MCV106AXX03)

MAXIMUM HYSTERESIS
.4% of modulating range when cycled at .01 Hz

THRESHOLD PRESSURE
12 psid (MCV106AXX01)
120 psid (MCV106AXX02)
217 psid (MCV106AXX03)

SPECIFICATIONS *(continued page 2)*

SPECIFICATIONS (continued from page 1)

SENSITIVITY

A 1 of-modulating-range charge in pilot differential pressure will cause a detectable output change

DIMENSIONS

See Figure 1.

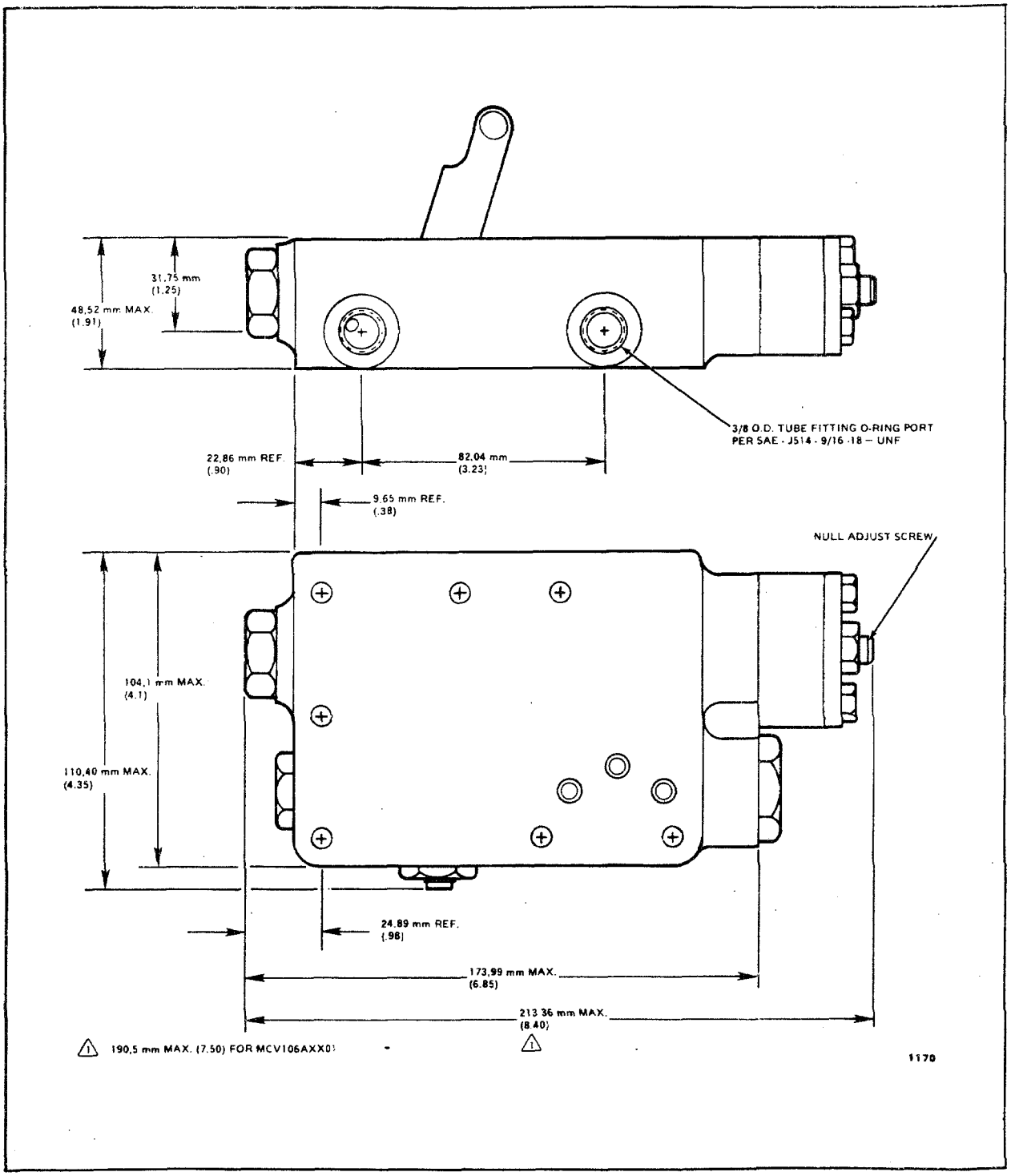


FIGURE 1. Dimensions in millimeters (inches).

THEORY OF OPERATION

The HDC uses a unique double spool arrangement that serves to separate the null deadband from the feedback, giving both safety against null drift and quick dynamic response to command changes.

The command signal for the MCV106A is usually a remote hydraulic control handle, as shown in Figure 2, although other pressure sources could be used. The handle modulates supply pressure from the pump (or another source) so as to apply a proportional differential pressure across the C1 and C2 input ports.

The HDC's null adjust is set with the modulating spring compressed to the equivalent of 12, 120 or 217 psi, depending on the output characteristics of the command source, representing the differential pressure required to move the actuator spool one direction or the other. This is a factory setting that defines the width of the actuator spool deadband and cannot be changed in the field. By tightening or loosening the null adjust screw, the fixed deadband is moved toward or away from the "A"' control port in order to null the valve.

As differential control pressure (C1-C2) rises beyond the deadband, the actuator spool moves in one direction or the other, pivoting the crosslink about its center. The pivoting crosslink pushes or pulls the porting spool in the opposite direction of the actuator spool. When the porting spool has moved far enough to open A or B to supply pressure, oil is ported to the pump servocylinders to move the swashplate. As the swashplate moves, the feedback link follows, pivoting the crosslink about the stationary end of the actuator spool, driving the porting spool back to its neutral position. Because the feedback signal is entered into the control loop after the command has been input, response time and accuracy are enhanced.

INSTALLATION

A highly reliable connection between the swashplate and the drag link is necessary for safe operation. An unreliable connection may result in loss of feedback with a resulting loss of control. Series 3X pumps meet this requirement, but all Series 2X units not already equipped with an HDC or EDC must be retrofitted with the appropriate drag link, press fit pin and retaining ring, replacing the slip fit headless pin and E-rings used to attach the original drag link.

Series 3X pumps with serial numbers of 82-34-00000 or greater will accept the HDC without modification of the pump. These units have a clearance notch cast into the swashplate that provides additional room for link movement. Series 3X pumps with serial numbers of less than 82-33-99999 may not be fitted with the HDC without modification of the swashplate by Sundstrand.

Prior to mounting any control on a pump, ensure that both the control and the feedback link are correct for the pump as evidenced by the series number stamped on the link and the part number labeled on the control body. See Table A, below.

TABLE A

Table A correlates the pump series number with the series number stamped on the side of the feedback link protruding from the control.

SERIES	LINK MARKING
20	20 No Spacer
21, 22	21, 22
23	23
24	24
25	25
26	26
27	27
33, 34, 36	33, 34, 36

WARNING

The control and feedback link must have the proper identification in order to be installed. Installing a control with an improper feedback link can result in a control failure which can cause the pump swashplate to move to full angle and remain there independent of signal input.

Do not attempt to install an HDC on a pump for which it was not originally designed without using the full linkage assembly. Merely changing the drag link is inadequate. See Ordering Information for linkage assembly numbers.

Installing a control not designed for use with the Pressure Limiter on 33, 34 and 36 Series pumps will prevent the Pressure Limiter from operating.

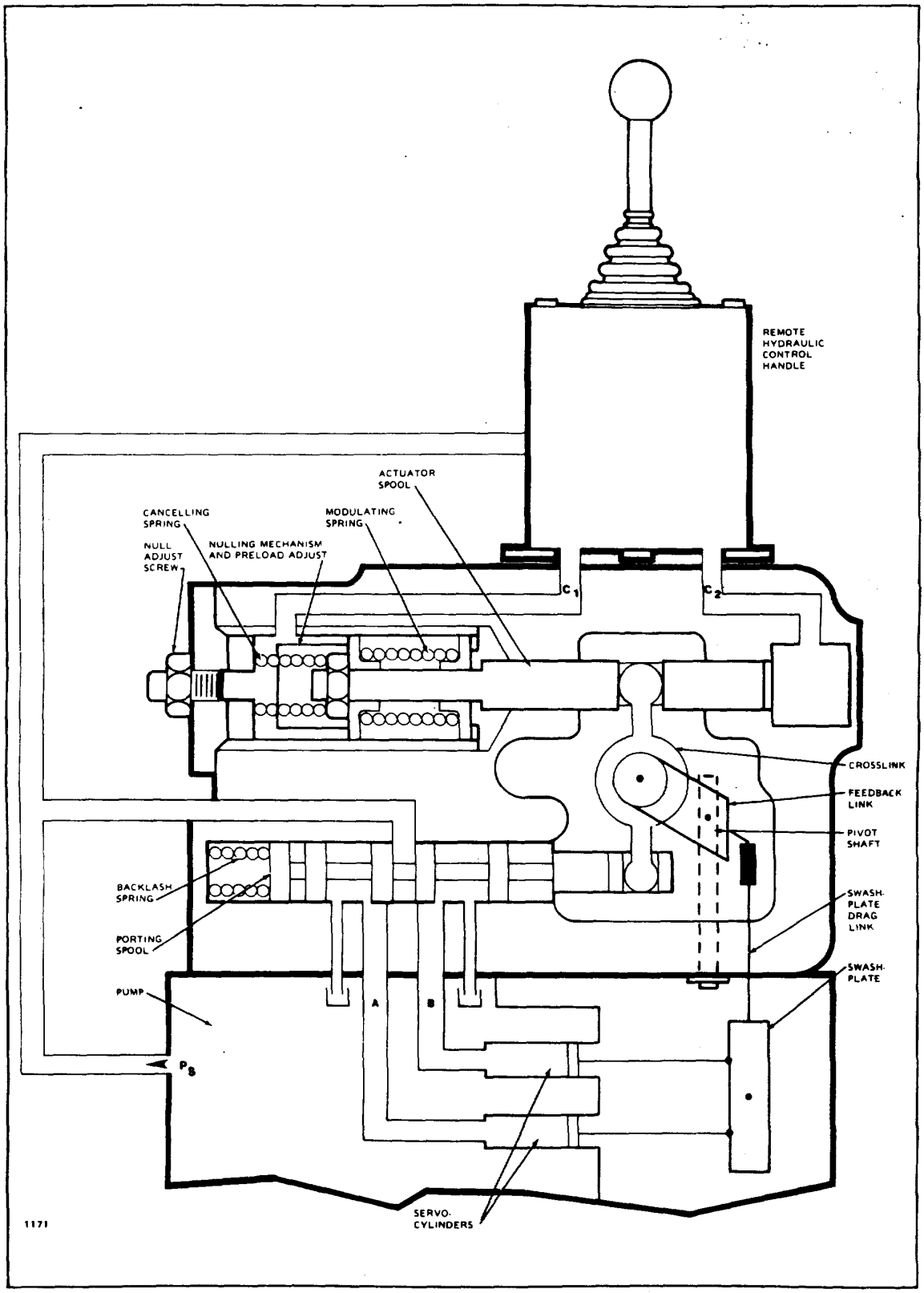


FIGURE 2. Schematic of the internal workings of the MCW106A. Control handle supply pressure may also be provided by an auxiliary pilot pump.

MOUNTING

FOLLOW THE PROCEDURE OUTLINED BELOW TO ATTACH THE HDC TO THE PUMP.

REMOVING THE OLD HARDWARE

- •1. Thoroughly clean all external surfaces of the pump and control with steam or solvent. Blow dry.

- •2. Remove the existing control from the pump by removing the nine hex head screws from the housing. Slip the pin on the control linkage out of the end of the drag link. See Figure 3.

  pump on which the control was mounted.

- •4. Remove the E-ring from the inside end of the connecting pin. Use caution not to drop the E-ring into the housing during the removal. See Figure 4.

- •5. Remove the pin from the drag link and swashplate through the case drain port using a magnet or other tool. Remove the drag link. On some models it may be necessary to hold the swashplate off neutral to align the pin with the case drain hole. See Figure 5.

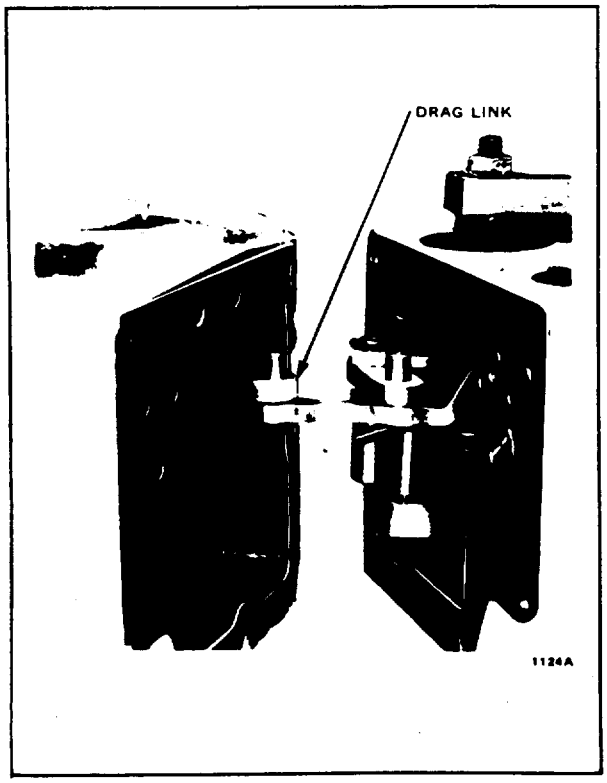


FIGURE 3. Drag link/Control link connector between original control and pump.

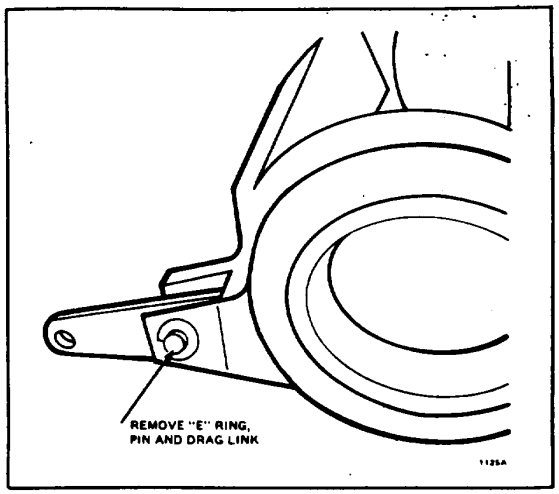


FIGURE 4. Pin connection to swashplate. Shown disassembled for clarity.

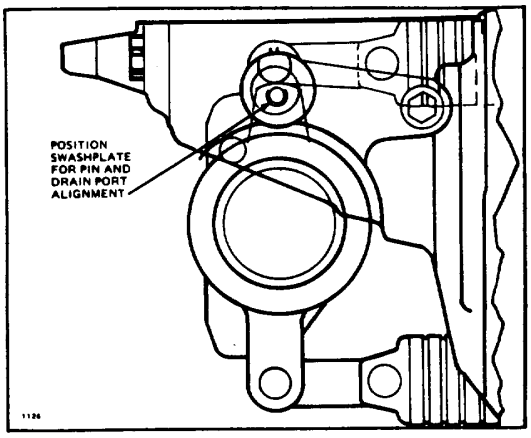


FIGURE 5. Location of swashplate assembly in pump housing.

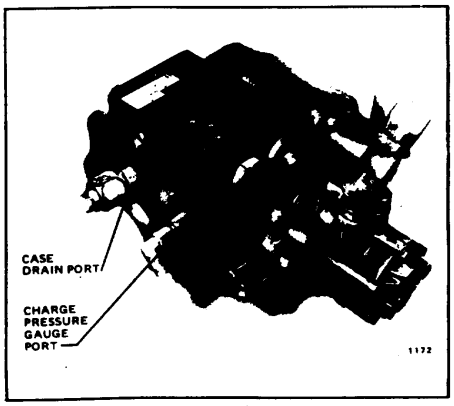


FIGURE 6. Location of parts when installing a new link and ball assembly.

MOUNTING THE NEW HARDWARE

- •1. Re-check the series number on the control feedback link to ensure that it is compatible with the pump. If the control is an MCV106AX9XX (i.e., control less linkage assembly), follow the procedure outlined below to install the linkage:
  - A. Unscrew the bushing, using care not to damage its O-ring. See Figure 6.
  - B. Install the new linkage assembly shaft through the swashplate feedback shaft hole. Place the ball in the crosslink ball cavity.
  - C. Lubricate the shaft O-ring and replace the bushing over the shaft. Torque to the body (10-15 foot-pounds) so that the feedback shaft extends through the bushing.
  - D. Install the retaining ring in the groove on the shaft.
- •2. Align one end of the replacement drag link with the holes in the swashplate link arms.
- •3. Insert the press fit pin through the case drain port to trap the drag link in the swashplate clevis. It will be necessary to tap the pin into place until the head of the pin is flush to the clevis.
- •4. Install the retaining ring by forcing it onto the tapered end of the pin until it locks into the recess on the pin shaft. Again, use caution not to drop any components into the pump housing.
- •5. One .042.inch diameter orifice must be installed in the supply passage on pressure override-compatible valves. (See Ordering Information.) For all others, a .042-inch diameter orifice may be installed in the supply passage if reduced swashplate response is desired.
- •6. Engage the pin on the control in the drag link and swing the control into place against the pump housing. The drag link should be on the cylinder block side of the swashplate. Install the seven mounting screws and tighten to 10-11 foot-pounds of torque.
- •7. Connect the pipe or tubing from the control handle into the C1 and C2 ports (9/16-18 UNF threads per SAE J514). Phasing of the HDC is such that a pressure rise at the C2 port causes a pressure rise at the A output port of the pump, given a clockwise ↷ pump prime mover rotation as viewed into the input shaft.

PUMP NEUTRAL ADJUSTMENT

USE THE FOLLOWING PROCEDURE TO BRING THE PUMP TO NEUTRAL ONCE THE HYDRAULIC DISPLACEMENT CONTROL HAS BEEN MOUNTED.

- •1. Install a 300 psi gauge into the charge pressure gauge port on the pump. See Figure 7.
- •2. Using a 9/16-inch wrench, loosen the hex lock nut on the null adjustment screw. See Figure 1.

WARNING

To adjust neutral requires operating the pump. Take the necessary safety precautions such as having unnecessary personnel stand away from the machine. Maximum system pressure may occur upon start up, and the machine may move. Ensure that the operator is not in a position to be injured should the machine move.

- • 3. Set the hydraulic control handle to neutral,
- • 4. Start the prime mover and run at low idle.
- • 5. Warm the system up for several minutes to bleed air.
- • 6. Slowly increase the prime mover speed to rated rpm.

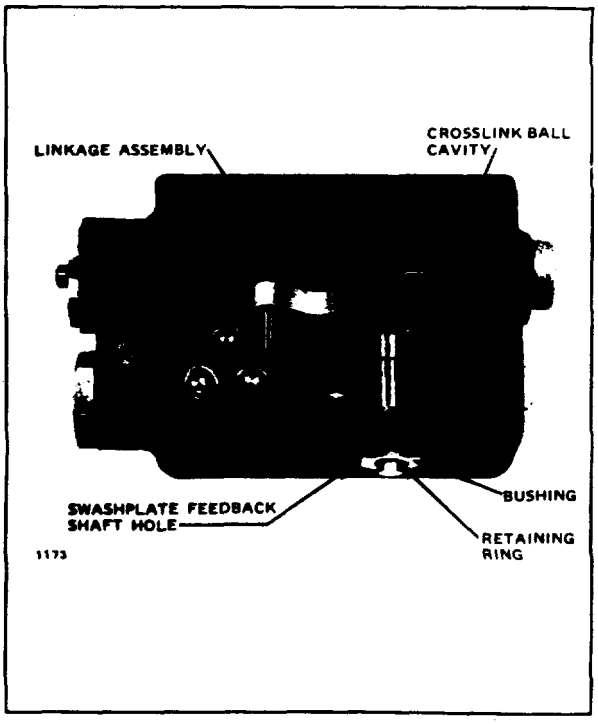


FIGURE 7. Location of pump ports.

PUMP NEUTRAL ADJUSTMENT (continued page 7)

PUMP NEUTRAL ADJUSTMENT ***(continued from page 6)***

•7. If the transmission operates as shown by motor shaft rotation, reduce speed to idle. Using a 3/16inch internal hex wrench, slowly turn the null adjustment screw clockwise or counterclockwise until the transmission does not operate. Repeat step 6. Note that charge pressure should drop approximately 20 psi with forward or reverse stroking of the pump swashplate due to the shifting of the shuttle valve in the motor manifold.

•8. With a 3/16-inch internal the wrench, slowly turn the null adjustment screw clockwise until charge pressure begins to decrease. Then slowly turn the adjustment screw counterclockwise , observing the angle of rotation, until charge pressure decreases again (charge pressure will rise in neutral and drop when going into stroke).

•9. Turn the adjustment screw clockwise half the amount of the turn observed in step 8. This should be the center of neutral.

•10. Hold the adjustment screw and securely tighten the hex lock nut on the adjustment screw to 14-18 foot-pounds. Note that if a motor is used which does not have a manifold, neutral should be adjusted (steps 810) by observing the motor output shaft rotation without a load.

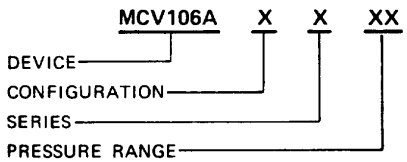
•11. Stop the prime mover.

•12. Run the system briefly to ensure that it operates proportionally on both sides of the null command. Swashplate movement can be verified by watching movement of the swashplate feedback shaft, shown in Figure 1. The Pressure Override and Pressure Limiter accomplish the same function-they shift the pump swashplate toward neutral when system pressure crosses a pre-set threshold. They thus limit system pressure, protect components from heat generated by flow across relief valves and conserve pump horsepower.

ORDERING INFORMATION

A range of options to the basic HDC allows it to be custom-tailored to each application. The control is specified by filling in each slot of the order number, as is shown in Table B, with the appropriate model code. Other options are possible. Consult Sundstrand Mobile Controls with further questions.

TABLE B. INFORMATION NECESSARY TO SPECIFY THE HYDRAULIC DISPLACEMENT CONTROL.



1. DEVICE IDENTITY

This is the basic HDC. The model code is MCV106A.

2. CONFIGURATION (including assembly kit)

PRESSURE MODEL CODE OVERRIDE	WITH LIMITER OR PRESSURE	ANNULAR CONTROL
5	NO*	NO
6	NO	YES
7	YES*	NO
8	YES*	YES

*PRESSURE OVERRIDE ONLY

**MODEL CODE 7 DEVICES MAY NOT BE USED ON SERIES 3X PUMPS IF ORDERED LESS LINKAGE ASSEMBLY ("9" UNDER THE SERIES PARAMETER).

Pressure override is available only for Series 2X pumps, and pressure limiting is available only for Series 3X pumps. Pressure limiting and annular control are not available together. If the model code chosen indicates that the pressure override/pressure limiting function is desired (i.e., "yes" is chosen in the second column of the configuration parameter, above), only pressure limiting will be provided directly by Sundstrand Mobile Controls (pressure limiting is accomplished using a different porting spool); the Pressure Override Valve must be obtained through Sundstrand Hydrotransmission. See below.

Stroke controls with annular control have a groove cut into the spool bore of the housing that allows for higher flow from the control ports when they are uncovered, increasing swashplate response.

Kits are needed in order to install the HDC onto the pump. Which kit is shipped with the HDC depends on which pump series is ordered. Included in the kit are: retaining rings, swashplate pin, drag link, orifice, hex screws, O-rings and gasket. In some cases not all of the above are necessary for installation, and they are not included with the kit. Individual drag links will not be supplied by Sundstrand. Consult Mobile Controls for replacement parts.

ORDERING INFORMATION (*continued page 8*)

ORDERING INFORMATION (*continued from page 7*)

3. SERIES

MODEL CODE	PUMP SIZE
0	20
1	21, 22
3	23
4	24
5	25
6	26
7	27
8	33, 34, 36
9	Any size, less linkage

Order the appropriate HDC for the pump series on which it is to be mounted. Generic valves less link may be ordered, as well as spare linkage assemblies. See below.

4. PRESSURE RANGE

DIFFERENTIAL MODEL CODE PRESSURE	DIFFERENTIAL THRESHOLD PRESSURE	FULL-STROKE MODULATING
01	12 psid	160 psid
02	120 psid	550 psid
03	217 psid	435 psid

The threshold and full stroke modulating pressures come in three ranges, as shown above. The threshold (the amount of differential pressure necessary to move the actuator spool) and full stroke (the amount of differential pressure necessary to yield maximum swashplate displacement) ranges should be chosen so as to be compatible with the hydraulic signal from the command source, which is usually a control handle. The full stroke figures shown are nominal. "02" and "03" models use a spacer plate which makes the body longer, as shown in Figure 1.

Order Sundstrand Pressure Override Valve through Sundstrand Hydro-Transmissior or Sundstrand distributors. Consult Sundstrand Hydro-Transmission at (515) 239-6620 for further information.

Order additional linkage assemblies through Sundstrand Mobile Controls:

PUMP SERIES	LINKAGE ASSEMBLIES
20	12499678-001
21, 22	12499678-003
23	12499678-004
24	12499678-005
25	12499678-006
26	12499678-011
27	12499678-008
33, 34, 36	12499678-009

Contact Sundstrand Mobile Controls for application assistance.

ORDER FROM:

SUNDSTRAND MOBILE CONTROLS
3900 Annapolis Lane North
Minneapolis, Minnesota 55441
(612) 559-2121

DEVICE REPAIR:

For devices in need of repair, include a description of the problem, a copy of the purchase order and your name and address.

RETURN TO:

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Return Goods Department
3900 Annapolis Lane North
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SALES, SERVICE OR REPAIR CONTACT:

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3900 Annapolis Lane North
Minneapolis, Minnesota 55441
(612) 559-2121

TELEX: 9105762716

Sundstrand Mobile Controls
MINNEAPOLIS, MINNESOTA 55441
unit of Sundstrand Corporation

MCV 106AXXXX
Hydraulic Displacement
Control-PV

BULLETIN 95-8972

APPLICATION

The MCV106A Hydraulic Displacement Control (HDC) is a cost-effective hydraulic pump stroke control which uses mechanical feedback to establish closed-loop control of the swashplate angle of Sundstrand Series 2X and Series 3X pumps.

The HDC accepts a differential hydraulic pressure signal from a control handle or servovalve and uses the differential pressure to drive its double spool arrangement and port oil to the pump servocylinders. The spool configuration allows a null deadband for machine safety in the pump's output while maintaining optimum dynamic response to control commands.

FEATURES

- Servo control deadband independent of signal null deadband: offers safety combined with accurate and responsive control
- Resistant to the environment: shock, vibration and humidity tested
- High porting spool force resists chip plugging
- Swashplate movement can be visually detected at the feedback shaft

* Low cost

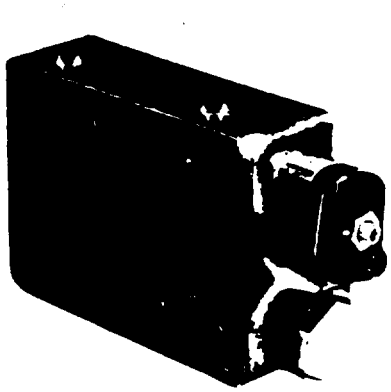
SPECIFICATIONS

HYDRAULIC

OIL VISCOSITY
40-6000 SSU

OIL TEMPERATURE
-40° to 121° C (-40° to 250° F) operating range
21° to 82° C(70" to 180° F) rated performance range-2X Series
21° to 104" C (70° to 220° F) rated performance range-3X Series

MINIMUM SYSTEM FILTRATION
10 Microdh



ENVIRONMENTAL

SHOCK
50 g for 11 milliseconds. Three shocks in both directions of the three mutually perpendicular axes for a total of 18 shocks.

VIBRATION
Withstands a vibration test designed for mobile equipment controls consisting of two parts:

1. Cycling from 5 to 2000 Hz in each of the three axes.
2. Resonance dwell for one million cycles for each resonance point in each of the three axes.

Subject to acceleration levels of 1 g to 46 g. Acceleration level varies with frequency.

PERFORMANCE

MODULATING RANGE
148 psid (MCV106AXX01)
430 paid (MCV106AXX02)
218 paid (MCV106AXX03)

MAXIMUM HYSTERESIS
.4% of modulating range when cycled at .01 Hz

THRESHOLD PRESSURE
12 psid (MCV106AXX01)
120 psid (MCV106AXX02)
217 psid (MCV106AXX03)

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SENSITIVITY

A 1%-of-modulating-range change in pilot differential pressure will cause a detectable output change

DIMENSIONS

See Figure 1.

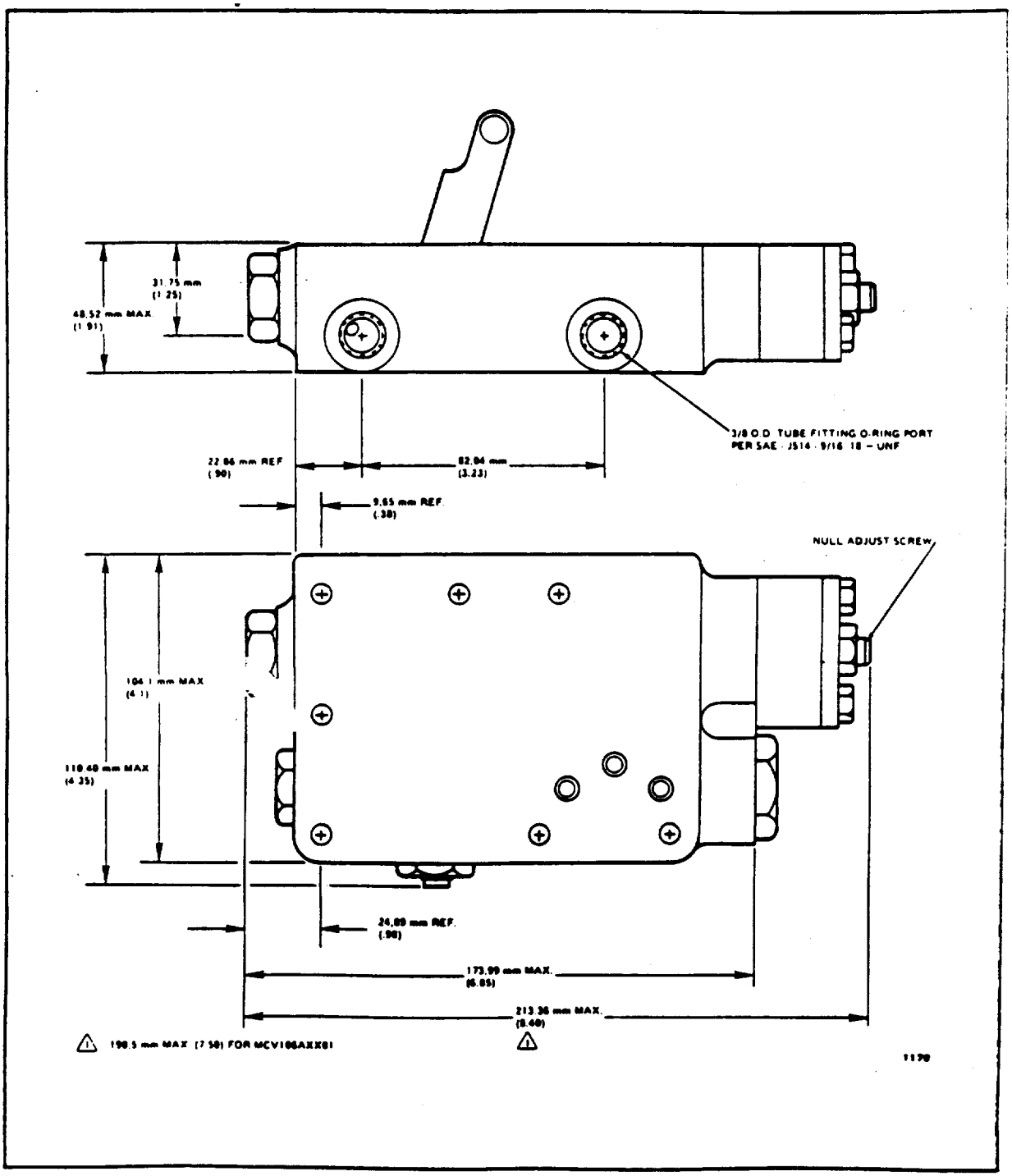

FIGURE 1. Dimensions in millimeters (inches).

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THEORY OF OPERATION

The HDC uses a unique double spool arrangement that serves to separate the null deadband from the feedback, giving both safety against null drift and quick dynamic response to command changes.

The command signal for the MCV106A is usually a remote hydraulic Control handle, as shown in Figure 2, although other pressure sources could be used. The handle modulates supply pressure from the pump (or another source) so as to apply a proportional differential pressure across the C1 and C2 input ports.

The HDC's null adjust is set with the modulating spring compressed to the equivalent of 12, 120 or 217 psi, depending on the output characteristics of the command source, representing the differential pressure required to move the actuator spool one direction or the other. This is a factory setting that defines the width of the actuator spool deadband and cannot be changed .in the field. By tightening or loosening the null adjust screw, the fixed deadband is moved toward or away from the "A" control port in order to null the valve.

As differential control pressure (C1-C2) rises beyond the deadband, the actuator spool moves in one direction or the other, pivoting the crosslink about its center. The pivoting crosslink pushes or pulls the porting spool in the opposite direction of the actuator spool. When the porting spool has moved far enough to open A or B to supply pressure, oil is ported to the pump servocylinders to move the swashplate. As the swashplate moves, the feedback link follows, pivoting the crosslink about the stationary end of the actuator spool, driving the porting spool back to its neutral position. Because the feedback signal is entered into the control loop after the command has been input, response time and accuracy are enhanced.

INSTALLATION

A highly reliable connection between the swashplate and the drag link is necessary for safe operation. An unreliable connection may result in loss of feedback with a resulting loss of control. Series 3X pumps meet this requirement, but all Series 2X units not already equipped with an HDC or EDC must be retrofitted with the appropriate drag link, press fit pin and retaining ring, replacing the slip fit headless pin and E-rings used to attach the original drag link.

Series 3X pumps with serial numbers of 82-34-00000 or greater will accept the HDC without modification of the pump. These units have a clearance notch cast into the swashplate that provides additional room for link movement. Series 3X pumps with serial numbers of less than 82-33-99999 may not be fitted with the HDC without modification of the swashplate by Sundstrand.

Prior to mounting any control on a pump, ensure that both the control and the feedback link are correct for the pump as evidenced by the series number stamped on the link and the part number labeled on the control body. See Table A, below.

TABLE A

Table A correlates the pump series number with the series number stamped on the side of the feedback link protruding from the control.

SERIES	LINK MARKING
20	20 No Spacer
21, 22	21, 22
23	23
24	24
25	25
26	26
27	27
33, 34, 36	33, 34, 36

WARNING

The control and feedback link must have the proper Identification In order to be installed. Installing control with an improper feedback link can result in a control failure which can cause the pump plate to move to full angle and remain there independent of signal input

Do not attempt to Install an HDC on a pump for which It was not originally designed without using the full link. assembly. Merely changing the drag link It inadequate. See Ordering; Information for linkage assembly numbers.

Installing a control not designed for use with the Pressure Limiter on 33, 34 and 36 Series pumps will prevent the Pressure Limiter from operating

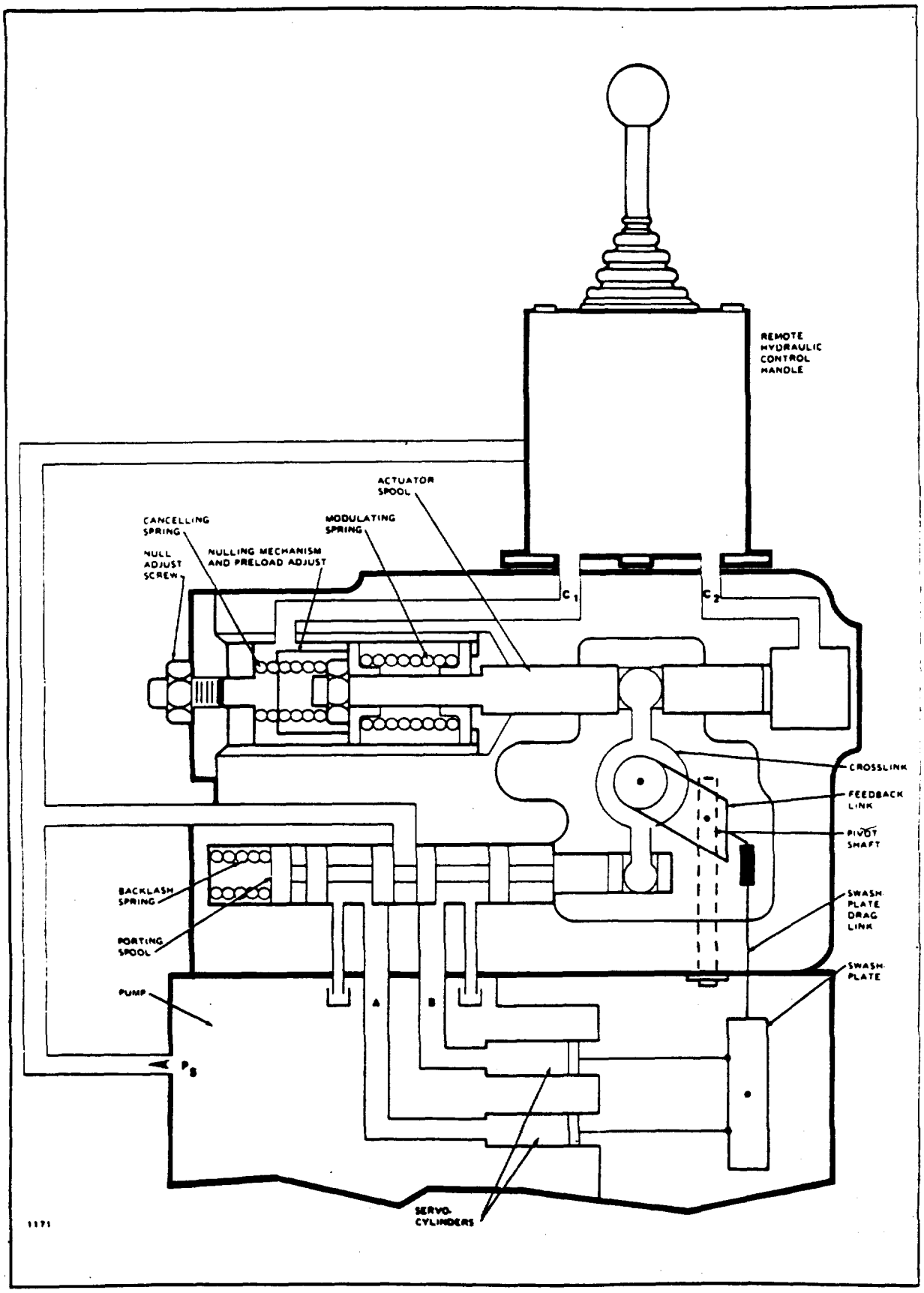

FIGURE 2 Schematic of the internal workings of the MCW106A. Control handle supply pressure may also be provided by an auxiliary pilot pump.

MOUNTING

FOLLOW THE PROCEDURE OUTLINED BELOW TO ATTACH THE HDC TO THE PUMP.

REMOVING THE OLD HARDWARE

- •1. Thoroughly clean all external surfaces of the pump and control with steam or solvent. Blow dry.
- •2. Remove the existing control from the pump by removing the nine hex head screws from the housing Slip the pin on the control linkage out of the end of the drag link. See Figure 3.
- •3. Remove the case drain fitting from the side of the pump on which the control was mounted.
- •4. Remove the E-ring from the inside end of the connecting pin. Use caution not to drop the E-ring into the housing during the removal. See Figure 4.
- •5. Remove the pin from the drag link and swashplate through the case drain port using a magnet or other tool. Remove the drag link. On some models it may be necessary to hold the swashplate off neutral to align the pin with the case drain hole. See Figure 5.

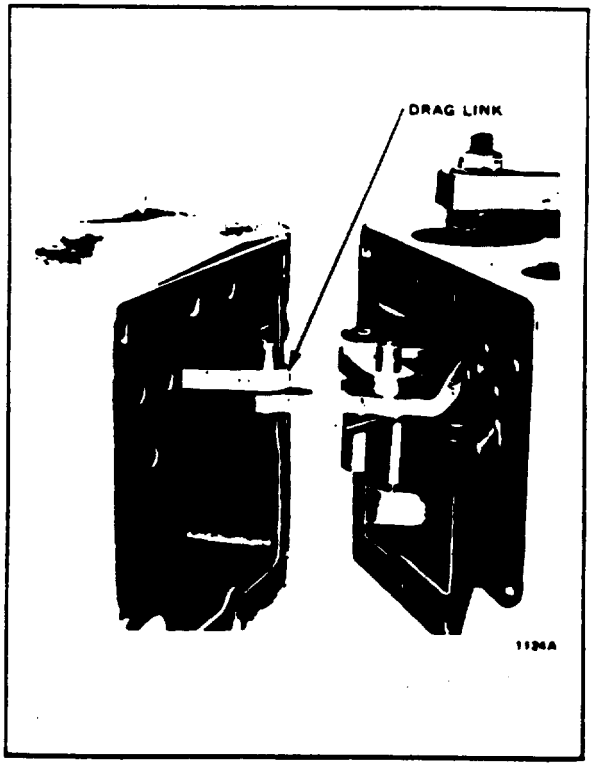

FIGURE 3. Dry link/Control link connector between ordinal control and pump.

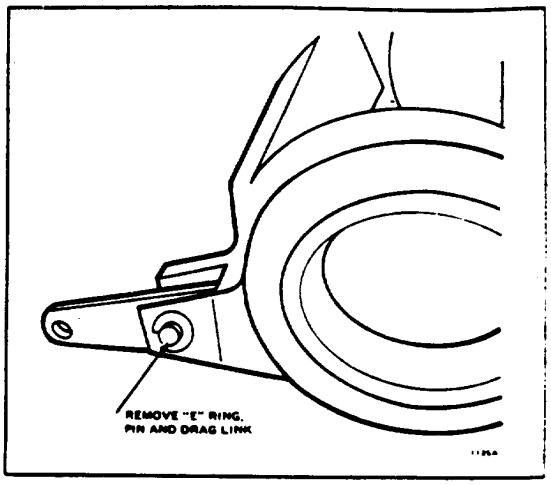

FIGURE 4. Pin connection to swashplate. Shown disassembled for clarity.

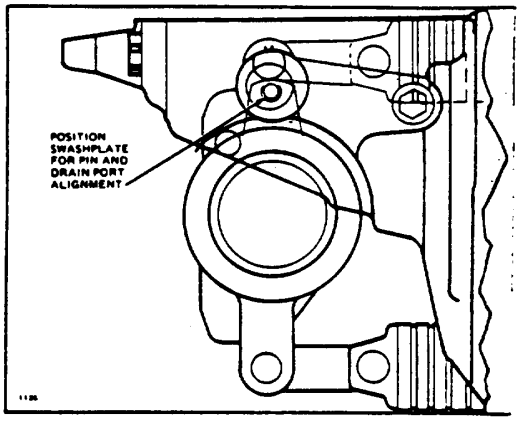

FIGURE 5. Location of swashplate assembly in pump housing

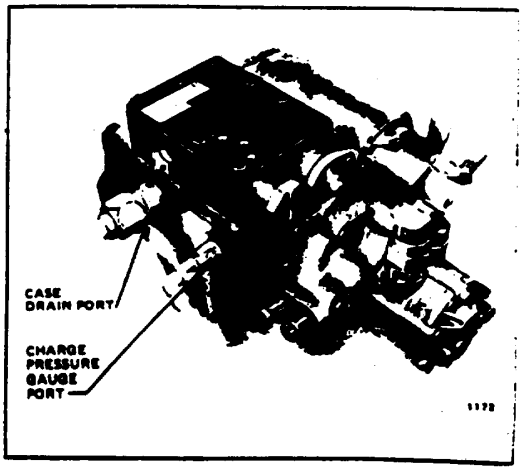

FIGURE 6. Location of parts when installing a new link and bell assembly.

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MOUNTING THE NEW HARDWARE

- •1. Re-check the series number on the control feedback link to ensure that it is compatible with the pump. If the control is In MCV106AX9XX (i.e., control less linkage assembly), follow the procedure outlined below to install the linkage:
  - A. Unscrew the bushing, using care not to damage its O-ring. See Figure 6.
  - B. Install the new linkage assembly shaft through the swashplate feedback shaft hole. Place the ball in the crosslink ball cavity.
  - C. Lubricate the shaft O-ring and replace the bushing over the shaft. Torque to the body (10-15 foot-pounds) so that the feedback shaft extends through the bushing.
  - D. Install the retaining ring in the groove on the shaft.
- •2. Align one end of the replacement drag link with the holes in the swashplate link arms.
- •3. Insert the press fit pin through the case drain port to trap the drag link in the swashplate clevis. It will be necessary to tap the pin into place until the head of the pin is flush to the clevis
- •4. Install the retaining ring by forcing it onto the tapered end of the pin until it locks into the recess on the pin shaft. Again, use caution not to drop any components into the pump housing.
- •5. One .042 inch diameter orifice must be installed in the supply passage on pressure override-compatible valves. (See Ordering Information.) For all others. a .042-inch diameter orifice may be installed in the supply passage if reduced swashplate response is desired.
- •6. Engage the pin on the control in the drag link and swing the control into place against the pump housing. The drag link should be on the cylinder block side of the swashplate. Install the seven mounting screws and tighten to 10-11 footpounds of torque.
- •7. Connect the pipe or tubing from the control handle into the C1 and C2 ports (9/16-18 UNF threads per SAE J514}. Phasing of the HDC is such that a pressure rise at the C2 port causes a pressure rise at the A output port of the pump, given a clockwise ↷ pump prime mover rotation as viewed into the input shaft.

PUMP NEUTRAL ADJUSTMENT

USE THE FOLLOWING PROCEDURE TO BRING THE PUMP TO NEUTRAL ONCE THE HYDRAULIC DISPLACEMENT CONTROL HAS BEEN MOUNTED.

- •1. Install a 300 psi gauge into the charge pressure gauge port on the pump. See Figure 7.
- •2. Using a 9/16-inch wrench. loosen the hex lock nut on the null adjustment screw. See Figure 1.

WARNING

To adjust neutral requires operating the pump. Take the necessary safety precautions such as having necessary personnel stand away from the machine Maximum system pressure may occur upon start up, and the machine may move. Ensure that the operator is not in a position to be injured should the machine move.

- •3. Set the hydraulic control handle to neutral.
- •4. Start the prime mover and run at low idle.
- •5. Warm the system up for several minutes to bleed air.
- •6. Slowly increase the prime mover speed to rated rpm.

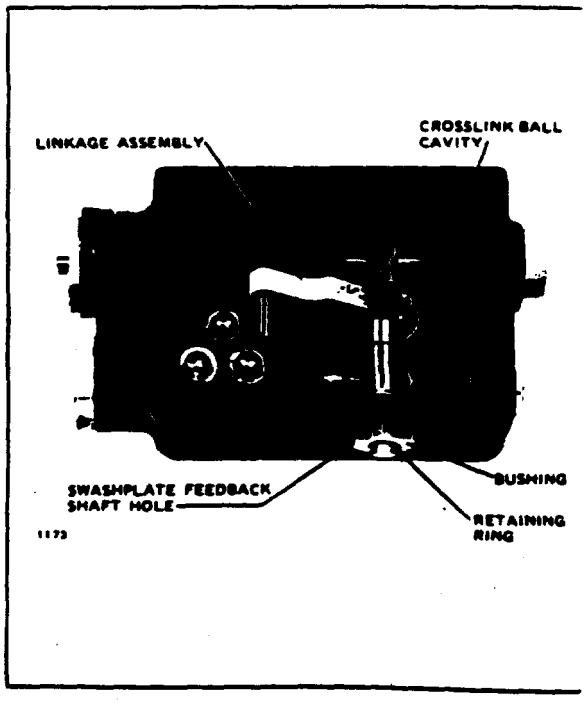

FIGURE 7. Location of pump ports.
PUMP NEUTRAL ADJUSTMENT

ORDERING INFORMATION (*continued from page 7*)

3. SERIES

MODEL CODE	PUMP SIZE
0	20
1	21, 22
3	23
4	24
5	25
6	26
7	27
8	33, 34, 36
9	Any size, less linkage.

Order the appropriate HDC for the pump series on which it is to be mounted. Generic valves less link may be ordered, as well as spare linkage assemblies. See below.

4. PRESSURE RANGE

MODEL CODE	DIFFERENTIAL THRESHOLD PRESSURE	DIFFERENTIAL FULL-STROKE MODULATING PRESSURE
01	12 psid	160 psid
02	120 psid	560 psid
03	217 psid	435 psid

The threshold and full stroke modulating pressures come in three ranges, as shown above. The threshold (the amount of differential pressure necessary to move the actuator spool) and full stroke (the amount of differential pressure necessary to yield maximum swashplate displacement) ranges should be chosen so as to be compatible with the hydraulic signal from the command source, which is usually a control handle. The full stroke figures shown are nominal "02" and "03" models use a spacer plate which makes the body longer, as shown in Figure 1.

Order Sundstrand Pressure Override Valve through Sundstrand Hydro-Transmission or Sundstrand distributors. Consult Sundstrand Hydro-Transmission at (515) 239-6620 for further information.

Order additional linkage assemblies through Sundstrand Mobile Controls:

PUMP SERIES	LINKAGE ASSEMBLIES
20	12499678-001
21,22	12499678-003
23	12499676-004
24	12499678-005
25	12499678-006
26	12499678-011
27	12499678-008
33, 34, 36	12499678-009

Contact Sundstrand Mobile Controls for application assistance.

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3900 Annapolis Lane North
Minneapolis, Minnesota 55441
(612) 559-2121

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3900 Annapolis Lane North
Minneapolis, MN 55441

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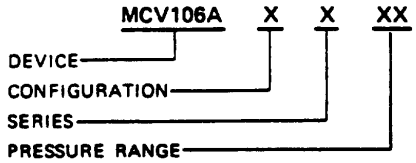
PUMP NEUTRAL ADJUSTMENT (*continued from page 6*)

- •7. If the transmission operates as shown by motor shaft rotation, reduce sped to idle. Using a 3/16 inch internal hex wrench, slowly turn the null adjustment screw clockwise ↷ or counterclockwise ↶ until the transmission does not operate. Repeat step 6 Note that charge pressure should drop approximately 20 psi with forward or reverse stroking of the pump washplate due to the shifting of the shuttle valve in the motor manifold.
- •8. With a 3/16-inch internal hex wrench, slowly turn the null adjustment screw clockwise ↷ until charge pressure begins to decrease. Then slowly turn the adjustment screw counterclockwise ↶ , observing the angle of rotation, until charge pressure decreases again (charge pressure will rise in neutral and drop when going into stroke).
- •9. Turn the adjustment screw clockwise ↷ half the amount of the turn observed in step 8. This should be the center of neutral.
- •10. Hold the adjustment screw and securely tighten the hex lock nut on the adjustment screw to 14-18 foot-pounds. Note that if a motor is used which does not have a manifold, neutral should be adjusted (steps 8.10) by observing the motor output shaft rotation without a load.
- •11. Stop the prime mover.
- •12. Run the system briefly to ensure that it operates proportionally on both sides of the null command. Swashplate movement can be verified by watching movement of the swashplate feedback shaft, shown in Figure 1.

ORDERING INFORMATION

A range of options to the basic HDC allows it to be custom tailored to each application. The control is specified by filling in each slot of the order number, as is shown in Table B, with the appropriate model code. Other options are possible. Consult Sundstrand Mobile Controls with further questions.

TABLE B. INFORMATION NECESSARY TO SPECIFY THE HYDRAULIC DISPLACEMENT CONTROL



1. DEVICE IDENTITY

   This is the basic HDC. The model code is MCV106A.

2 CONFIGURATION (including assembly kit)

MODEL CODE	PRESURE LIMITER OR PRESSURE OVERRIDE	WITH ANNULAR CONTROL
5	NO*	NO
8	NO	YES
7	YES**	NO
8	YES*	YES

*PRESSURE OVERRIDE ONLY

**MODEL CODE 7 DEVICES MAY NOT BE USED ON SERIES 3X PUMPS IF ORDERED LESS LINKAGE ASSEMBLY ("9" UNDER THE SERIES PARAMETER).

The Pressure Override and Pressure Limiter accomplish the same function-they shift the pump swashplate toward neutral when system pressure crosses a pre-set threshold. They thus limit system pressure, protect components from heat generated by flow across relief valves and conserve pump horsepower. Pressure override is available only for Series 2X pumps, and pressure limiting is available only for Series 3X pumps. Pressure limiting and annular control are not available together. If the model code chosen indicates that the pressure override/pressure limiting function is desired (i.e., "yes" is chosen in the second column of the configuration parameter, above), only pressure limiting will be provided directly by Soundstrand Mobile Controls (pressure limiting is accomplished using a different porting spool); the Pressure Override Valve must be obtained through Sundstrand Hydrotransmission. See below.

Stroke controls with annular control have a groove cut into the spool bore of the housing that allows for higher flow from the control ports when they are uncovered, increasing swashplate response.

Kits are needed in order to install the HDC onto the pump. Which kit is shipped with the HDC depends on which pump series is ordered. Included in the kit are: retaining rings, swashplate pin, drag link, orifice, hex screws, O-rings and gasket In some cases not all of the above are necessary for installation and they are not included with the kit. Individual drag links will not be supplied by Sundstrand. Consult Mobile Controls for replacement parts-

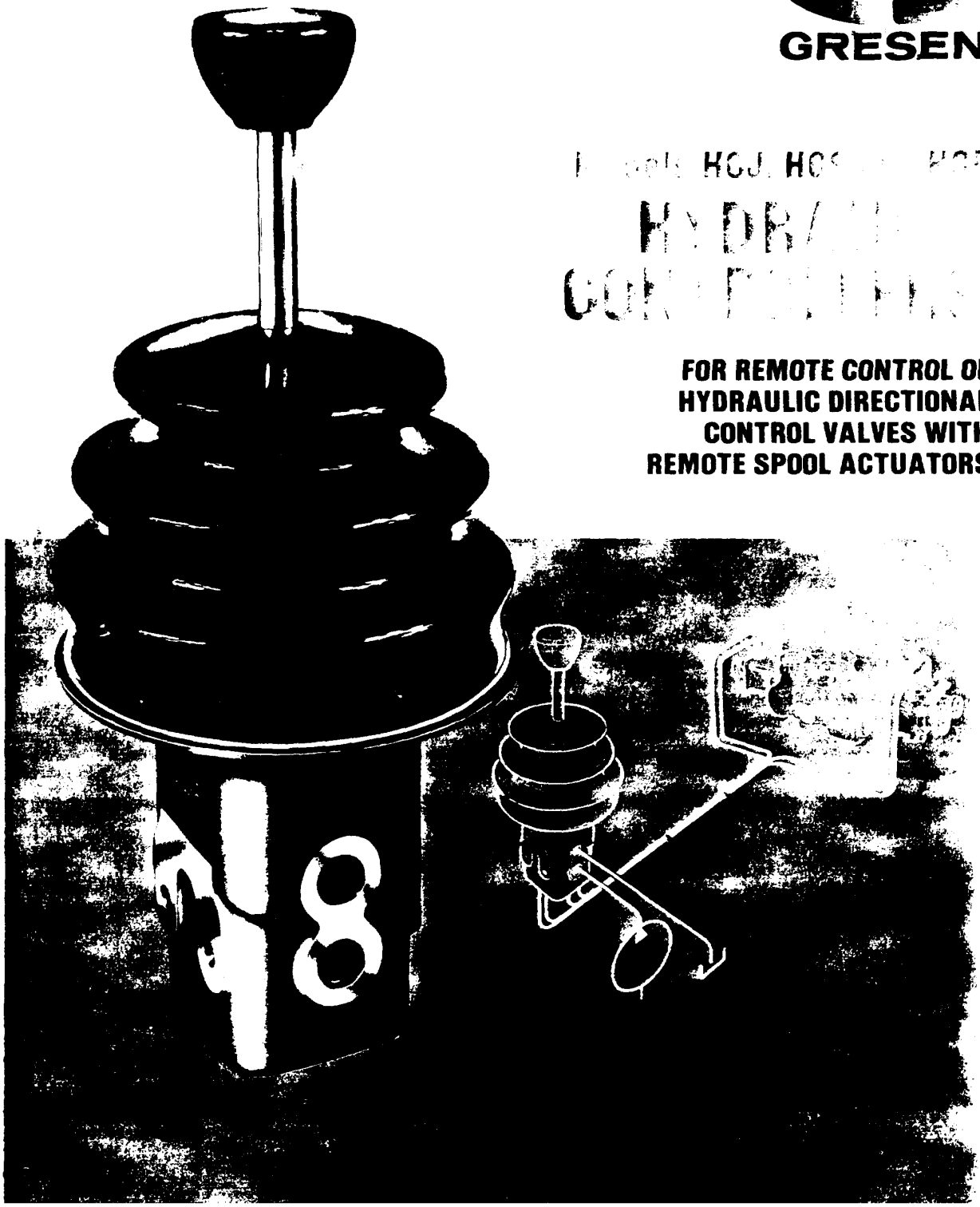
ORDERING INFORMATION

PC-4001

GRESEN

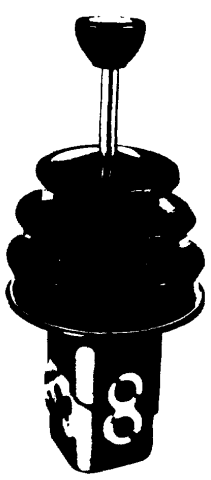
HYDRAULIC CONTROLS

FOR REMOTE CONTROL OF HYDRAULIC DIRECTIONAL CONTROL VALVES WITH REMOTE SPOOL ACTUATORS



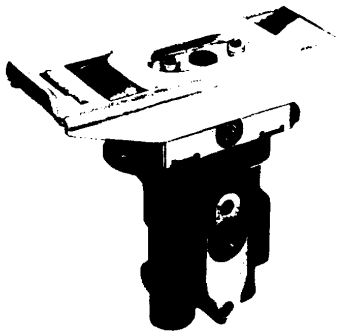
GRESEN

Models HCJ, HCS and HCF
HYDRAULIC CONTROLLERS



Model HCJ

Model HCS
(with 3 sections)



Model HCF
Foot Treadle

Gresen's Model HCJ, Joystick Type, Model HCS, Sectional Type and Model HCF, Foot Treadle Type Hydraulic Controllers control the hydraulic pilot pressure required to operate hydraulic remote, spool actuated, directional control valves. Each remotely located Controller provides spool positioning for precise control of mobile, agricultural, and industrial hydraulic applications.

Remote operation, low flow, and low pilot pressure...all mean less noise in the operator compartment or at the operator station.

The design of the Hydraulic Controllers is based on the pressure reducing valve principle...pilot pressure is varied proportionately with the lever stroke. Because of low pressure in the pilot line (500 PSI [34,5 bar]), resistance to movement of the controller handle is much lower than that required for mechanical linkage or for handles mounted directly on the control valve.

Model HCJ - Joystick Type Controllers provide remote hydraulic control for two directional control valve work sections simultaneously. It is ideal for armrest mounting because of its low "handle effort". An optional pistol grip handle with thumb switch is available for controlling an ON-OFF solenoid-operated control valve simultaneously with the two hydraulic remote functions. The handle movement from neutral to full power is 19° to 24° in a 360° rotation.

Model HCS - Sectional Type Controllers provide control for a single directional control valve work section. Model HCS Controllers may be used singly or stacked into multiple sections with studs and section seals. The handle movement from neutral to full power is 19°, forward and backward only

Model HCF-Foot Treadle Controllers provide maximum comfort and control for the operator. The treadle has both raised cleats and heel lip to reduce foot slippage. A light heel or toe force controls pilot pressure from 0 to 500 PSI [34,5 bar]. A 19° travel of heel or toe provides full pilot pressure at each control port.

The Model HCF will mount flush with the floor of the operator compartment. All hydraulic connections are below the floor and out of the way. The HCF's low profile eliminates unnecessary and potentially unsafe clutter.

A grease fitting in the pivot bearing provides easy lubrication to minimize wear and increase trouble-free hours.

FEATURES • Choice of either Joystick, Sectional or Foot Treadle Models.

- Optional pistol grip handle with electrical switch available for Joystick Models.
- Low operating pressure hysteresis.
- Adjustable start-pressure reduces valve deadband.
- Compatible with all hydraulic remote directional control valves:
- Marine Duty options available.

*Pressure range springs are available to accommodate various pressure ranges.

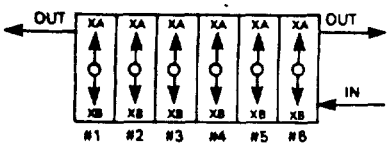
SPECIFICATIONS

	Joystick Model HCJ	Sectional Model HCS	Foot Treadle Model HCF
Maximum Supply Pressure	500 PSI [34.5 bar]		
Recommended Flow	3 to 5 GPM [11 to 19 litres/min]		
Maximum Return Line Pressure	50 PSI [3.4 bar]		
Hysteresis (Approx.)	5 PSI [0.3 bar]		
Filtration Required (Min.)	10 micron		

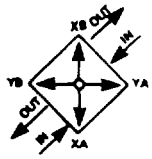
WARNING
Failure to comply with the 10 micron filtration requirement may cause valve plungers to bind or stick in a power position. Plungers that bind cannot be returned to neutral with the handle or foot treadle.

Operating Oil Temperature Range	-20°F to 180°F [-29°C to 82°C]		
Movement From Neutral to Full Power (Approx.)	19° to 24°	19°	19°
Lever Effort (At 500 PSI [34.5 bar] supply pressure. Approx.)	1 Function 30 in.-lbs [3.4 joules]	30 in.-lbs [3.4 joules]	8-12 lbs. [3.6-5.5 kg] (Heel or toe force)
	2 Function 40 in.-lbs [4.5 joules]	—	—
Weight	9¼ pounds [4.2 kg]	5½ pounds [2.5 kg] 1 Section	6 pounds [2.7 kg]

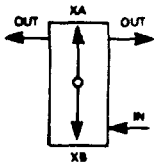
CONTROLLER OPTIONS



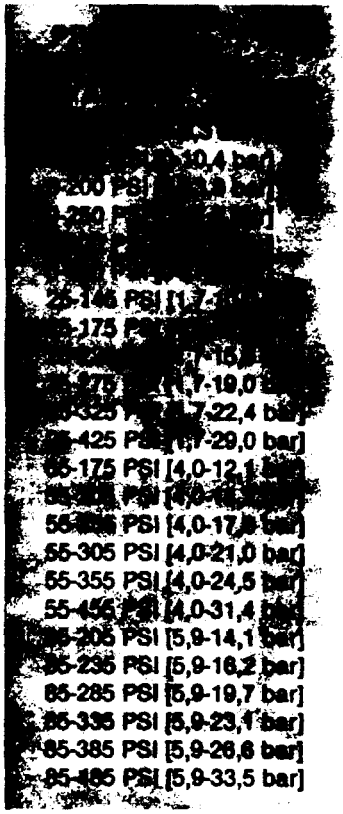
HCS CONTROLLER

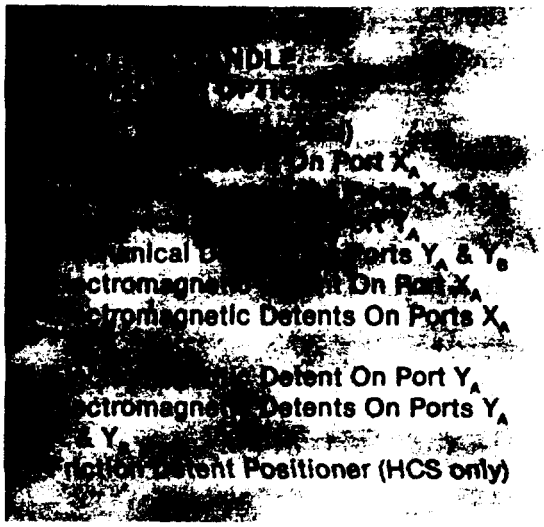


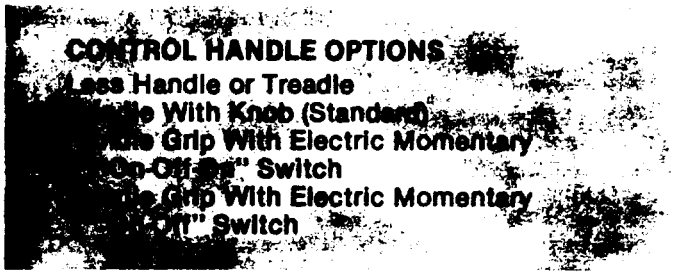
HCJ CONTROLLER

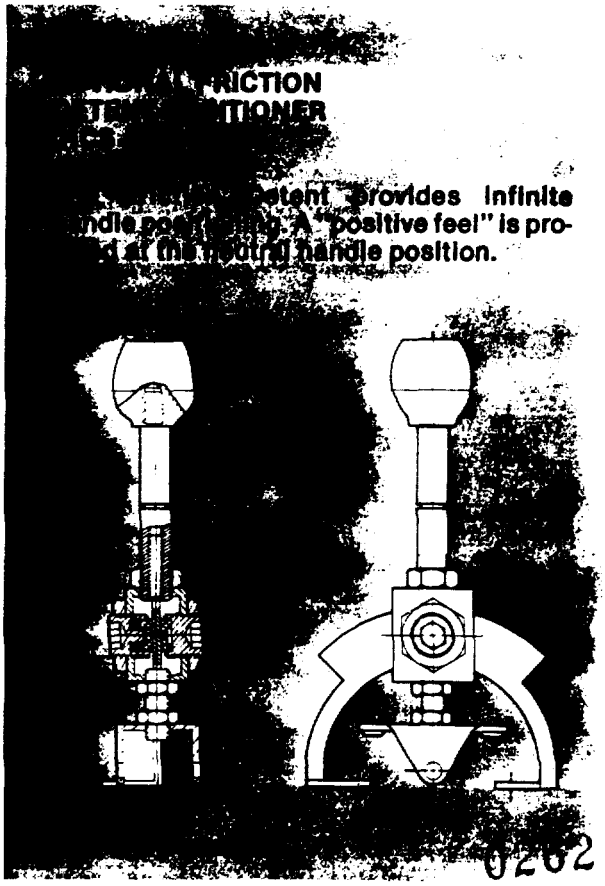


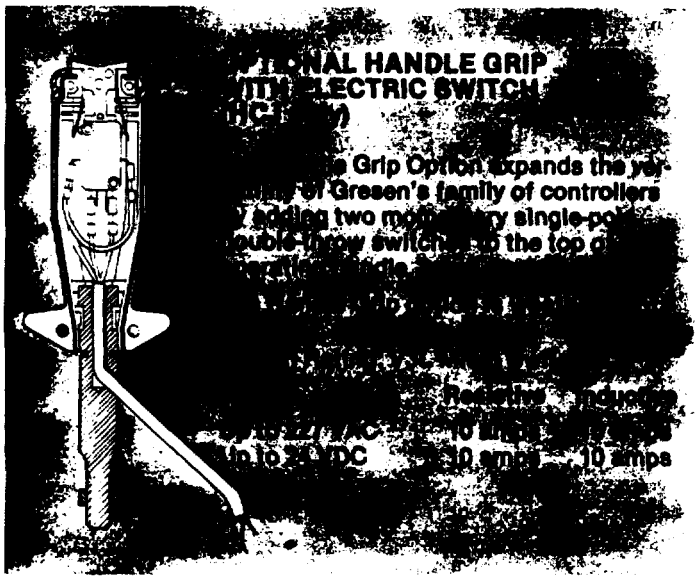
HCF CONTROLLER



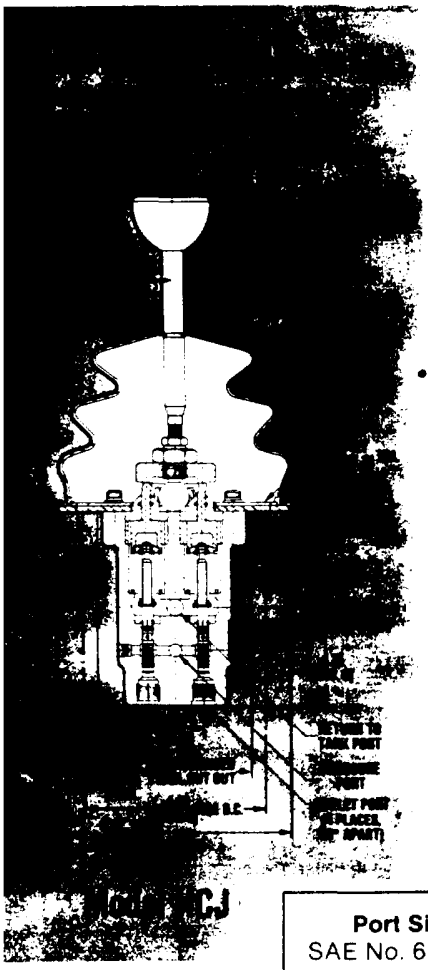


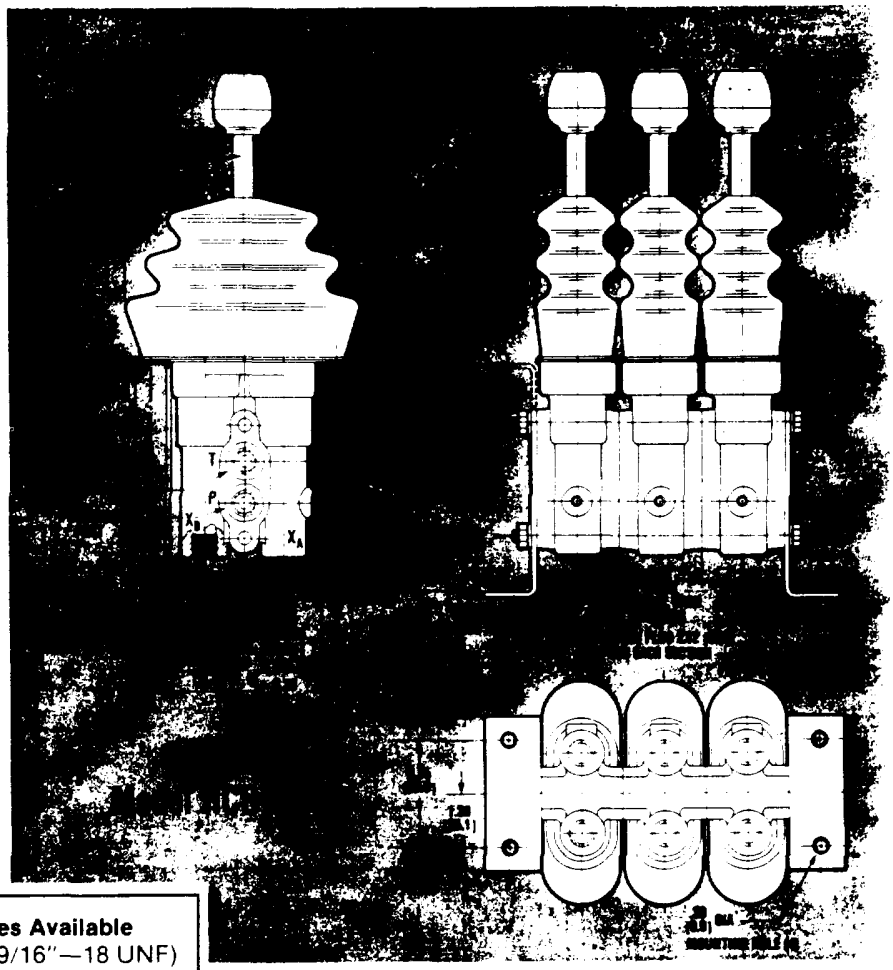




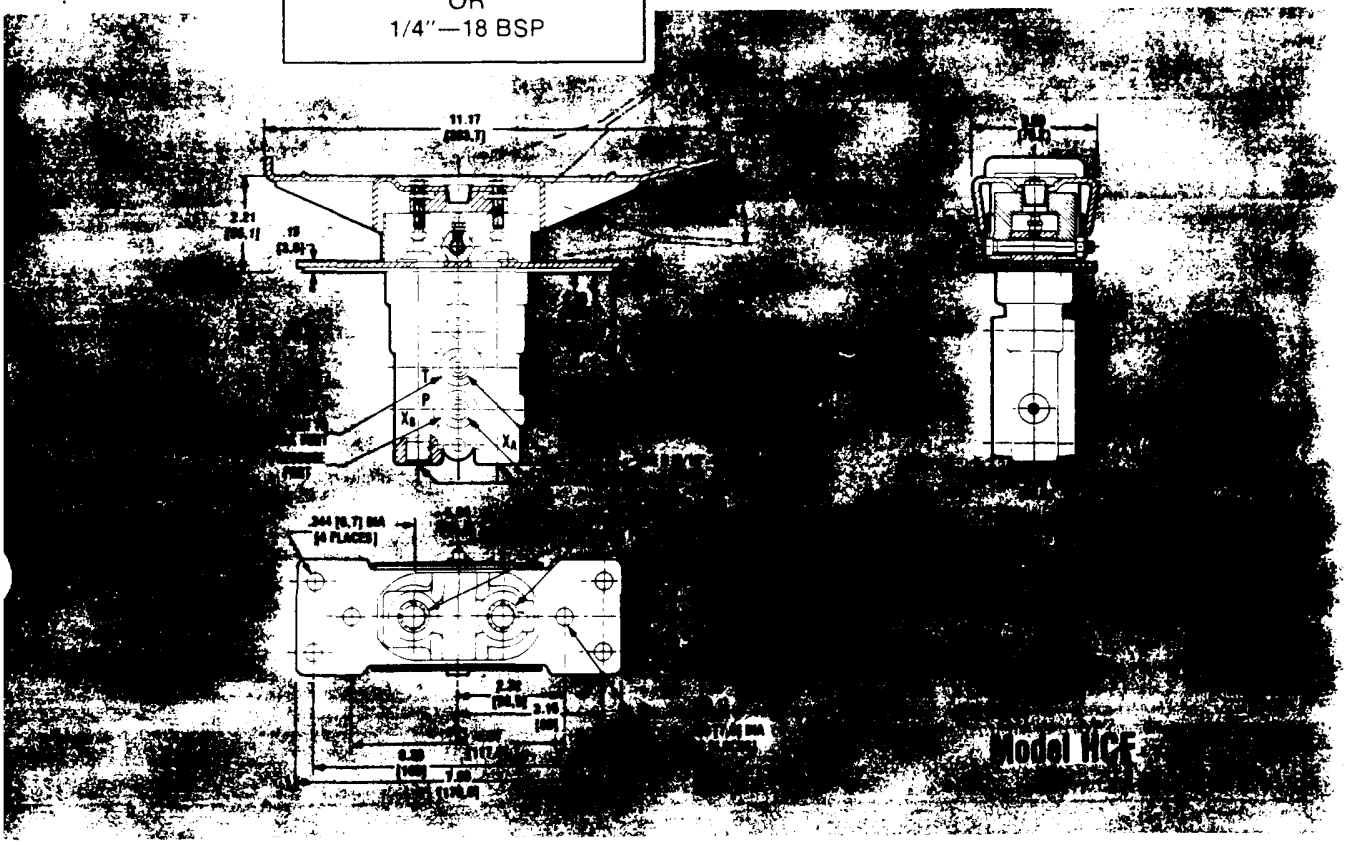


0202





Port Sizes Available
SAE No. 6 (9/16"—18 UNF)
OR
1/4"—18 BSP



GRESEN

MODEL HCS HYDRAULIC CONTROLLER

CONTROL SECTION		#1	#2	#3	#4	#5	#6
MODEL NUMBER		HCL	HCR	HCR	HCR	HCR	HCR
BILL OF MATERIAL NUMBER							
CONTROL HOUSING	PORT TYPE & SIZE						
	PRESSURE CONTROL RANGE						
	MODEL NO.	HCL	HCR	HCR	HCR	HCR	HCR
	BILL OF MATERIAL NO.						
POSITIONER OPTIONS	DETENT	☐ XA ☐ XB ☐ MECH ☐ ELEC MAG	☐ XA ☐ XB ☐ MECH ☐ ELEC MAG	☐ XA ☐ XB ☐ MECH ☐ ELEC MAG	☐ XA ☐ XB ☐ MECH ☐ ELEC MAG	☐ XA ☐ XB ☐ MECH ☐ ELEC MAG	☐ XA ☐ XB ☐ MECH ☐ ELEC MAG
	FRICTION DETENT	☐	☐	☐	☐	☐	☐
FUNCTION OF SECTION							

SECTION SPACING ☐ STANDARD 2-1/8" ☐ OPTIONAL

HANDLE OPTIONS

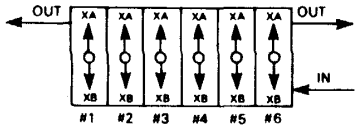
- ☐ STANDARD
- ☐ LESS HANDLE ONLY (LHO)
- ☐ OTHER _____

NOTE: Sectional Hydraulic Controllers (Model HCS) are available in two casting configurations:

1. **HCL** - Used for left sections in multiple section controller assemblies.
   or
   Used for single section controllers.
2. **HCR** - Used for right (inlet) or center sections in multiple section controller assemblies.

MOUNTING OPTION ☐ CONSOLE ☐ BRACKET, FOOT ☐ BRACKET, (INVERTED) ☐ OTHER

REMARKS:



HCS CONTROLLER

LET	DATE	AUTHORITY

PILOT SYSTEM OPERATES AT

PRESS _____ PSI MIN

FLOW _____ G P M MAX

APPLICATION _____

CUSTOMER PART NO _____

CUSTOMER _____

ORIG BY _____ DATE

ERO _____ ENGR APPR

B/M

ORDER DESIGN HC

GRESEN **MODEL HCJ HYDRAULIC CONTROLLER**

CONTROL AXIS		XA & XB	YA & YB
CONTROL HOUSING	PORT TYPE & SIZE PRESSURE CONTROL RANGE		
	MODEL NO. BILL OF MATERIAL NO.		
DETENT OPTION		☐ XA ☐ YA ☐ MECH ☐ XB ☐ YB ☐ ELEC-MAG	
FUNCTION OF AXIS			

HANDLE OPTIONS

- ☐ STANDARD
- ☐ GRIP
- ☐ LESS HANDLE ONLY (LHO)
- ☐ OTHER
- ☐ ROCKER SWITCH (MOMENTARY)
- ☐ PUSH BUTTON SWITCH (MOMENTARY)

MOUNTING OPTION	☐ CONSOLE	☐ OTHER

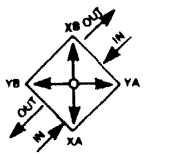
INSTRUCTIONS FOR COMPLETING FORM:

1. Determine which type controller is to be ordered, fill out the appropriate side:
   (HCS Sectional Controller - Side 1)
   (HCJ Joystick or HCF Foot Operated - Side 2)
2. Write in **Customer Name**, **Part Number** & **Initials** of person filling out form. (Lower right corner of appropriate side)
3. **Pilot System Operates At:** Indicate maximum flow and pressure of the pilot.
4. **HCS Sectional Controller:** Determine number of sections required and cross out the un-used sections on the form.
5. **Port Type & Size:** Specify port type & Size (Example: SAE #6)
6. **Pressure Control Range:** Specify appropriate pressure control range (Example: 55-255 PSI)
7. **Options:** Check the required handle & mounting options.
8. Write in function of each section or axis. If, for example controller is to be used on a crane, specify which is the boom, winch and swing functions.
9. This form, when completed will be assigned an order designation number which will be stamped on the identification plate attached to the controller. This number will be assigned at factory, and should be used whenever ordering additional controllers.

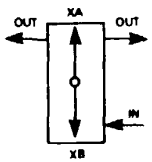
MODEL HCF HYDRAULIC CONTROLLER

CONTROL HOUSING	PORT TYPE & SIZE _____	
	PRESSURE CONTROL RANGE _____	
	MODEL NO. _____	
	BILL OF MATERIAL NO. _____	
FOOT TREADLE	☐ STD	☐ OTHER
FUNCTION OF CONTROLLER _____		
MOUNTING	☐ STD (FLUSH)	☐ BRACKET FOOT

REMARKS:



HCJ CONTROLLER



HCF CONTROLLER

PILOT SYSTEM OPERATES AT:

PRESS _____ PSI MIN

FLOW _____ G.P.M. MAX

APPLICATION _____

CUSTOMER PART NO. _____

CUSTOMER _____

LET	DATE	AUTHORITY	

ORIG BY: DATE:

ERO ENGR APPRO.

B/M

ORDER DESIGN HC-

FORM #6013 Rev. 4-82

SIDE 2

ORDERING INSTRUCTONS

To assure delivery of the proper Controller, Form No) 6013, pages 6 and 7, (or a facsimile) must be completed. Instructions for completing the forms are shown on page 7.

The following is a chart specifying the recommended pressure control ranges for the HCJ, HCS or HCF Hydraulic Controllers when used with Gresen directional control valves with hydraulic remote spool actuators.

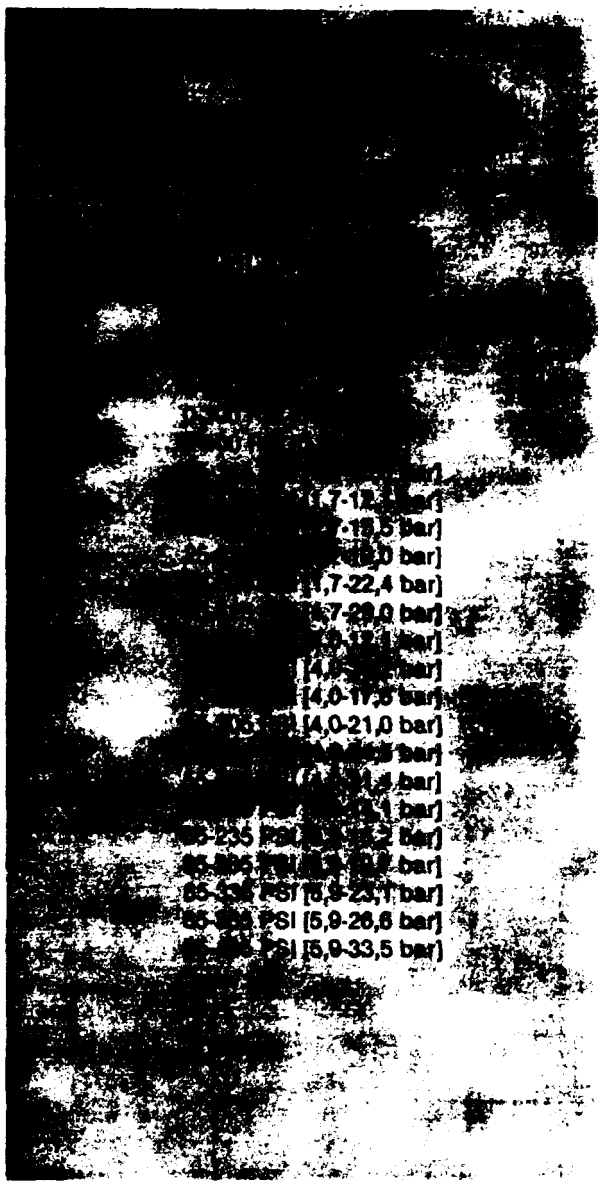
	Pressure Control Range
Model V20 Control Valve	.55-255 PSI [3,8-17,6bar]
Model V42 Control Valve	.25-145 PSI [1,7-10,0 bar]
Model V70 Control Valve	.25-225 PSI [1,7-15,5 bar]

If other directional control valve applications are encountered, contact the factory

The following pressure control ranges (spring range) are available:

Spring Part NO.	Range
8844-001	0-120 PSI [0-8,3 bar]
8845-001	0-200 PSI [0-13,8 bar]
8842-001	0-250 PSI [0-17,3 bar]
8846-001	0-300 PSI [0-20,7 bar]
8847-001	0-400 PSI [0-27.6 bar]

When specifying a pressure control range, always specify the start pressure in the range. The start pressure must be added to the spring range (Example: A 0-200 PSI range spring with a start pressure of 55 PSI should be specified as "55-255 PSI".) The start pressure is shim adjustable and increases the pressure from 0 PSI to the desired start pressure: for instance, 55 PSI at a 4° handle stroke. This start pressure allows the valve spool to shift past the neutral deadband of the spool travel and start into the metering portion of the spool travel at the first 4° of handle movement.



Gresen Manufacturing Company reserves the right to discontinue modify or revise the specifications for the products described herein All specifications are approximate and may vary depending upon installation Ail metric conversions herein have been rounded oft to the nearest decimal or whole number for clarity and expediency

GRESEN

DANA

GRESEN MANUFACTURING · DIVISION OF DANA CORPORATION P.O. BOX1313, MINNEAPOLIS, MN 55440 TELEPHONE: (612) 623-1960 TELEX 290492

CATALOG NO PC-4001 (4182 Printed in U.S.A.

PRODUCT PIPELINE

NUMBER 4
February 22, 1982

PRESSURE CONTROL RANGE CHART
FOR HCJ, HCS & HCF HYDRAULIC CONTROLLER

Attached is a chart showing the number and thickness of shims to use with the various springs when adjusting the pressure control range in the hydraulic controllers. This chart can be used to change the hydraulic controllers for use with Gresen control valves or any other directional control valves where the pressure control range is known.

EXAMPLE: Use the following procedure to re-adjust the pressure control range to 25-225 PSI:

1. Remove the spool assembly from the controller housing, (See attached drawing).
2. Remove retaining ring, (Item #2) on end of spool.
3. Remove spring retainer (Item #5),spring ('Item #4), and shims (Items 3,6 & 7).
4. Using the chart, select spring #8845-001 (0-200 PSI) which would be the nearest to the 25-225 PSI range.
5. Since a 25 PSI start pressure is not shown on the chart, select the number and thickness of shims to equal .180" which is the same for both the 20 PSI and 30 PSI adjustments. (Adjustment accuracy is limited to ± 15 PSI)
6. Place the proper amount of shims on the spool stem.
7. Slide the 8845-001 (Red) spring over the spool stem and compress the spring with the spring retainer,

GRESEN
DANA

DECKMASTER

ATTACHMENT PRODUCT PIPELINE # 4

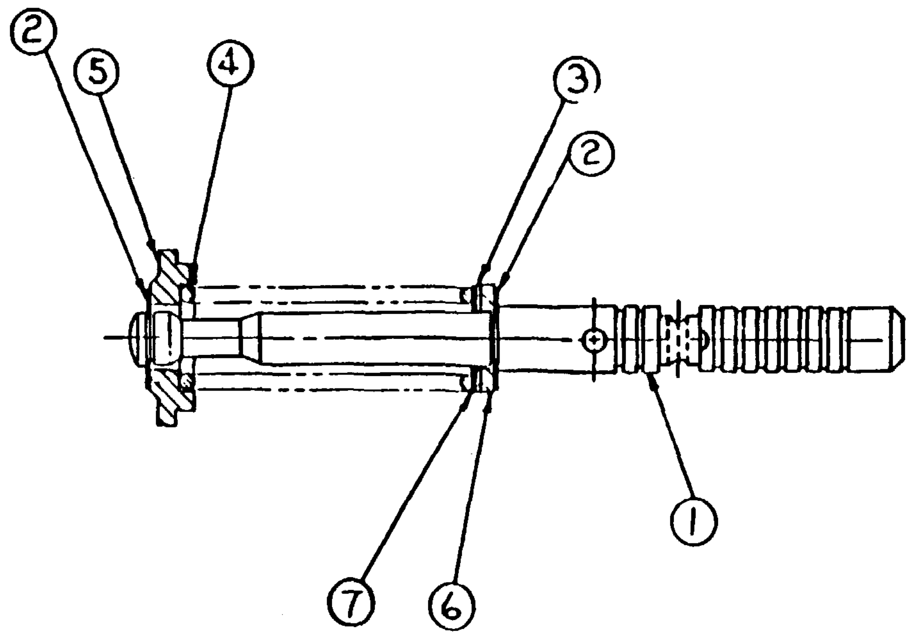
HCJ, HCS & HCF HYDRAULIC CONTROLLER
SPRING/SHIM CHART
(Suggested Shim Usage)

	SPRING RANGE				
	0-120 PSI	**0-200 PSI**	**0-250 PSI**	**0-300 PSI**	**0-400 PSI**
START PRESSURE	**Spring P/N 8844-001 (Gray)**	**Spring P/N 8845-001 (Red)**	**Spring P/N 8842-001 (Yellow)**	**Spring P/N 8846-001 (Black)**	**Spring P/N 8847-001 (Silver)**
0 PSI	1 sml 1 med 1 lrg	1 sml 1 med 2 lrg	4 sml 2 lrg	1 sml 3 med 2 lrg	3 lrg
10 PSI	1 sml 2 med 1 lrg	2 sml 1 med 2 lrg	2 sml 2 med 2 lrg	3 lrg	1 sml 3 lrg
20 PSI	2 lrg	3 med 2 lrg	3 lrg	1 sml 3 lrg	1 med 3 lrg
30 PSI	1 sml 1 med 2 lrg	3 lrg	1 sml 3 lrg	1 med 3 lrg	2 sml 3 lrg
40 PSI	3 med 2 lrg	2 sml 3 lrg	2 sml 3 lrg	1 sml 1 med 3 lrg	1 sml 1 med 3 lrg
50 PSI	3 lrg	1 sml 1 med 3 lrg	1 sml 1 med 3 lrg	2 med 3 lrg	2 med 3 lrg
60 PSI	2 red 3 Lrg	2 med 3 lrg	2 med 3 lrg	1 sml 2 med 3 lrg	1 sml 2 med 3 lrg
70 PSI	1 sml 2 med 3 lrg	1 sml 2 med 3 lrg	1 sml 2 med 3 lrg	1 sml 2 med 3 lrg	1 sml 2 med 3 lrg
80 PSI	4 lrg	4 lrg	4 lrg	1 sml 3 med 3 lrg	1 sml 1 med 3 lrg
90 PSI	1 med 4 lrg	1 sml 4 lrg	1 sml 4 lrg	4 lrg	4 lrg
100 PSI	2 med 4 lrg	1 med 4 lrg	1 med 4 lrg	1 sml 4 lrg	1 sml 4 lrg

	PART NO.	**THICKNESS**
Small Shim	8911-001	.010"
Medium Shim	8830-001	.020"
Large Shim	8831-001	.060"

Attachment
PRODUCT PIPELINE #4

ITEM	DESCRIPTION
1.	Spool
2.	Retaining Ring
3.	Shim
4.	Spring
5.	Spring Retainer
6.	Shim
7.	Shim



LTR.	ERO	DATE
F		
E		
D		
C	14183	7-17-80
B	14100	11/29/79
A	13869	10-1-79

REVISIONS

RELEASE FOR PRODUCTION — ERO 13900 — DATE 8-23-79

LIMITED RELEASE ONLY — ERO — DATE

TOLERANCE UNLESS OTHERWISE SPECIFIED
DEC. XX ± ~   MAX. ⊙ ~ T.I.R.
DEC. XXX ± ~
ANGULAR ± ~   MACHINE FINISH: √
INTERPRET DIMENSIONS, SYMBOLS, ETC., PER ENGRG. SPEC. E 004 001.

SCALE
DWN. [illegible]
DATE 7/31/79
DES.
CK'D. [illegible]

GRESEN MANUFACTURING CO.
MINNEAPOLIS MINNESOTA

PROPRIETARY & TRADE SECRET NOTICE
[illegible]

SUPERSEDES DWG.

EXP. NO. ~~TTB3-01-164~~

TITLE
ASS'Y., SPOOL

DWG. NO. 5062-8838-002

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.	5
Quantity Required:	One
Description:	Joystick Pump and Disc Brake Controller
Manufacturer:	GRESEN
Part Number:	HCS- 6-Bi-Bi-H
Source:	Gresen Manufacturing Dana Corporation P. O. Box 1313 Minneapolis, MN 55440
Tele #:	1-612-623-1960
TELEX #:	290492

8. Install retaining ring in groove on spool stem.
9. Re-install spool assembly in the controller housing and repeat steps 1 through 8 on the other spool assembly(s) in the controller.

NOTE

The shims installed to set the start pressure also add the same amount of pressure to the maximum pressure of the spring range.

(Example: A 0-200 PSI spring with a start pressure of 25 PSI would be a pressure control range of 25-225 PSI).

Doug Van Erem
Applications Engineer

ss

Attachments - Chart
Drawing

DECKMSTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	6
Quantity Required:	One
Description:	Gear Pump
Manufacturer:	Commercial Shearing
Part Number:	P 15 H 301 GEAB5 - 17
Source: 175 Logan Avenue Youngstown, Ohio 44501	Commercial Shearing, Inc.

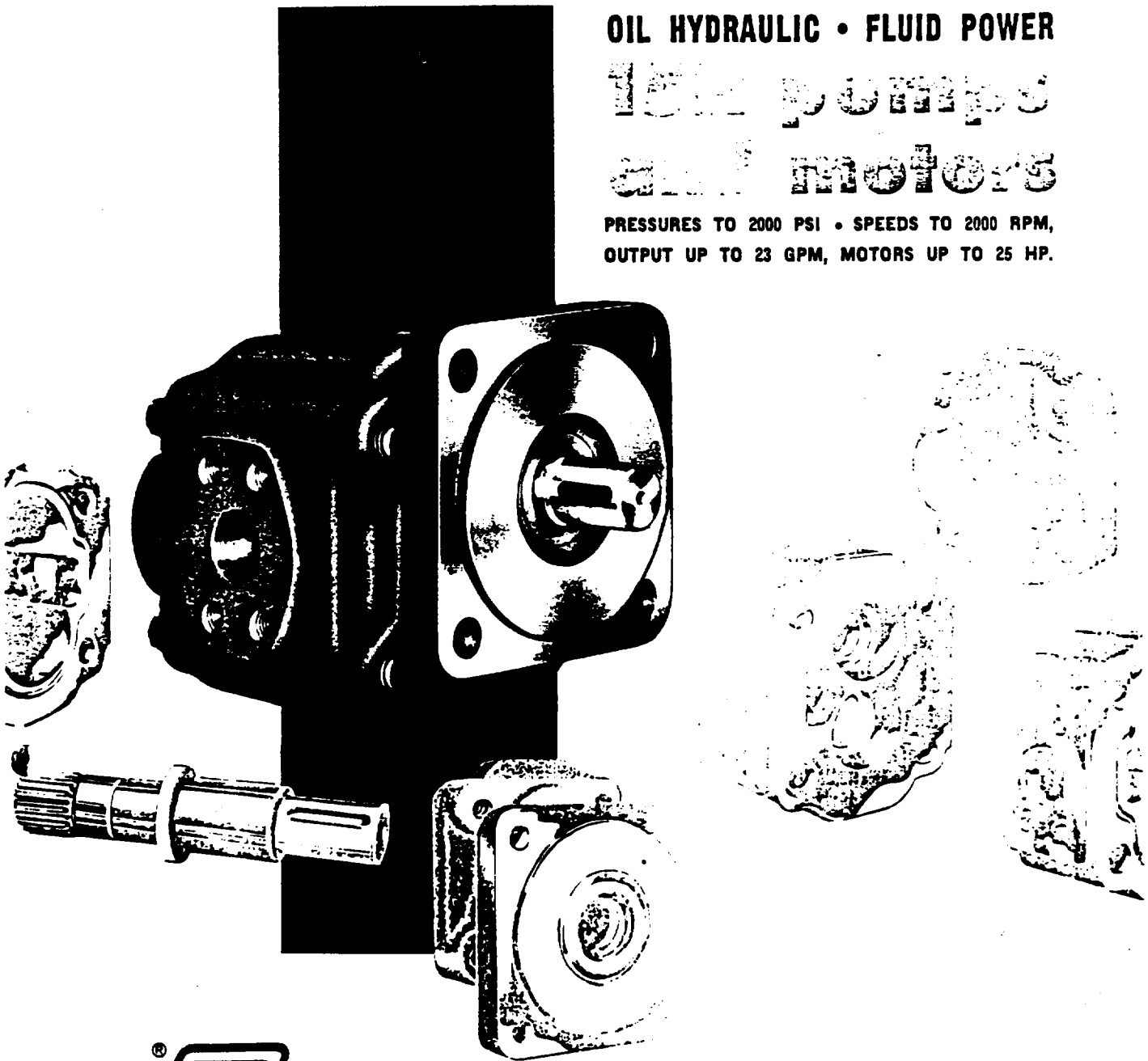
Tele #: 1-216-746-8011
TELEX #: 098-2420

Commercial's

OIL HYDRAULIC • FLUID POWER

[illegible] pumps and motors

PRESSURES TO 2000 PSI • SPEEDS TO 2000 RPM, OUTPUT UP TO 23 GPM, MOTORS UP TO 25 HP.



COMMERCIAL SHEARING, INC.

DECKMASTER

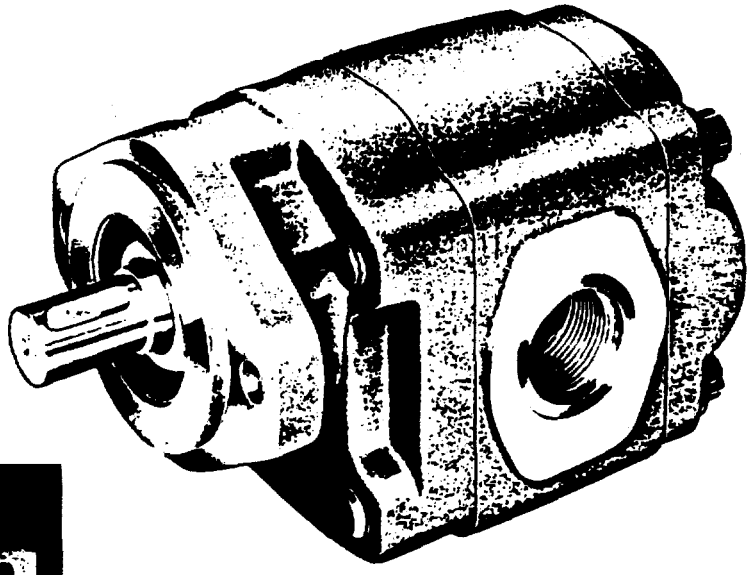
fluid power pumps

A pump is a device which converts mechanical energy into fluid energy. Always driven by a prime mover such as an internal combustion engine or an electric motor, it is the component which generates pressure energy in a fluid power system.

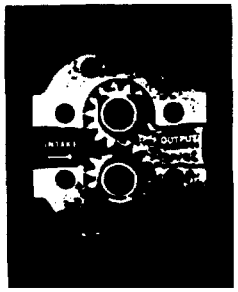
When there is no resistance to flow in the circuit, the pump discharge is at zero pressure. When resistance to flow is encountered due to loading of the circuit, a pressure build-up occurs instantly. When pressure build-up exceeds the pressure resistance to flow, fluid energy in the circuit is available to perform work.

COMMERCIAL Model H gear pumps deliver a constant flow per revolution due to their internal fixed displacement construction. Two matched spur gears, revolving inside a close fitting housing, trap oil between gear teeth as the teeth move out of mesh. This volume of oil is carried from the pump inlet around the periphery and discharged to the outlet side as the teeth move into mesh.

Pump delivery is measured in gallons per minute at specified pump revolutions per minute. Pump delivery volume for any one size of gears can only be varied as the speed (rpm) of the pump is changed.

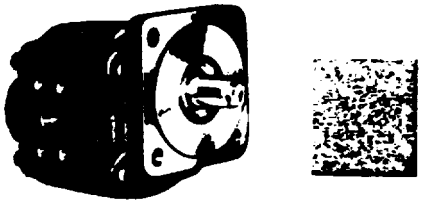


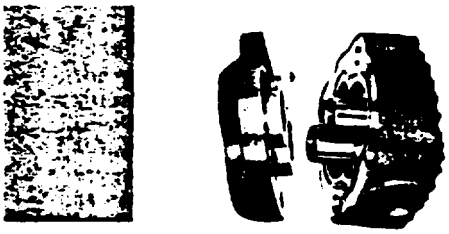
fluid power pumps

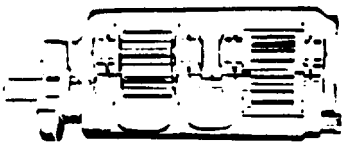


cutaway schematic of fixed displacement gear pump showing intake from tank, output delivery pressurized

DECKMASTER







2000 psi

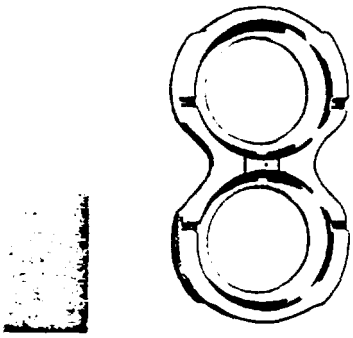
To satisfy the ever increasing demand for faster. more positive acting original equipment, fluid power components are needed which will perform more satisfactorily at higher operating pressures. Heavy duty gear pumps anti motors are preferred over vane or piston types due to their simplified construction, their ability to stand up under rugged operating conditions and their economies in cost and maintenance. COMMERCIAL Model 15H pumps and motors were made available to meet this demand. They are suitable for continuous heavy duty service at 2000 psi. Since their introduction, they have met with outstanding acceptance as proven by their wide usage on equipment in the OEM market.

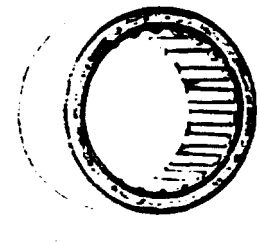
Longer life

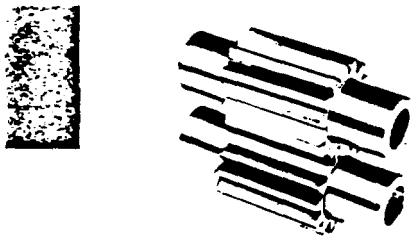
Insuring dependable, long life operation, Model 15H pumps anti motors are of heavy duty construction throughout. They are made with fewer working parts thin other types of pumps or motors. Extra heavy bearings, four to each single unit, are placed on the ends of each gear anti are designed to take all unbalanced loadings, prevent shaft misalignment anti eliminate corner loading and spawling. .All castings are of a special alloy iron, precision machined, with metal positioned to resist bursting under severe shock loading. Thus, these long life units are a result of years of experience and "know how" built into every COMMERCIAL pump and motor.

Performance

Accurate alignment of finely machined parts under load, excellent lubrication, positive scaling of blocked oil passageways and perfect joining of gear contact surfaces are check points to consider in evaluating performance characteristics of pumps and motors. Ratio of output to input is much higher than normally associated with gear pumps or motors, particularly when operating at pressure as high as 200 psi. Complete performance data pertaining to COMMERCIAL. Motel 15H fluid power pumps and motors is recorded on pages 10 through 19.







Thrust plate

COMMERCIAL'S original "pressure-pocketed" thrust plates are another built-in feature of Model 15H pumps and motors and serve a most important function. By "pressure-pocketing", a dynamic seal is created which prevents oil under high pressure from flowing toward the low pressure side of the thrust plate. Therefore, a positive seal is created which contributes to volumetric efficiency of pumps in excess of 90%. These floating type thrust plates exert a force at all times against the small sealing area at the gear faces. The small loss of mechanical efficiency due to friction between thrust plates and gear faces results in considerable gain in this volumetric efficiency.

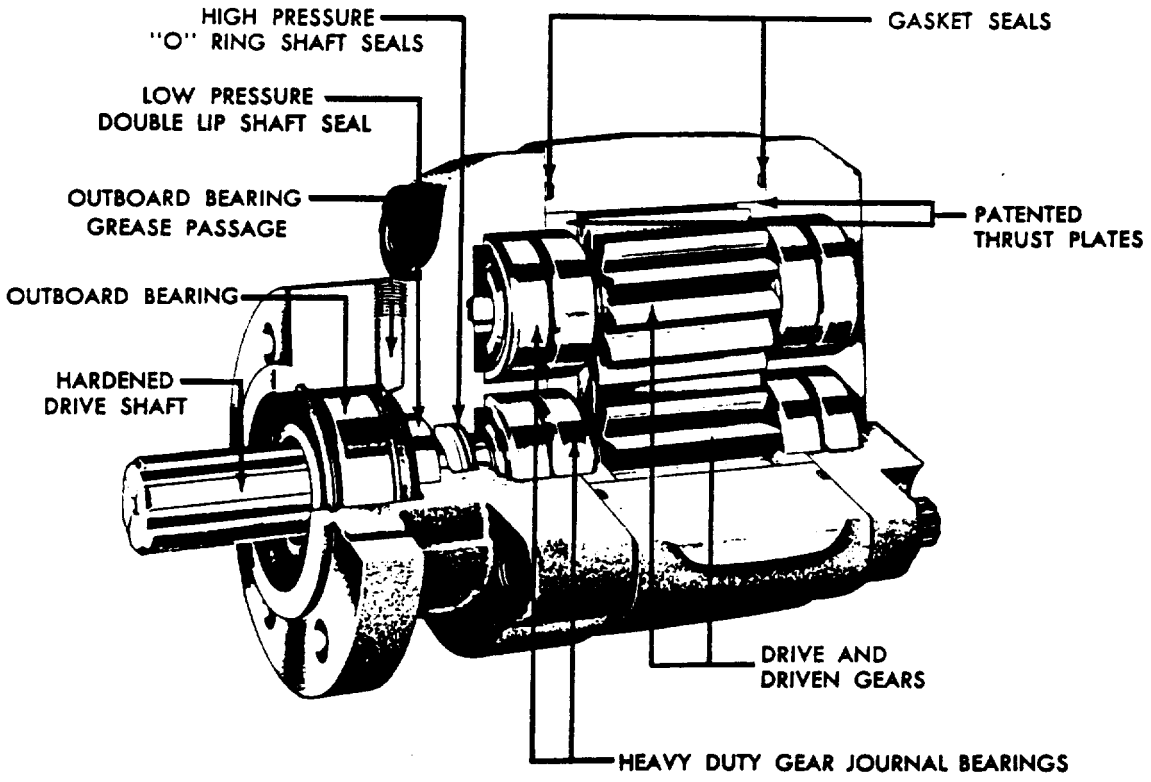
Bearings

Bearings are built into COMMERCIAL Model 15H pumps and motors to maintain positive shaft and gear alignment. Anti-friction bearings are designed to absorb all radial and thrust loads always present to the unbalanced loading conditions inherent in gear type and motors. Two heavy duty, anti-friction inboard gear journal. ings are provided for each gear. COMMERCIAL also provides a ruls6¢d outboard bearing, a ball bearing type, for all pumps and motors. Bearings are fit to the gear hubs, not to the drive shaft. Because gear hub is integral with the gear, larger bearings, necessary for satisfactory operation at 2000 psi, are possible. Such gear hub construction
permits more accurate machining held to closer tolerance.

Gears

For high volumetric efficiency of gear type pumps and motors, complete sealing between all gear tooth contact surfaces must be maintained. As operating pressures increase, this contact becomes more difficult to maintain. COMMERCIAL found that gears which were obtainable on the open market did not have tooth surfaces smooth and sufficiently accurate for high efficiency operation at 1500 psi and higher. Gear surfaces are precision finished, each pair. matched perfectly. COMMERCIAL manufactures gears for all their pumps and motors and makes every effort in design and manufacture to assure producing gears which will give the quietest and most efficient operation.

single fluid power pump



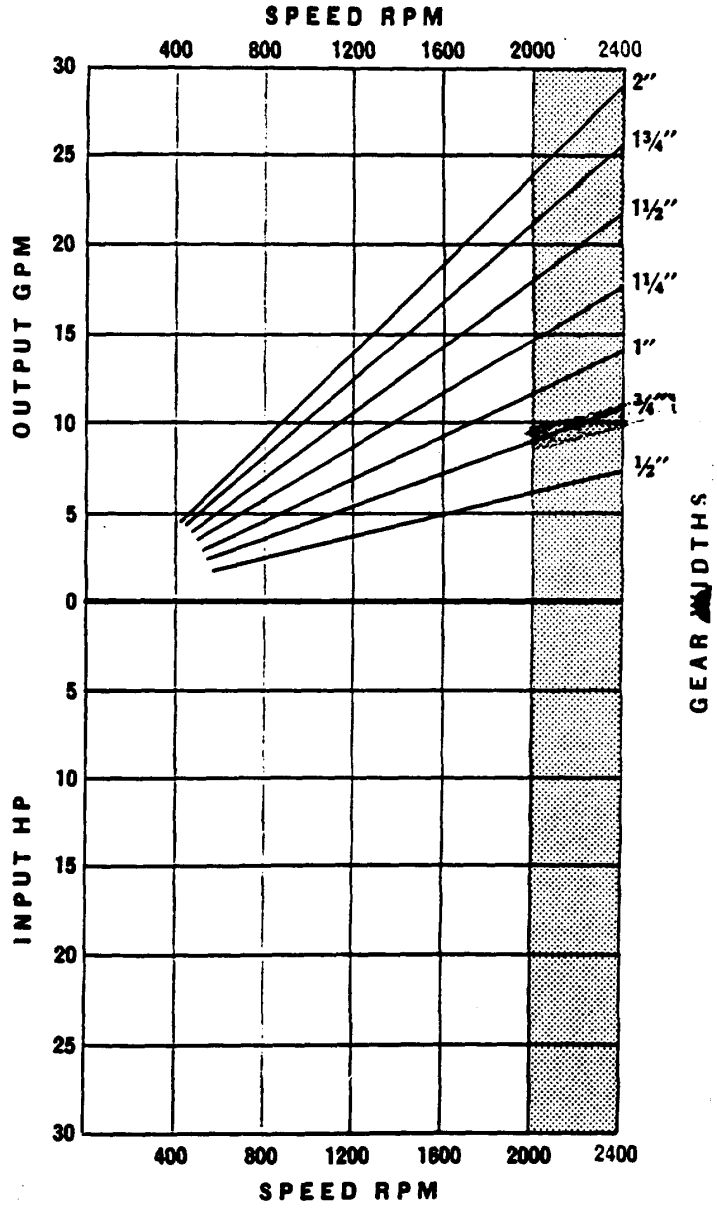
DECKMASTER

performance data · pumps

100 psi operating pressure

output gpm

speed rpm	gear size (inches) ½	¾	1	1¼	1½	1¾	2
400	1.0	1.5	2.0	3.0	3.5	4.0	4.5
800	2.5	3.5	4.5	6.0	7.0	8.5	9.5
1200	3.5	5.5	7.0	9.0	11.0	12.5	14.5
1600	5.0	7.0	9.5	12.0	14.5	17.0	19.0
2000	6.0	9.0	12.0	15.0	18.0	21.0	24.0
2400	7.5	11.0	14.5	18.0	22.0	25.5	29.0



Applications involving pump speeds from 2000 to 2400 rpm subject to engineering approval.

Performance data recorded above is the average result based on a series of laboratory tests of production units and are not necessarily representative of any one unit. Request for more specific data will be referred to our engineering department.

Tests were made under continuous duty operation with oil temperature 120°F., viscosity 180 SSU @ 100°F.

DECKMASTER

performance data · pumps

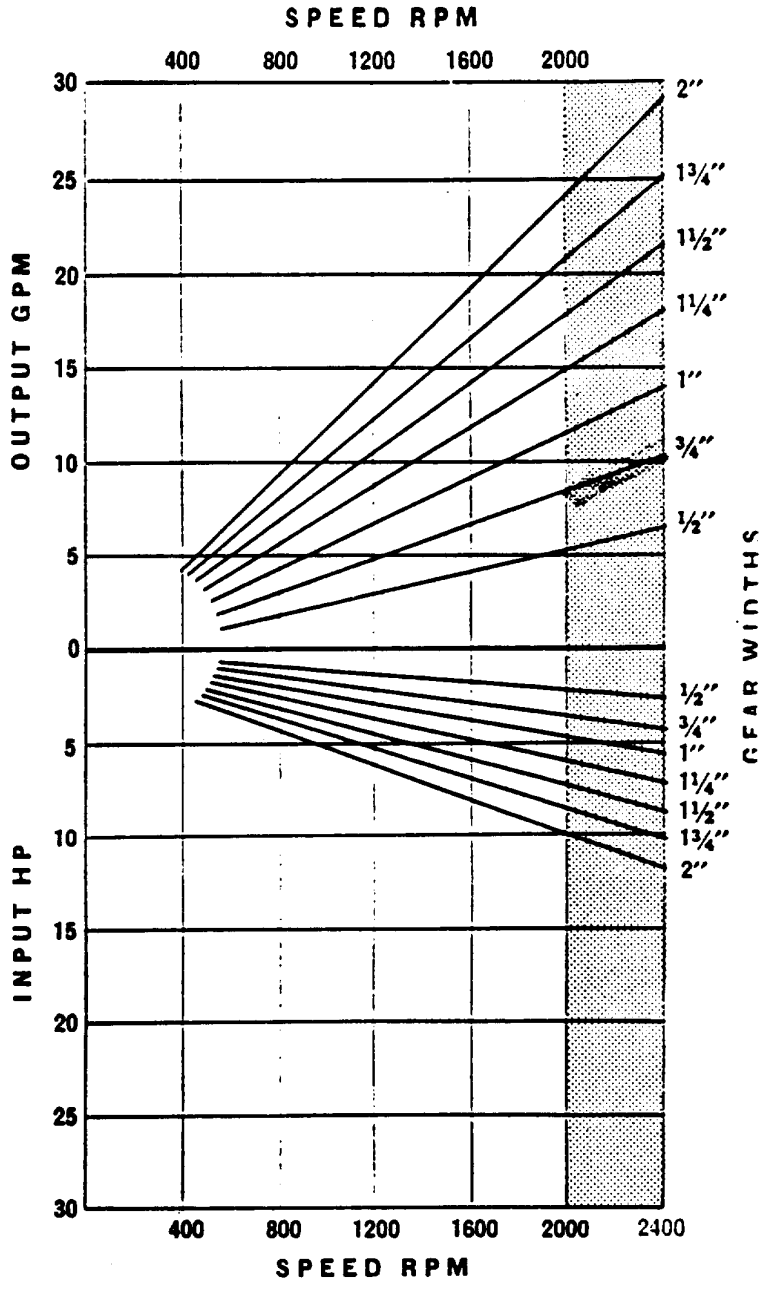
500 psi operating pressure

output gpm

speed rpm	gear size (inches) ½	¾	1	1¼	1½	1¾	2
400	1.0	1.5	2.0	2.5	3.0	3.5	4.0
800	2.0	3.0	4.5	6.0	7.0	8.0	9.0
1200	3.0	5.0	7.0	9.0	10.5	12.0	14.0
1600	4.5	7.0	9.5	12.0	14.0	16.5	19.0
2000	6.0	9.0	12.0	15.0	17.5	21.0	24.0
2400	7.0	10.5	14.0	18.0	21.0	25.0	29.0

input hp

400	0.5	0.7	1.0	1.3	1.5	1.8	2.2
800	1.0	1.5	2.0	2.5	3.0	3.5	4.0
1200	1.5	2.0	3.0	3.5	4.5	5.0	6.0
1600	2.0	3.0	4.0	5.0	5.5	6.5	7.5
2000	2.5	3.5	4.5	6.0	7.0	8.0	9.5
2400	3.0	4.0	5.5	7.0	8.5	9.5	11.0



Applications involving pump s[illegible] to 2400 rpm subject to engineering approval.

Performance data recorded above is the average result based on a series of laboratory tests of production units and are not necessarily representative of any one unit. Request for more specific data will be referred to our engineering department.

Tests were made under continuous duty operation with oil temperature 120°F., viscosity 180 SSU @ 100°F.

DECKMASTER

coding examples:
single unit, as illustrated to left, when specified as a pump-code sequence is as follows:

SINGLE PUMP ..... component
1. PUMP ..... P
2. SERIES..... 15
3. MODEL ..... H
4. SHAFT END COVER 300
5. PORT END COVER ..... BE
6. GEAR HOUSING RL20
7. DRIVE SHAFT 2

UNIT CODE NUMBER
P15H300BERL20-2

reference to specifications

ROTATION
Rotation on all COMMERCIAL Model H pumps and motors must be specified so that inlet and outlet porting sizes and locations can be properly selected. Rotation is orientated by looking at the shaft end of the unit. When the drive shaft is above horizontal center line of the unit, right and left sides are right and left respectively. When the drive shaft is toward the bottom, the side to your right is the established left side and the side to your left is the established right side of the device. COMMERCIAL pumps are built for clockwise rotation, counterclockwise rotation or for rotation in either direction. COMMERCIAL motors are always built for rotation in either direction.

SHAFT END COVERS
Determine and specify code number for shaft end cover desired. 15H pumps and motors are furnished in styles for flange or pad mounting. Numerical code breakdown: First digit indicates direction of rotation. It is important that rotation desired be specified by proper code number. Last two digits indicate shaft end cover pattern which links particular shaft end cover to proper drive shafts. When ordering shaft end cover, complete CODE number must be 'specified. Details of each style shaft end cover are shown on pages 22 thru 25.

PORT END COVERS
Determine and specify code number for port end cover desired. 15H pumps and motors are furnished in two basic porting arrangement-no porting and end porting. Single and tandem pumps and motors are furnished with recessed head type fasteners. Details of each style port end cover are shown on pages 26 and 27.

GEAR HOUSINGS
Determine and specify code number for each pump or motor gear housing desired. 15H pumps and motors are furnished with tapered thread, SAE split flange or straight thread fittings. Port selection includes no porting, left and/or right hand side porting. Gear sizes range from 1/2" to 2". Details of each style gear housing are shown on pages 28 through 31.

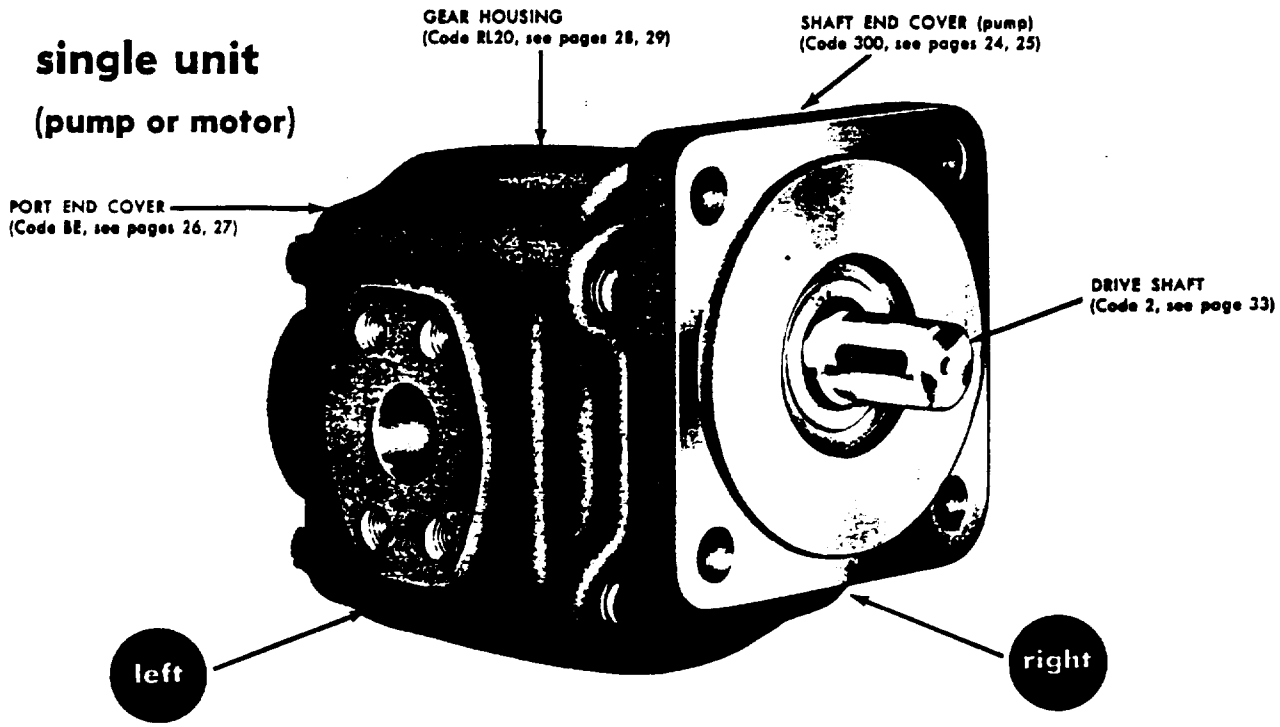
SHAFTS
Determine and specify code number for shaft desired. 15H pumps and motors are furnished with splined or straight keyed shafts. When selecting, drive shaft must be coordinated with proper shaft end cover as designated by pattern number. Pattern number only links drive shafts to proper shaft end cover. Shafts must be ordered by CODE number. Details of each style shaft are shown on pages 32 and 33.

BEARING CARRIERS for tandem pumps and motors only
Determine and specify code number for bearing carrier desired when selecting a tandem unit. One bearing carrier must always be placed between two adjacent pumps or motors. 15H pumps and motors are furnished with tapered thread, SAE split flange and straight thread fittings. Port selection includes no porting, left and/or right ,and side porting. Internal drilled ports must be selected for proper direction of oil flow into adjacent pumps or motors. Details of each style bearing carrier are shown on pages 34 and 35.

how to specify and code

single unit

(pump or motor)



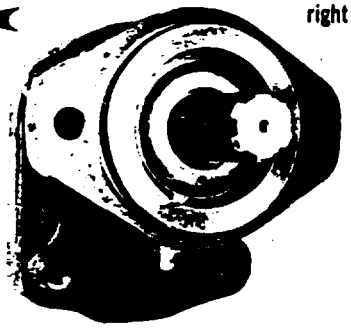
flange mounting • two bolt

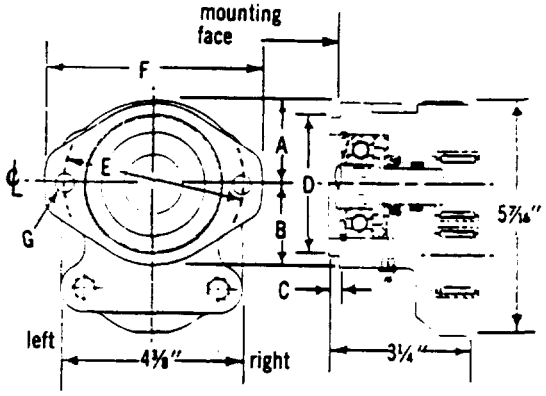
3¼" pilot dia.
(SAE C flange)

pattern 01

4" pilot dia.
(SAE B flange)

pattern 07





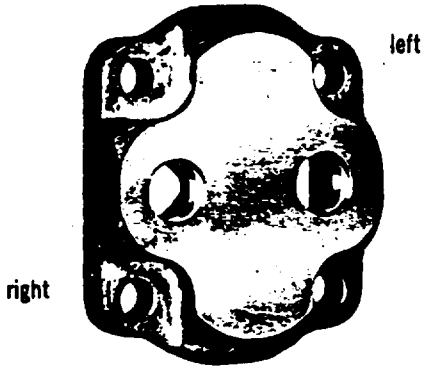
DRAWING NOT TO SCALE

Shaft end cover pattern numbers are a pick-up of the last two digits of shaft end cover code numbers. Pattern numbers are only used for reference to establish the dimension from mounting face of shaft end cover to end of shaft. See X dimension in tables on pages 32 and 33.

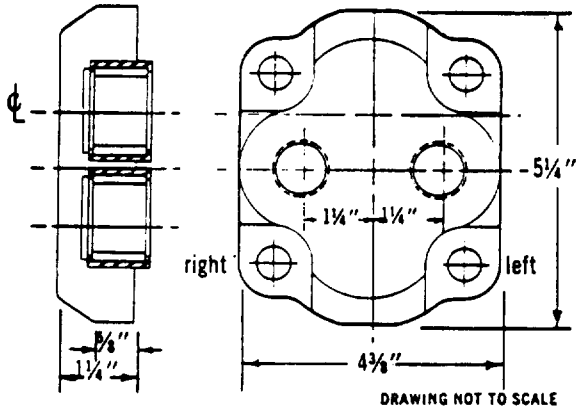
Pumps are furnished with double lip and "O" ring seals.	drill	1⅛	1⅛	¼	3¼	4³⁄₁₆	5⅛	⅞	—	**101** **201** **301**	clockwise rotation counterclockwise rotation double rotation
Motors are furnished with double "O" ring seals.	drill	1⅛	1⅛	¼	3¼	4³⁄₁₆	5⅛	⅞	—	**901**	double rotation
Pumps are furnished with double lip and "O" ring seals.	drill	2⅛	2⅛	¼	4	5¾	6⅛	⅞ •	—	**107** **207** **307**	clockwise rotation counterclockwise rotation double rotation
Motors are furnished with double"O" ring seals.	drill	2⅛	2⅛	¼	4	5¾	6⅛	⅞	—	**907**	double rotation

port end covers

tapered thread • NPT



envelope dimensions



detail of fastener

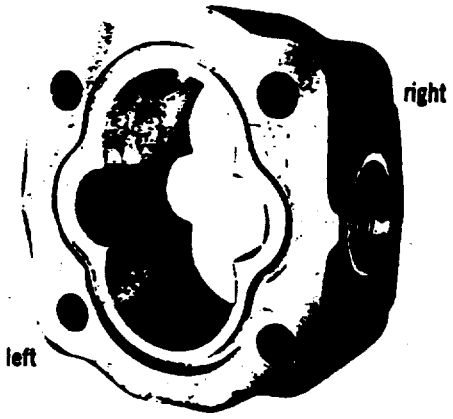
12 pt. cap screws standard for single units only

Allenut and stud standard for tandem units only

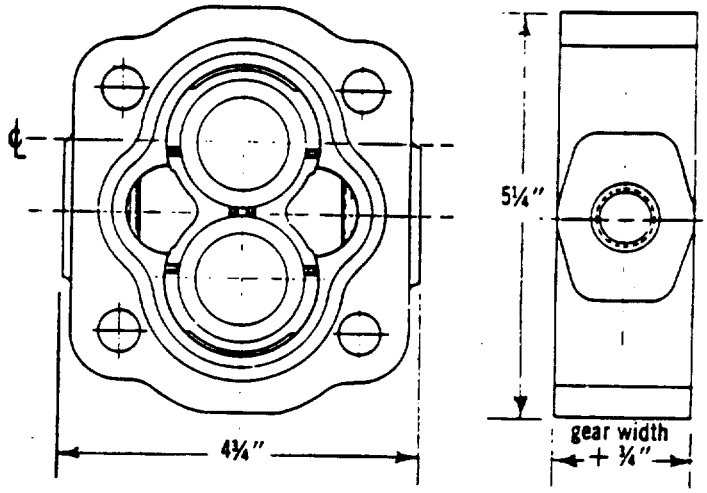
port size pipe dia. (in.) left	port size pipe dia. (in.) right	CODE for single units only	CODE for tandem units only	port size pipe dia. (in.) left	port size pipe dia. (in.) right	CODE for single units only	CODE for tandem units only
[illegible]	[illegible]	[illegible]	BI				
none	½	CE	CI	¼	½	KE	KI
none	¾	DE	DI	¼	¾	LE	LI
none	1	ME	MI	½	1	SE	SI
½	none	FE	FI	1	½	RE	RI
¾	none	JE	JI	¼	1	VE	VI
1	none	NE	NI	1	¾	TE	TI
½	½	GE	GI	1	1	PE	PI
½	¾	HE	HI				

gear housings

straight thread—tube O.D.



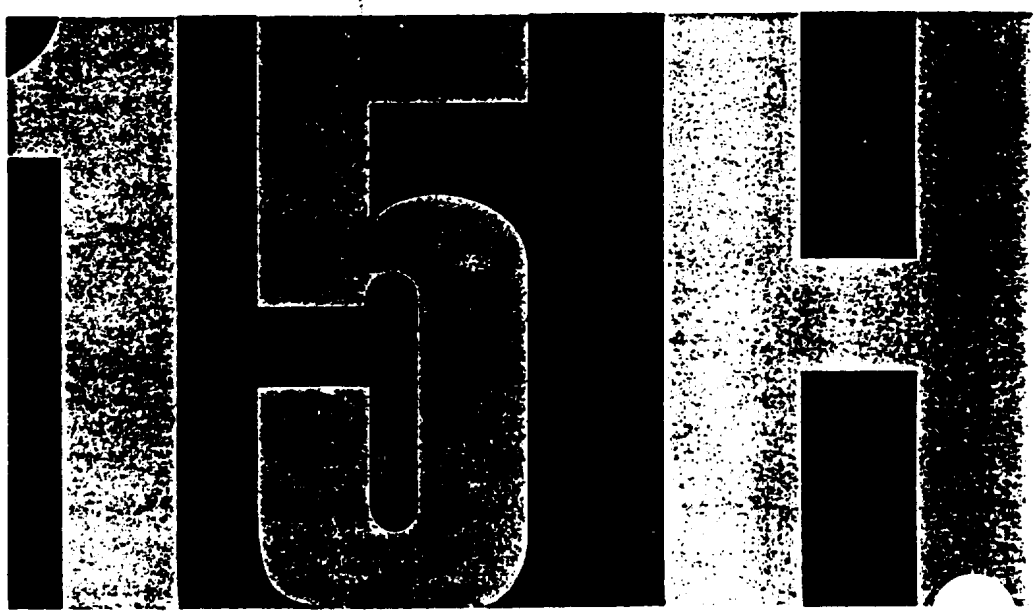
envelope dimensions



port size tube O.D. (in.)		CODE gear width (inches)						
left	right	½	¾	1	1¼	1½	1¾	2
none	none	AB5	AB7	AB10	AB12	AB15	AB17	AB20
none	½	•	UC7	UC10	UC12	•	•	•
½	none	•	UP7	UP10	UP12	•	•	•
½	½	•	YC7	YC10	YC12	•	•	•
none	⅝	•	•	UD10	UD12	UD15	•	•
none	¼	•	•	UF10	UF12	UF15	UF17	UF20
⅜	none	•	•	UQ10	UQ12	UQ15	•	•
¼	none	•	•	UR10	UR12	UR15	UR17	UR20
½	⅜	•	•	•	•	•	•	•
⅜	½	•	•	•	•	•	•	•
⅜	⅜	•	YK7	YK10	YK12	YK15	•	•
⅜	¼	•	•	YL10	•	•	•	•
¼	⅜	•	•	YQ10	•	•	•	•
¼	¼	•	•	YR10	YR12	YR15	YR17	YR20
none	⅜	•	•	•	•	•	•	•

SERVICE MANUAL

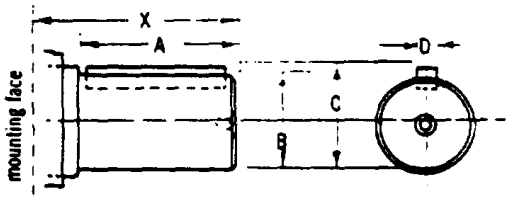
MODEL 15H SINGLE AND TANDEM
OIL HYDRAULIC PUMPS—MOTORS



COMMERCIAL SHEARING, INC.

PTO plain end

style	torque (max. in. lbs.)	A	B	C	D	E	F	G	H	X shaft end cover pattern							CODE
										00	01	02	03	07	09	10	
standard	1700	1¼	¾	1 3/16	3/16	–	–	–	–	1 5/16	1 5/16	1⅜	–	1 5/16	1¾	1 5/16	



foreword ...

This descriptive guidebook will familiarize you with COMMERCIAL Model 15H single and tandem pumps and motors - their component parts - relative position of each part - proper methods for assembly or disassembly of units - care and use of .these oil hydraulic units so that better performance and greater life expectancy will result for your benefit.

A photographic presentation with explanatory notes covers the steps that should be closely followed when servicing the elements that comprise these units. Before any work is done in the repair of these units. it is suggested that all of the steps used in tearing down the assembled unit and all of the steps used in building up the unit be read. Such a digest will familiarize you with the general procedure of the work to be done and give you the feel of the specific operations involved.

general instructions ...

Here you .have a gear type fixed displacement oil hydraulic pump or motor which has been built to very high standards and a new design. The result is the Model 15H pump and motor having operating characteristics far superior to other pumps and motors of its type. Close fits and small running tolerances were originally built in to insure peak performance and highest operating efficiency.

Slippage is a factor which has considerable bearing on the performance. As the amount of slippage is reduced, the higher the operating efficiency. Best results develop when a close fit is made between the gears and all surfaces they come in contact with. Allowance of a minimum running clearance is, of course, necessary.

Inspection of all COMMERCIAL pumps and motors will disclose gears in matched pairs-all are original equipment, made by COMMERCIAL on specially built machines which produce surfaces within limits much closer than is standard practice.

Seldom should you find it necessary to service the Model 15H oil hydraulic pump or motor during its life expectancy, but should a noticeable drop in performance occur it is advisable to make an inspection and replace such part or components which, due to some unusual condition, may have become worn. Should you find it advisable to replace the gears, insist that they be in matched pairs and the product of the original manufacturer. Matched gears are the very vitals of the gear type pump or motor. Expendable parts such as "0" ring shaft seals, pocket seals, single and double-lip oil seals and back-up rings should never be re-used even though inspection may show these items as being serviceable for future use. Such parts for replacement are available at a cost which is insignificant in view of your investment and when you consider the vital function of these items is to prevent leakage. All replacement parts should be given your final inspection to insure that no damage has resulted after final factory inspection was made.

lubrication ...

All parts of the units with the exception of the outboard bearing are lubricated by the hydraulic oil in the circuit. Particular attention must be paid to keep the oil in the circuit system clean. Whenever there is a pump or motor failure and there is reason to feel that metal particles may be in the system. the oil must be drained, the entire system flushed clean, and any filter screens thoroughly cleaned. New oil should be supplied for the entire system. Oil suitable and recommended for use in circuits involving Model 15H pumps and motors should meet the following specifications:

Hydraulic oils should have a viscosity index of 90 or higher and a viscosity SUS 150 to 200 at 100°F. Aniline point should be 165 or higher. Oil operating temperatures should not exceed 200°F.

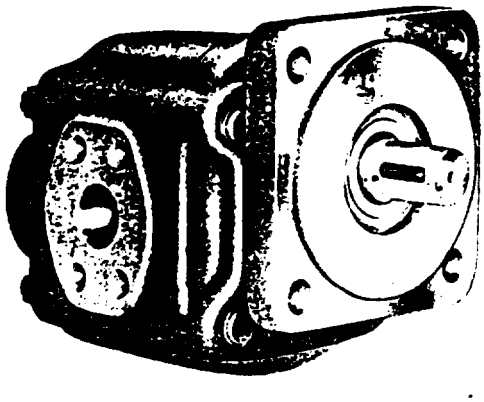
Oil should have anti-foam and anti-oxidation additives.

Do not use low viscosity naphtha base oils, aircraft hydraulic fluid, or hydraulic brake fluid.

Oil with a low pour point should be used when operation is to be in cold, low temperature climates.

At regular intervals the outboard bearing should be lubricated. You are cautioned that not all lubricants are satisfactory for proper lubrication of the outboard bearing. Results from tests and field operation indicate that a lubricant such as Texaco Starfak #2 is satisfactory.

single COMMERCIAL Model " 15H" Oil Hydraulic Heavy Duty Pump - Motor



Exploded view, showing all parts and their nomenclature which are used in the Model 15H single pump or motor, is shown on page 4.

Complete instructions are given on page 5 covering the disassembly by subassemblies of the single pump or motor.

Instructions to assemble all parts into subassemblies and to complete the assembly of the 15H single pump or motor, are outlined in detail on pages 6, 7, 8 and 9.

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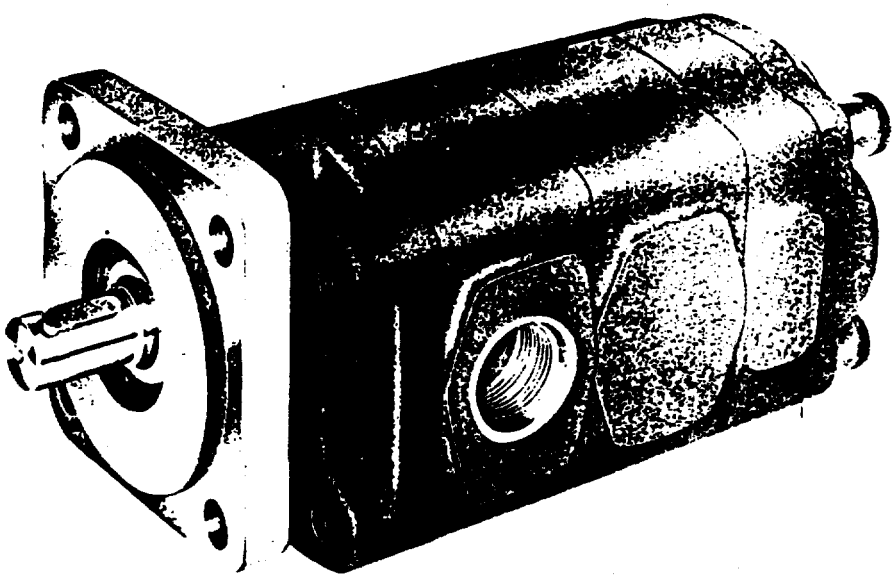
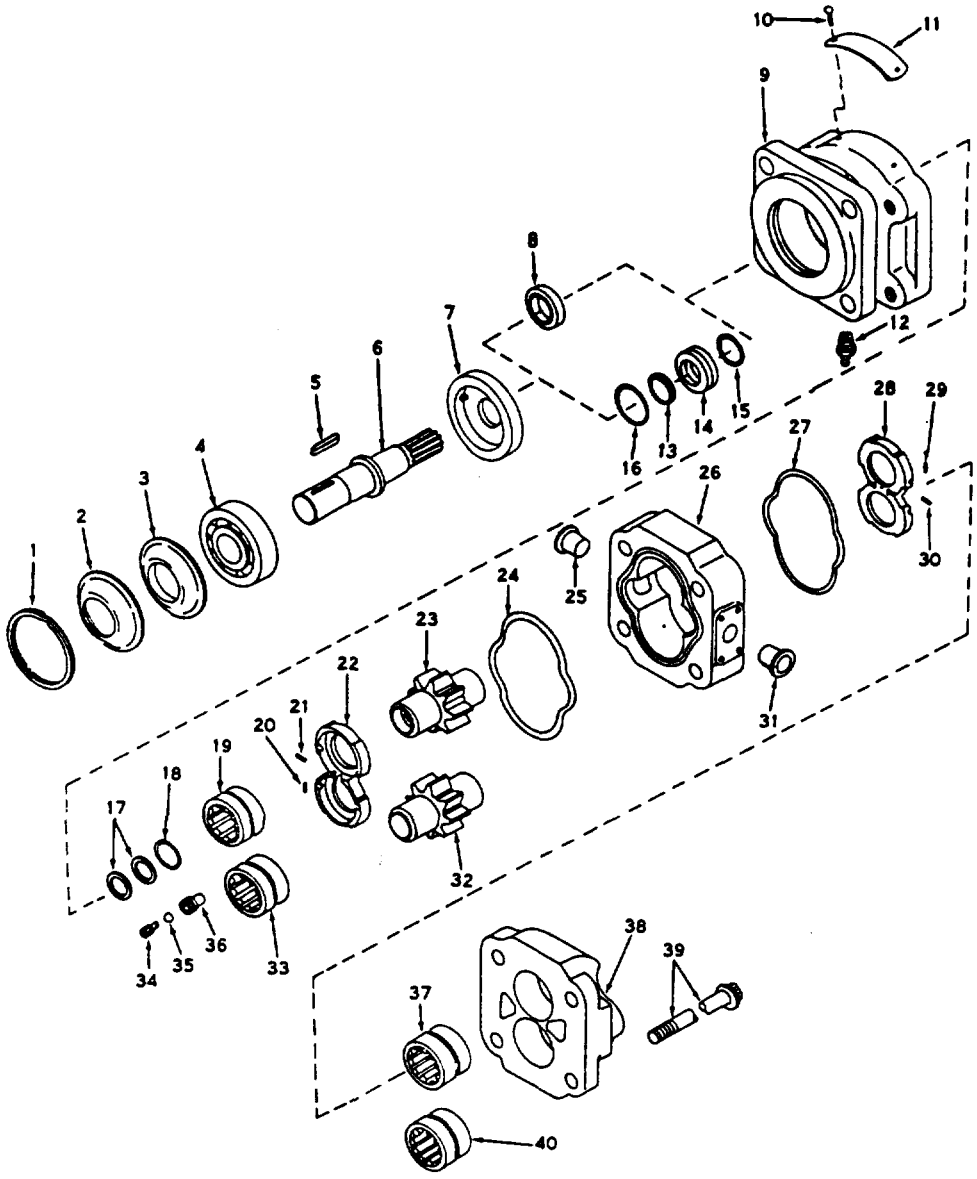
tandem COMMERCIAL Model "15H" Oil Hydraulic Heavy Duty Pump - Motor



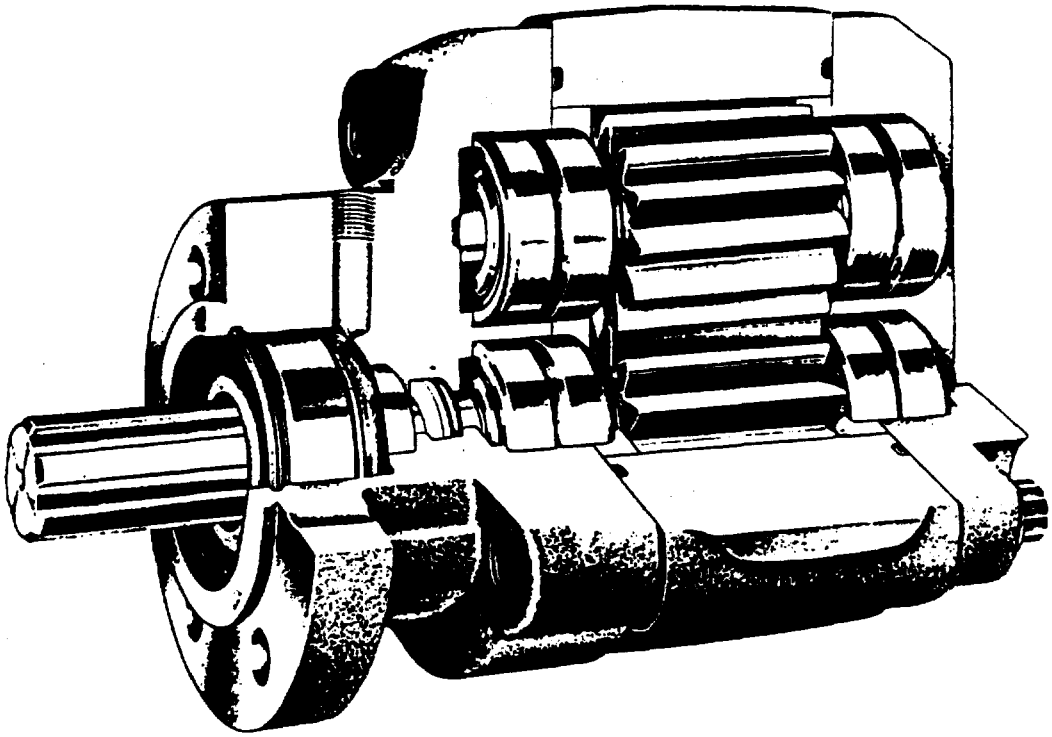
Exploded view, showing all parts and their nomenclature which are used in the Model 15H tandem pump or motor, is shown on page 10.

Complete instructions are given on page 11 covering the disassembly by subassemblies of the tandem pump or motor.

Instructions to assemble all parts into subassemblies and to complete the assembly of the Model 15H tandem pump or motor are outlined in detail on pages 12, 13, 14 and 15.



No.	Description
1	Spirolox Snap Ring
2	Bearing Shield
3	Bearing Seal
4	Shaft Ball Bearing
5	Key
6	Drive Shaft
7	Bearing Spacer
8	Oil Seal
9	Shaft End Cover
10	Drive Screws
11	Name Plate
12	Grease Fitting
13	Back-Up Ring
14	Bronze Insert
15	"O" Ring Shaft Seal
16	"O" Ring Gasket
17	Back-Up Rings
18	Shaft "O" Ring
19	Roller Bearing
20	Pocket Seals
21	Pocket Seals
22	Thrust Plate
23	Drive Gear
24	"O" Ring Gasket
25	Plastic Pipe Closure
26	Housing
27	"O" Ring Gasket
28	Thrust Plate
29	Pocket Seals
30	Pocket Seals
31	Plastic Pipe Closure
32	Driven Gear
33	Roller Bearing
34	Check Ball Retainer
35	Check Ball
36	Check Valve Seat
37	Roller Bearing
38	Port End Cover
39	Cap Screws
40	Roller Bearing



single pump disassembly

GENERAL NOTES
Remember dirt is the enemy of any hydraulic system. The best way to fight this enemy is to prevent its entry into the system. Make sure you disassemble and reassemble this pump in spotlessly clean surroundings. Apply a coating of grease (cup grease consistency) to surfaces of all "O" rings and oil seals to facilitate positive location as they are installed in a reassembly.

DISASSEMBLY BY SUBASSEMBLY

1. Index mark the port end cover (38), gear housing (26) and shaft end cover (9) to facilitate reassembly.
2. Remove the four cap screws (39) from the port end cover (38).
3. Lift off port end cover (38); the thrust plate (28) with pocket seals and the roller bearings (37, 40) will also be removed in this operation.
4. Remove the driven gear (32).
5. Remove the gear housing (26) and drive gear (23) from the shaft end cover (9). Be sure to keep gears together as they are a matched set.

SHAFT END COVER

1. Turn the shaft end cover (9) over so that the drive end of the shaft is facing up. With a screwdriver remove the snap ring (1) then remove the bearing shield (2) and bearing seal (3).
2. Pull the drive shaft (6) from the shaft end cover. The shaft ball bearing (4) will also be removed. Then lift out the bearing spacer (7).
3. Remove and discard the oil seal (8) from the shaft end cover.
4. Turn the cover over so that the thrust plate is up. Pry off thrust plate (22) carefully with a knife blade or thin screwdriver. Remove and discard the pocket seals (20), (21).
5. Pull the bearings (19, 33) with a bearing puller from the shaft end cover (9)-ONLY-if they) are being replaced.
6. Remove the check valve assemblies (34, 35, 36).
7. Remove the shaft "O" ring (18) and the back-up rings (17) from shaft end cover (9).
8. Remove key (5) and press bearing (4) from shaft (6).

HOUSING

1. Remove and discard "O" rings (24, 27) from grooves in housing (26).

PORT END COVER

1. Pry off the thrust plate (28) with a knife blade or thin screwdriver. Remove and discard the pocket seals (29), (30).
2. Pull the bearings (37, 40) with a hearing puller from the port end cover (38)-ONLY-if they are being replaced.

SHAFT END COVER SUBASSEMBLY

1. Install buck-up rings (17) and shaft "O" ring (18) in gear side of shaft end cover (9).

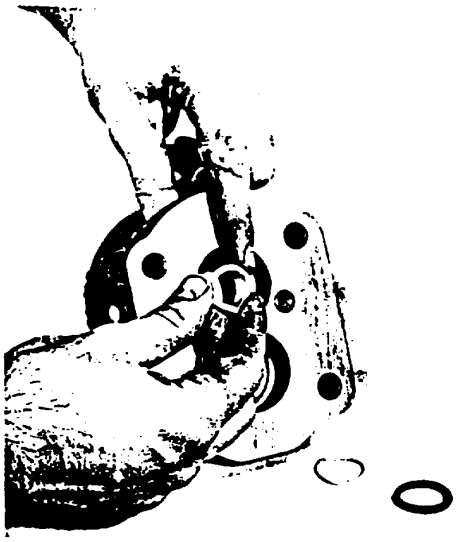


Fig. 3 Installing back-up ring

2. install two new roller bearings (19, 33) in the bores of the cover-IF-the used ones were removed.

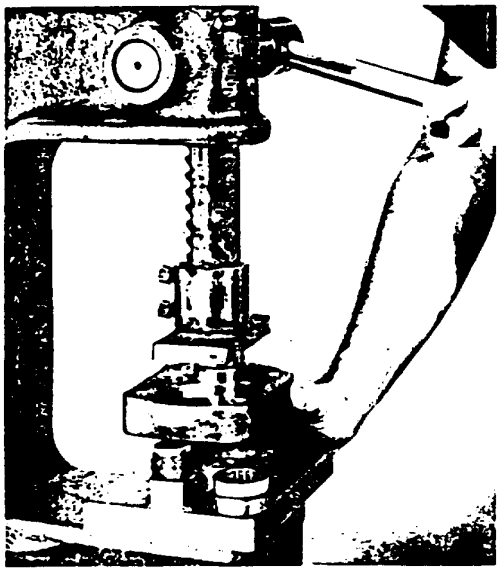


Fig. 4 Installing roller bearings

3. Place the shaft end cover (9) gear side up in a vise having soft jaws and reassemble the two check valves for double rotation by inserting the ball (35) into the check valve scat (36) and screwing the check hall retainer (34) flush into the check valve scat being sure the check ball is free to move. Screw the two check valve assemblies into their respective holes, approximately two threads below face of shaft end cover (9). Single rotation units do not require check assemblies. Instead, a plug is installed on the high-pressure side of pump with the low-pressure side left open. Peen over the check valve seat and ball retainer to prevent the valves from backing out.

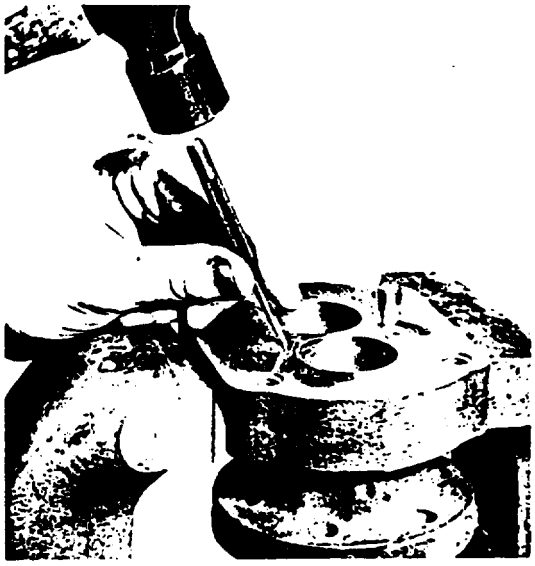


Fig. 5 Peening over check valve seat

4. Remove shaft end cover (9) from vise. turn over, place in ;arbor press and press in oil seal (8) with the open side down facing toward the bearing bore.

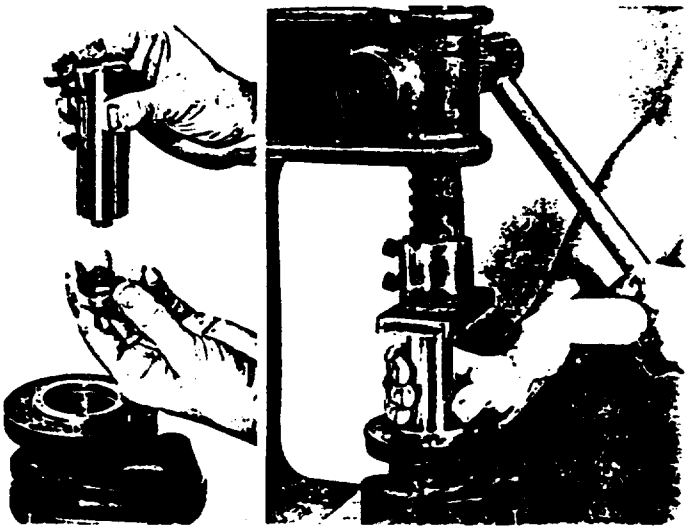


Fig. 6 Pressing in oil seal

5. Then install the bearing spacer (7) open side up. NOTE: For motors-use special bronze insert (14) with back-up ring (13) and shaft seal (15) in I.D. groove of insert and "O" ring gasket (16) in O.D. groove of insert.
6. Repack the shaft ball bearing (4) with a #2 consistency lithium base, high temperature, ball bearing grease. Press the bearing onto the drive shaft (6) being sure it is seated against the shaft shoulder.
7. Insert the assembled shaft into the shaft end cover (9).

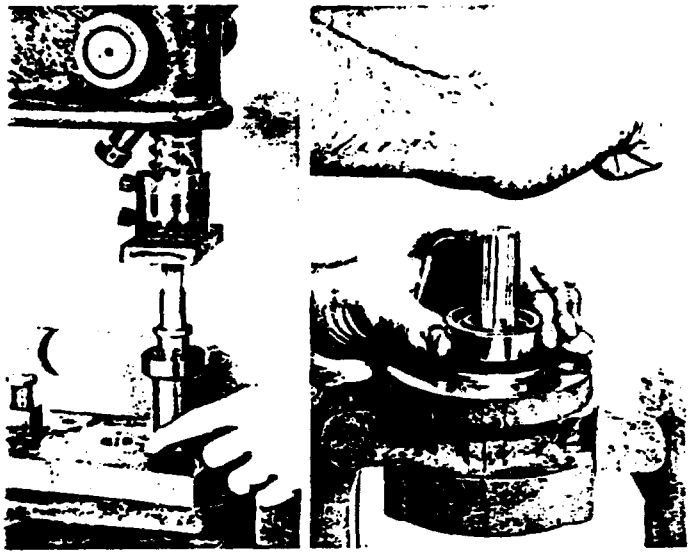


Fig. 7 Inserting assembled shaft

8. Place bearing seal (3) and bearing shield (2) on shaft.

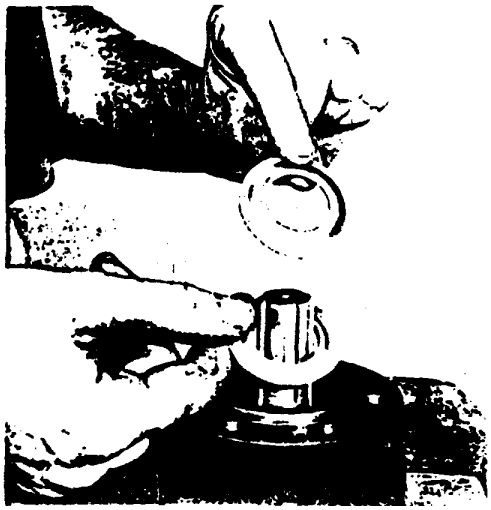


Fig. 8 Installing bearing seal and shield

9. With ends of "Spirolox" snap ring (1) spread apart, insert one end of snap ring into groove. Then wind balance of the snap ring into the groove.

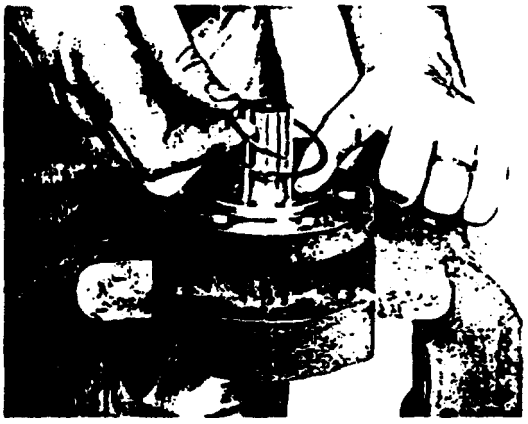


Fig. 9 Installing Spirolox snap ring

10. Turn shaft end cover over, place in vise with gear side up.
11. Lay the thrust plate (22) on the bench and cut four pocket seals (21) slightly (1/32” to 1/36") longer than the four outer slots in the thrust plate. Set them aside for a minute.
12. Place some heavy grease in the two middle slots of the thrust plate (22). Cut two pocket seals (20) 3/16" long. They may run 1/64" longer but if cut any shorter they must be discarded.

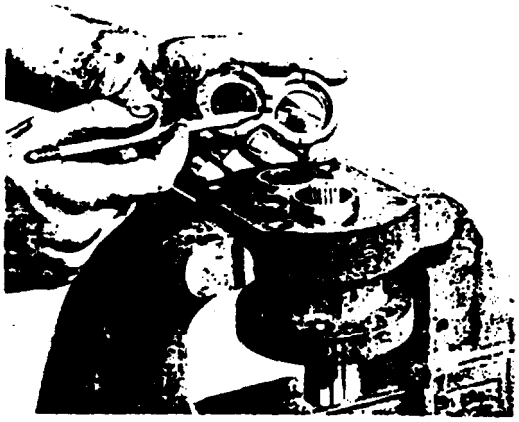


Fig. 10 Inserting pocket seals

NOTE
All pocket seals are cut from a strip obtainable as a service item. They must be cut with a razor blade as a rocket knife is not sharp enough.

Insert the seals in the slots.

single pump assembly continued

13. Place the thrust plate (22) with the slots toward the face of the shaft end cover (9) over the bearings (19, 33). Check to see that the pocket seals in the center slots are still in place. Now tap the thrust plate into position until a clearance of approximately 1/32" is left between the thrust plate (22) and the shaft end cover (9).

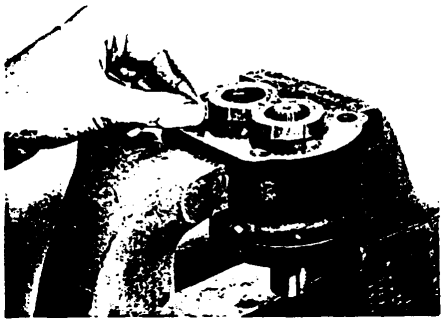


Fig. 11 Inserting pocket seal

14. Into each of the four slots in the thrust plate (22) insert one of the pocket seals (21) cut in Step 11. Be sure to push each seal all the way into the slot so that the hidden end is in contact with the roller bearing race. Then tap the assembled thrust plate until it rests against the shaft end cover.

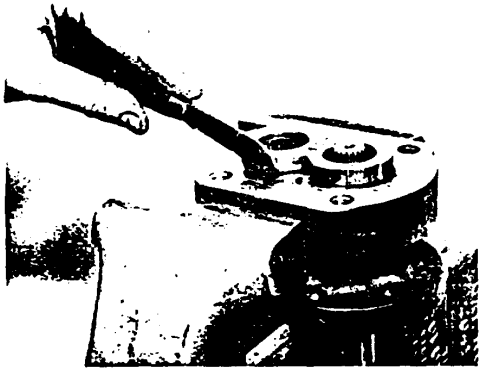


Fig. 12 Trimming pocket seal

15. Using a razor blade, trim away the excess from the exposed ends of the pocket seals (21) square and flush faith the sides of the thrust plate.

PORT END COVER SUBASSEMBLY

1. Install the nets roller bearings (37, 40) into the bores of the port end cover (38)-IF-the used ones \fs14 were removed.
2. Lay the thrust plate (28) on the bench and cut four pocket seals (30) slightly (1/32" to 1/16") longer than the four outer slots in the thrust plate. Set them aside for a minute.
3. Place some heavy grease in the two middle slots of the thrust plate (28). Cut two pocket seals (29) 3/16" long. They may run 1/64" longer but if cut any shorter they must be discarded.

NOTE

All pocket seals are cut from a strip obtainable as a service item. They must be cut with a razor blade as a pocket knife is not sharp enough.

Insert the seals in the slots.

4. Place the thrust plate (28) with the slots toward the face of the port end cover (38) over the bearings (37, 40). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plates into position. Leave a clearance of approximately 1/32" between the thrust plate (28) and the port end cover (38).
5. Into each of the four slots in the thrust plate (28) insert a pocket seal (30) cut in Step 2. Push each seal all the way into the slot so that the hidden end is in contact with the bearing race. Tap the assembled thrust plate into position against the face of the port end cover.
6. Using a razor blade, trim away the excess from the exposed ends of the pocket seals (30) square and flush with the sides of the thrust plate.

FINAL ASSEMBLY

1. Place the assembled shaft end cover in a vise, gear side up.
2. Pour a small amount of oil on face of thrust plate to provide lubrication of gears. Install the drive gear (23) on the shaft (6). Stone the gear ends before installation to remove any minute burrs.

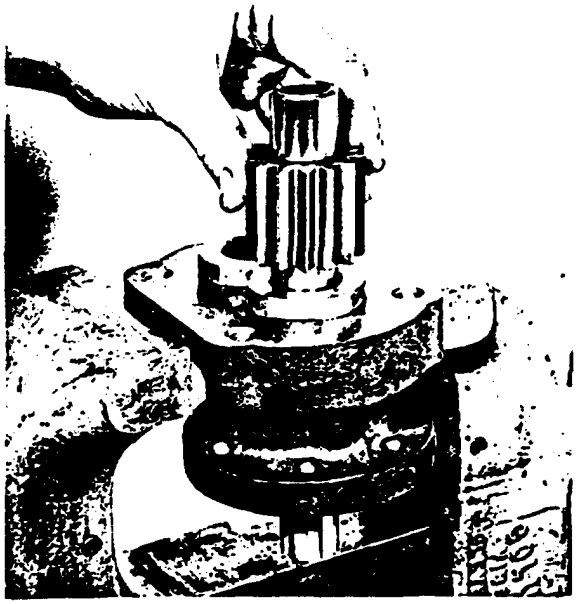


Fig. 13 Installing drive gear

3. Stone the faces of the gear housing (26) to remove and burrs that might occurred in handling. Clean all surfaces (air blast or wipe). Install pre-greased "O" rings (24, 27) in the grooves in the faces of the housing (26).

Fig. 14 Installing pre-greased "O" ring

4. Place the gear housing (26) over the drive gear (23) and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch the "O" ring (24) when positioning the housing. Install the driven gear (32) into its respective bore. Pour a small amount of oil over the gears to provide initial lubrication when putting the pump back into service.
5 Install the port end cover subassembly on the gear housing 126). Hubs of gears fit into the I.D. of the roller bearings (37, 40) and thrust plate (28) fits into the gear housing. Use a soft hammer to seat or position the port end cover assembly against the housing, making sure the "O" ring (27) on the face of the housing is not pinched.
6. Thread the four cap screws (39) into the shaft end cover. Tighten the four cap screws alternately to 100 ft. lbs. of torque.
7. Rotate the shaft with a six inch wrench. Protect the shaft splines when using a wrench. The shaft should rotate easily.
8. Thread the grease fitting (12) into the shaft end cover (9-IF-it was removed. Fill the cavity with a #2 consistency, lithium base, high temperature, ball bearing grease until a grease film appears around the shaft (6).

   The pump is now ready for installation and run-in.

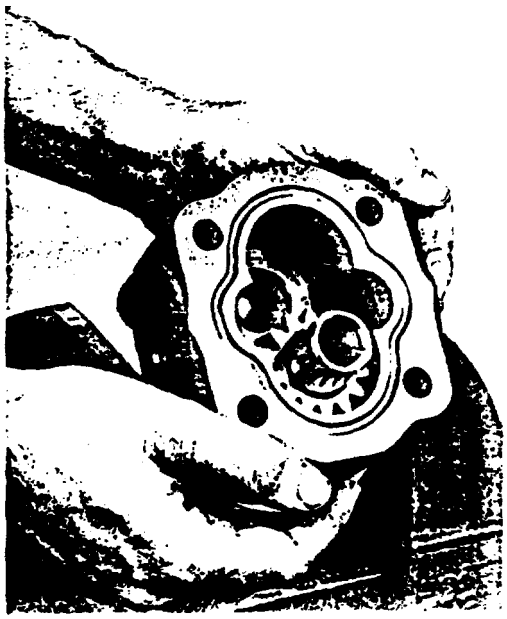


Fig. 15 Installing gear housing

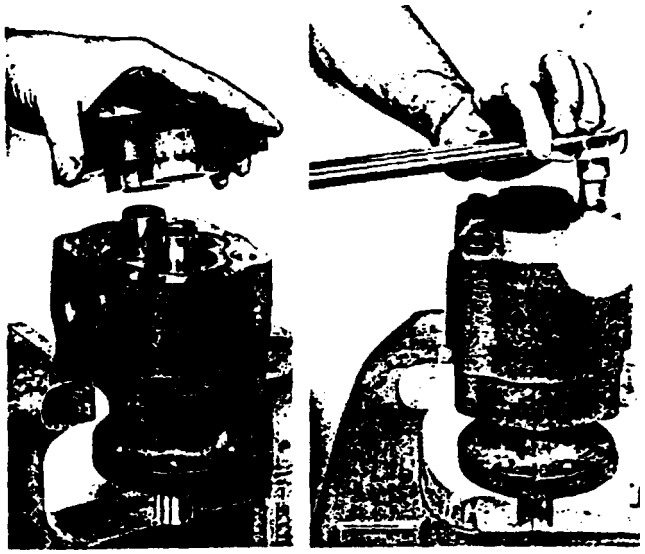


Fig. 16 Installing port end cover

IMPORTANT PRECAUTION TO OBSERVE BEFORE OPERATING NEW OR REBUILT HYDRAULIC PUMPS AND MOTORS

To avoid possible damage to a new or rebuilt hydraulic pump or motor. back off the main relief valve adjusting screw (or remove adjusting shims or spacers) before operating unit. Then. AFTER UNIT HAS RUN.IN FOR ABOUT 5 MINUTES AT ZERO PRESSURE (with all control levers in neutral position) adjust relief valve pressure to proper and prescribed setting. Failure to observe this precaution can result in almost immediate failure of the hydraulic unit-if the relief valve pressure setting should be excessive.

COMMERCIAL SHEARING, INC.
1775 Logan Avenue • Youngstown, Ohio 44501 U.S.A.

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TOKYO 102, Japan • Suite 624, Shuwa Kioicho TBR
• 7 Ban, Kojimachi 5 chome, Chiyoda-Ku (03-230-3271)
YOUNGSTOWN, Ohio 44501 • 1775 Logan Avenue (216) 746-8011

Overseas subsidiaries are incorporated under the name Commercial Hydraulics.

Designers and Manufacturers of

Fluid Power Components, Worldwide

Pressed Metal Products, North America

Underground Supports, Worldwide

Upset Forgings, North America

Pre-Engineered Buildings, Europe

AUTHORIZED DISTRIBUTOR

THIRD CLASS MAIL

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	7-A
Quantity Required:	Three
Description:	Pressure Gauge 0-5000 PSI
Manufacturer:	UCC
Part Number:	UC-3920
Source:	N L Rucker Products N L Industries, Inc. 15401 W. Vantage Parkway Suite 120 Houston, Texas 77032
Tele #:	1-713-987-2117

DECKMASTER

WINCH MODEL NO. WHR-102-12525

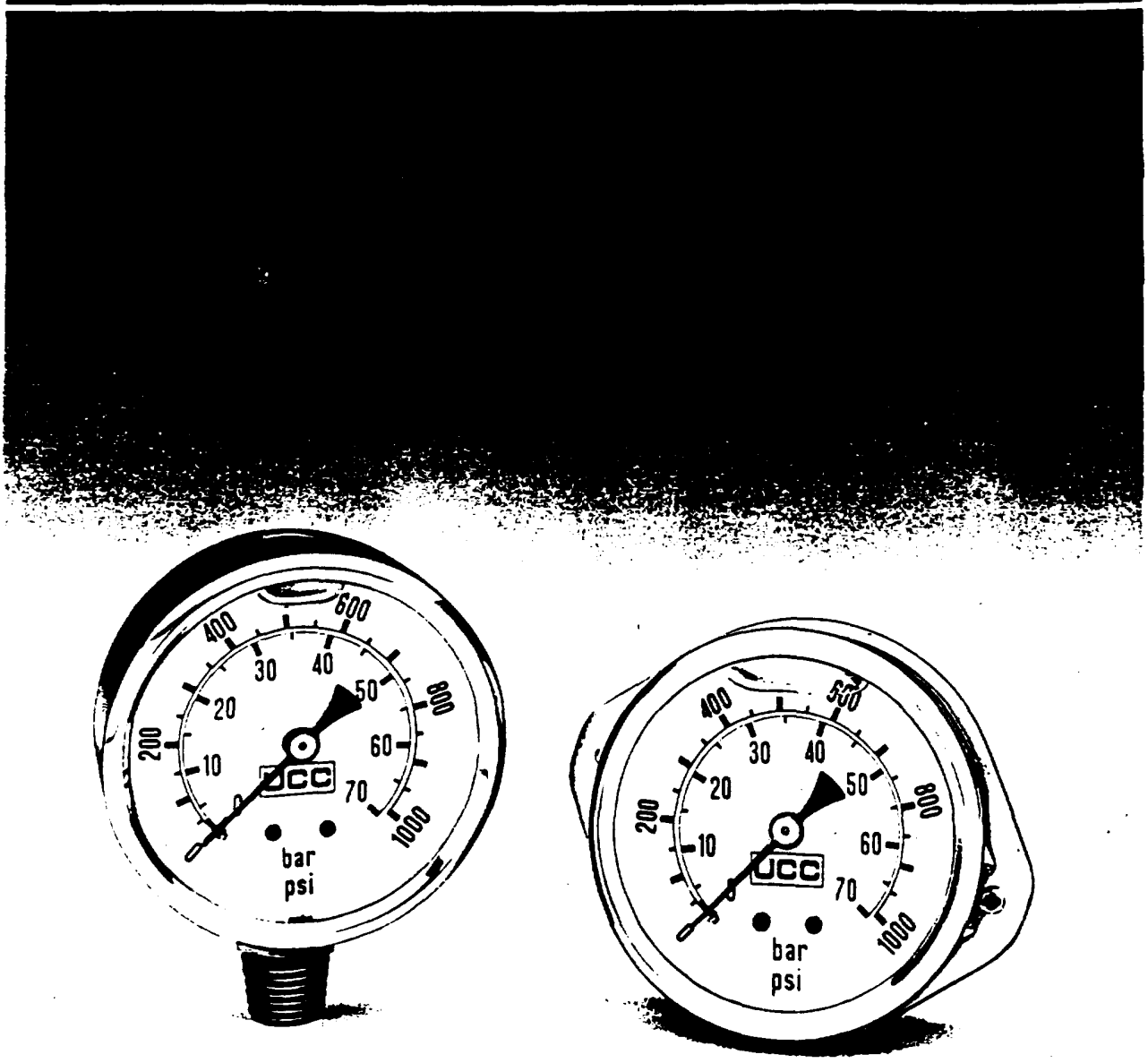
and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	7-B
Quantity Required:	Three
Description:	Pressure Gauge 0-500 PSI
Manufacturer:	UCC
Part Number:	UC-1616
Source:	N L Rucker Products N L Industries, Inc. 15401 W. Vantage Parkway Suite 120 Houston, Texas 77032
Tele #:	1-713-987-2117

2½" dia Pressure Gauges



The UCC range of dry and glycerine filled pressure gauges are suitable for working pressures up to 10,000 psi (700 bar).
Two types are available:

Bottom stem and narrow rim for panel mounting. The gauges have a bourdon tube movement and are accurate to within 1.6% full scale reading at 42°F (20°C).

All gauges have dual metric and imperial scales, internal movement bourdon tube, and fitted with internal snubber. The advantages of glycerine filled pressure gauges are: elimination of pointer flutter, dampening of pulsations ensuring accuracy and extended gauge life. It is recommended that all glycerine gauges should be mounted in the vertical position with gauge case relief valve uppermost.

UCC 2½" dia Pressure Gauges

Specifications:

Case: Stainless steel

Bezel: Chrome on brass

Window: Clear acrylic

Dial: White enamel on aluminium

Bourdon tube: Phosphor bronze

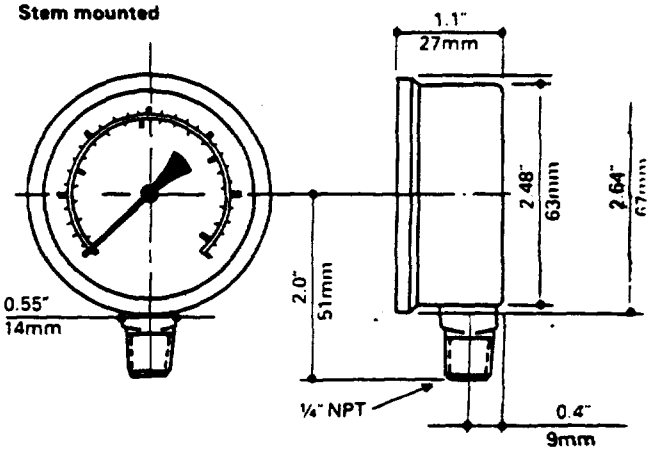
Accuracy: ± 1.6% of scale

Scale: 270° psi and bar

Ordering Information

Pressure Range		Model Number	
psi	bar	Liquid Filled	Dry
0-30" Hg	-1	UC-3919	
30" Hg.+20	-1+1.5	UC-3918	
0-60	0-4	UC-3923	
0-100	0-77	UC-3924	
0-160	0-10	UC-3925	
0-300	0-20	UC-3913	UC-3992
0-500	0-35	UC-1616	UC-1564
0-600	0-40	UC-3944	UC-3993
0-1000	0-70	UC-1619	UC-1446
0-1500	0-100	UC-3914	UC-3994
0-2000	0-140	UC-1622	UC-1421
0-3000	0-200	UC-3907	UC-3910
0-4000	0-280	UC-1625	UC-1424
[redacted]	0-350	[redacted]	UC-3942
0-6000	0-420	UC-3950	
0-10,000	0-700	UC-3995	

Stem mounted



DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH-HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	8
Quantity Required:	One
Description:	Relief Valve
Manufacturer:	Brand
Part Number:	RL-50
Source:	Brand Hydraulics Co., Inc. 2332 South 25th Street Omaha, Nebraska 68105
Tele #:	(402) 344-4434

BRAND HYDRAULICS CO., INC.
2332 SOUTH 25TH STREET
OMAHA, NEBRASKA 68105
PHONE (402) 344-4434 TELEX 484587

Hydraulic Relief Valves RL-50, RL-75

The RL-50 is a precision built low priced dependable relief valve. It is of the ball and spring design. The ball and spring type relief valve is the most dependable relief valve made. The ball will not jam lock, or seize and will always open. The spring has been shot peened stress relieved to increase spr life and consistent results. The chrome alloy steel ball is a grade No. 25 ball. The hardened alloy seat is removeable with an ordinary Allen wrench. This valve is available in two standard models.

RL-50		RL-75
350 to 3000 PSI		350 to 3000 PSI
0 to 20 GPM		0 to 20 GPM
½" NPTF ALL PORTS	Wt. 2.5 lbs, 1, 1 kg.	½" NPTF TANK, ¾" PRESSURE PORTS

DECKMASTER

WINCH MODEL NO. WHR-102-12525

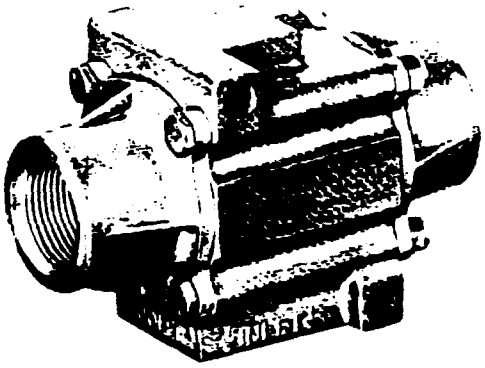
and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

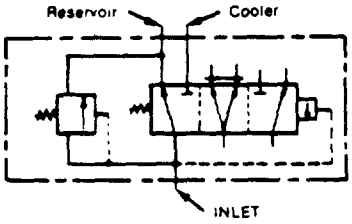
COMPONENT DESCRIPTION

Reference Item No.:	9-A
Quantity Required:	One
Description:	Thermal Bypass Valve
Manufacturer:	Thermal Transfer
Part Number:	65655
Source:	Thermal Transfer Products, Ltd. 5215 21st Street Racine, Wisconsin 53406
Tele #:	1-414-554-8330
TELEX #:	26-0068

Thermal Bypass Assembly



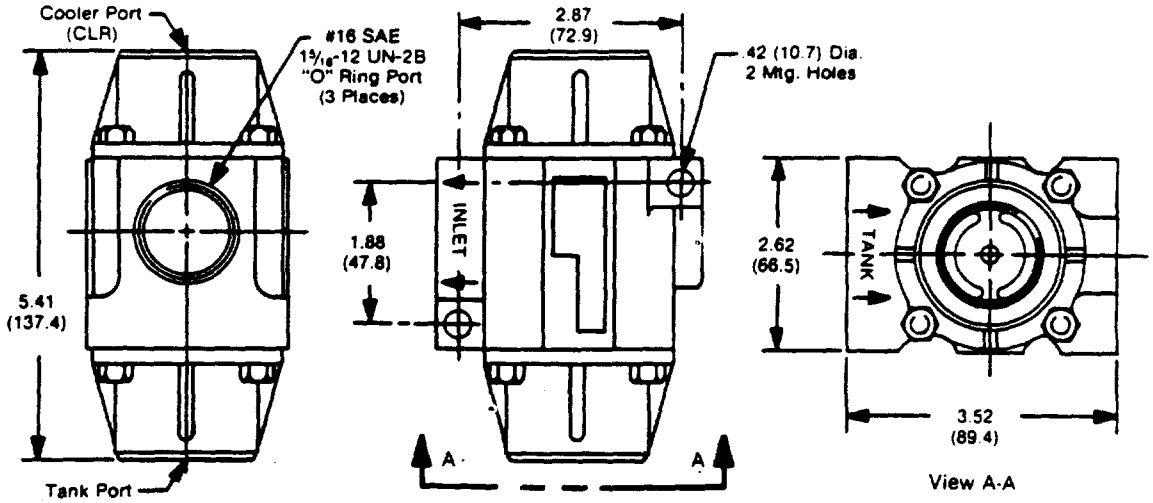
Graphic Symbol



This thermal bypass valve is ideally suited for hydrostatic drive circuits which require fast warm-up, controlled fluid temperature, and low return line back pressure. When installed in the return line of a hydraulic circuit that employs an oil cooler, this device will modulate fluid temperature by either shifting return line flow through the cooler, or bypassing directly to the reservoir. In addition, a built-in pressure relief function automatically relieves excess pressure to the reservoir should the cooler become restricted and resultant pressure drop become too high for the cooler circuit.

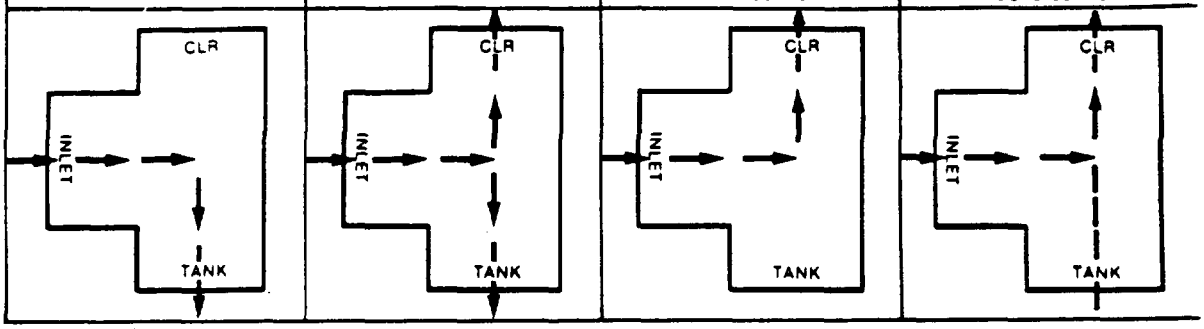
FEATURES:

1. Operating Characteristics:
   - A. Mode #1: At temperatures below the shift temperature oil flows inlet to tank port.
   - B. Mode #2: At temperatures between the start of shift and full shift the flow from the inlet port is divided between the cooler and tank ports.
   - C. Mode #3: At temperatures above the full shift temperature inlet flow is thru cooler port.
   - D. Mode #4: At temperatures above the full shift temperature the excess pressure is relieved thru the tank port.
2. Standard Shift Temperatures: 100° F (38° C). 120° F (49° C). 140° F (60° C) and 160° F (71° C)
3. Full Shift (Cooler Port Open) Temperature: Shift temperature plus 25° F (14° C)
4. Relief Valve Settings: Up to 85 psi (6 bar) in 5 psi increments. Please specify when ordering.
5. Maximum Operating Pressure: 250 psi (17 bar)
6. Proof Pressure: 300 psi (21 bar)
7. Minimum Burst Pressure:
   - A. Up to the full shift temperature: 325 psi (22 bar)
   - B. Above the full shift temperature: 600 psi (41 bar)
8. Minimum Operating Temperature: -30° F (-34° C)
9. Maximum Operating Temperature: Shift temperature plus 75° F (24° C)
10. Maximum Flow Rating: 60 gpm (227 l/m)
11. Leakage @ 250 psi (17 Bar) and 60 gpm (227 l/m) Inlet Flow:
    - A. Cooler Port:
      1. 0.5 gpm (2 l/m) maximum up to 5° F (3° C) before shift temp.
      2. 1.0 gpm (4 l/m) maximum from 5° F (3° C) before shift to shift.
    - B. Tank Port: 0.10 gpm (0.4 l/m) maximum
12. Operating Fluid: Mineral base hydraulic fluids
13. Construction: Aluminum die-cast housing.



Example: *Oil flow* ➔ ➔ *Excess pressurized oil* ➔➔➔

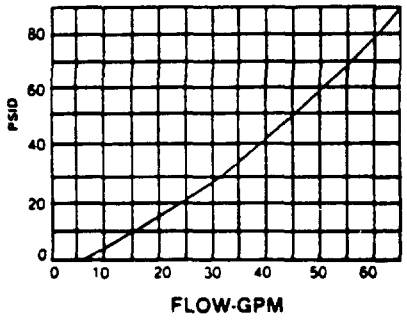
Mode #1 Cold Start-Up	Mode #2 Warm-Up Shifting	Mode #3 Fully Shifted	Mode #4 High Pressure
Up to 120°F	120°F to 145°F	Above 145°F & Below 65 PSI	Above 145°F & Above 65 PSI



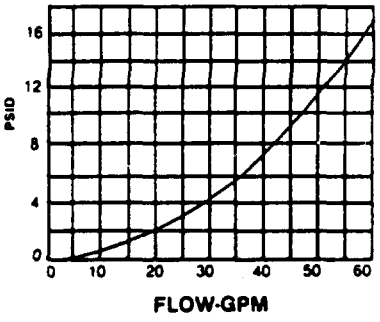
NOTE: If the temperature drops below 145°F the valve will shift back to modes 2 or 1.

Pressure Drop (Mobile DTE 26 Oil)

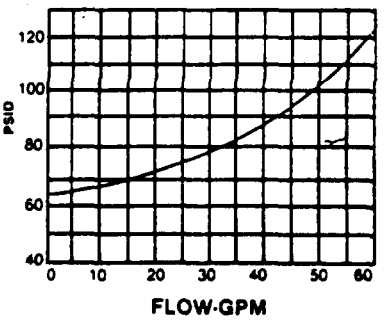
INLET PORT THRU TANK PORT
@ 100°F (38°C) (300 SUS)



INLET PORT THRU COOLER PORT
@ 145°F (63°C) (110 SUS)



INLET PORT OVER
INTEGRAL RELIEF VALVE
@ 170°F (77°C) (78 SUS)



NOTE: Pressure drop shown is added to relief valve crack pressure for total pressure drop.

Ordering Information:

Part Number	*Shift Temperature*	*Part Number*	*Shift Temperature*
65654	100°F (38°C)	65656	140°F (60°C)
[redacted]	[redacted]	65657	160°F (71°C)

DECKMASTER

WINCH MODEL NO. WHR-102-12525

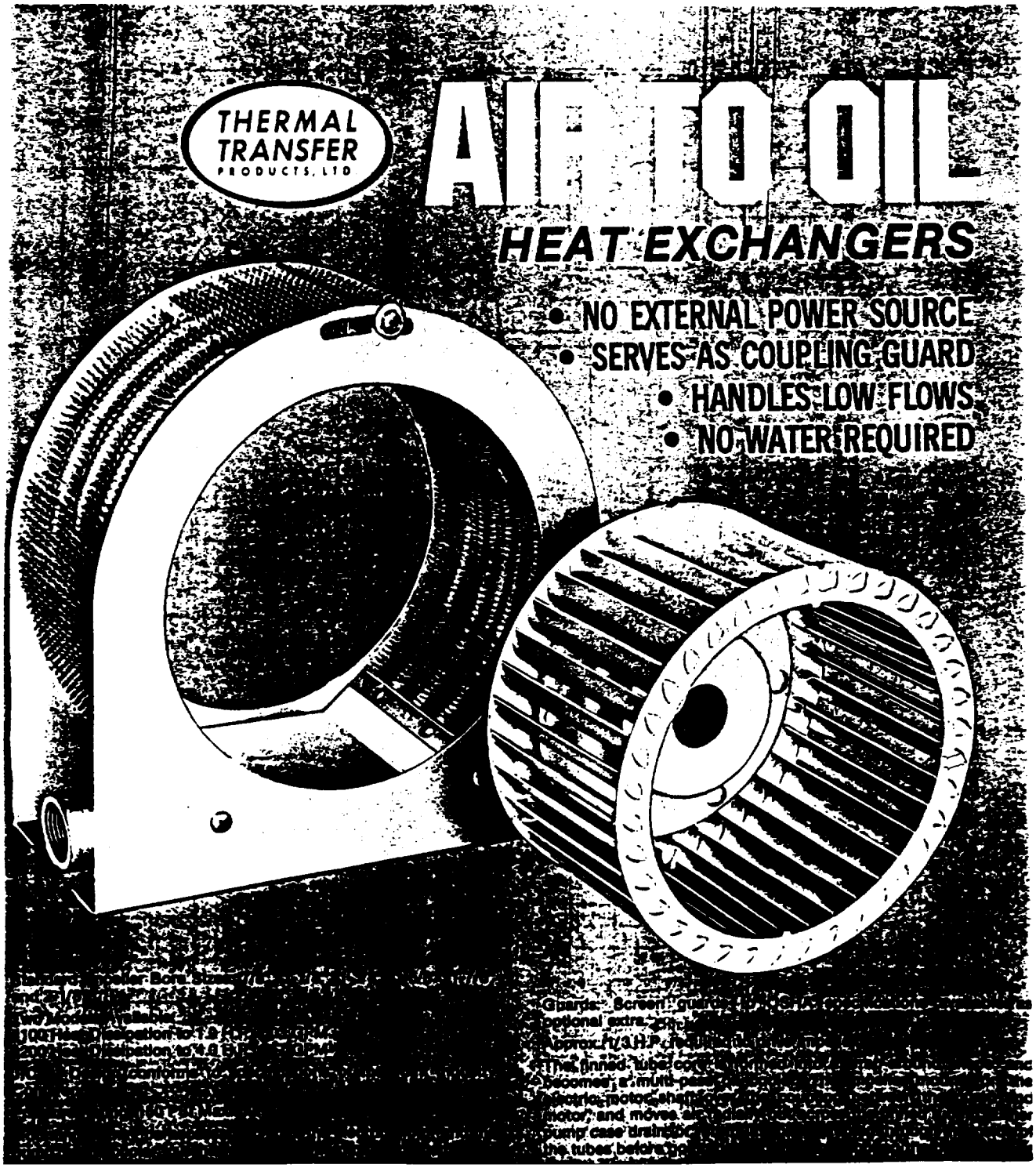
and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

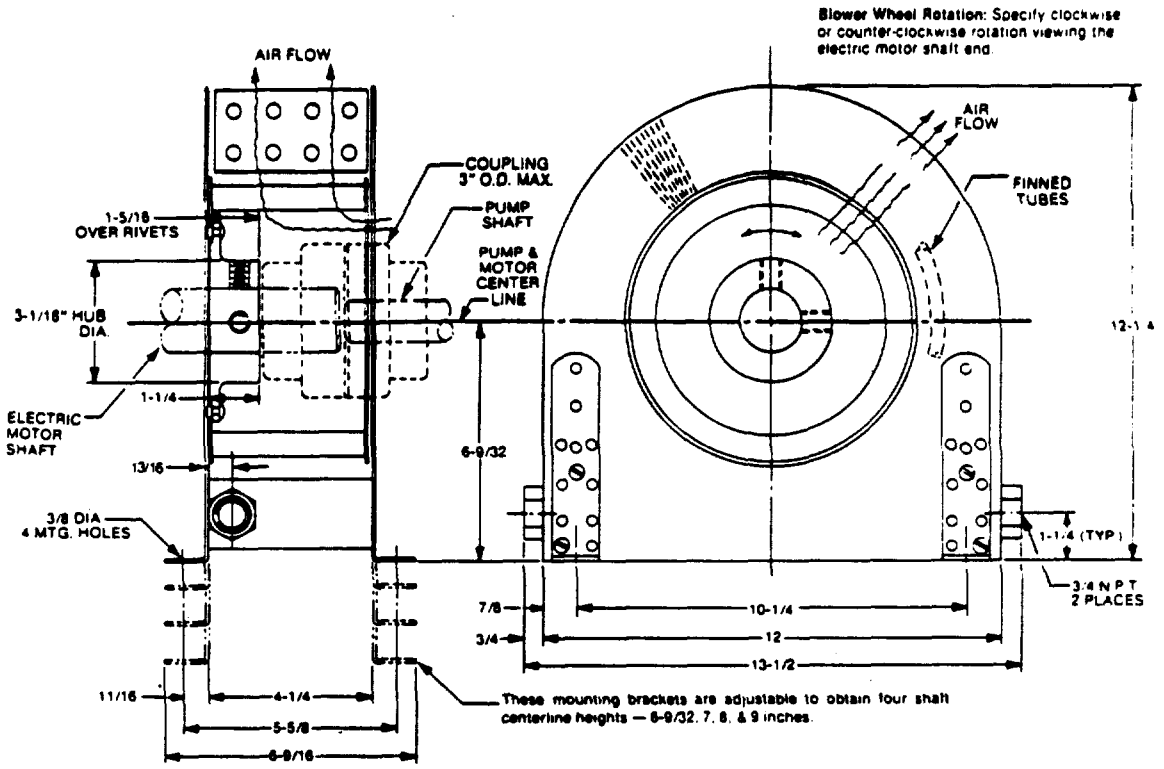
COMPONENT DESCRIPTION

Reference Item No.:	9-B
Quantity Required:	One
Description:	Oil Cooler
Manufacturer:	Thermal Transfer
Part Number:	L-71772
Source:	Thermal Transfer Products, Ltd. 5215 21st Street Racine, Wisconsin 53406
Tele #: TELEX #:	1-414-554-8330 26-0068

DECKMASTER

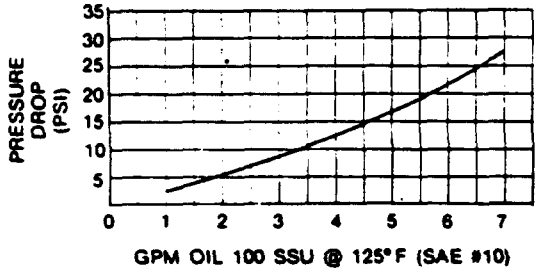

THERMAL TRANSFER PRODUCTS, LTD
AIR TO OIL
HEAT EXCHANGERS
• NO EXTERNAL POWER SOURCE
• SERVES AS COUPLING GUARD
• HANDLES LOW FLOWS
• NO WATER REQUIRED

DIMENSIONAL DATA MODEL #200



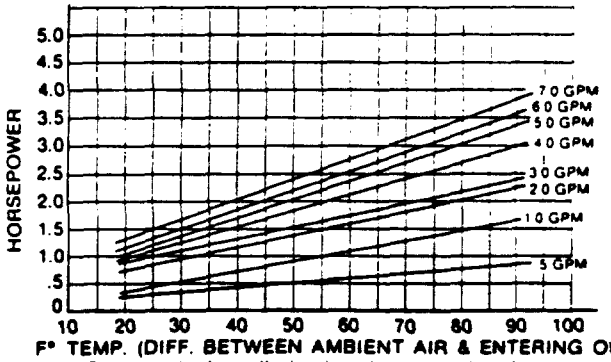
PERFORMANCE CHARACTERISTICS

CURVE A
PRESSURE DROP VS FLOW



Curve A shows pressure drop versus flow rate for applying the cooler to either the pump case drain or system return line.

CURVE B
HEAT DISSIPATION



Curve B shows the heat dissipation characteristics of the cooler at 1800 RPM: when a 1200 RPM drive is used, 2/3 plotted data will apply.

HOW TO ORDER

CLOCKWISE ROTATION
LEFT HAND (CCW) PUMP ROTATION

PART NO.	MODEL DESCRIPTION
L-73276	#200 with 7/8" Bore Impeller
L-73277	#200 with 7/8" Bore & OSHA Guards
L-73278	#200 with 1 1/8" Bore Impeller
L-73279	#200 with 1 1/8" Bore & OSHA Guards
L-73280	#200 with 1 3/8" Bore Impeller
L-73281	#200 with 1 3/8" Bore & OSHA Guards
L-73282	#200 with 1 5/8" Bore Impeller
L-73283	#200 with 1 5/8" Bore & OSHA Guards
L-73284	#200 with 1 7/8" Bore Impeller
L-73285	#200 with 1 7/8" Bore & OSHA Guards
L-73286	#200 with 2 1/8" Bore Impeller
L-73287	#200 with 2 1/8" Bore & OSHA Guards

COUNTER-CLOCKWISE ROTATION
RIGHT HAND (CW) PUMP ROTATION

PART NO.	MODEL DESCRIPTION
L-71765	#200 with 7/8" Bore Impeller
L-71766	#200 with 7/8" Bore & OSHA Guards
L-71767	#200 with 1 1/8" Bore Impeller
L-71768	#200 with 1 1/8" Bore & OSHA Guards
L-71769	#200 with 1 3/8" Bore Impeller
L-71770	#200 with 1 3/8" Bore & OSHA Guards
L-71771	#200 with 1 5/8" Bore Impeller
[redacted]	#200 with 1 5/8" Bore & OSHA Guards
L-71773	#200 with 1 7/8" Bore Impeller
L-71774	#200 with 1 7/8" Bore & OSHA Guards
L-71775	#200 with 2 1/8" Bore Impeller
L-71776	#200 with 2 1/8" Bore & OSHA Guards

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

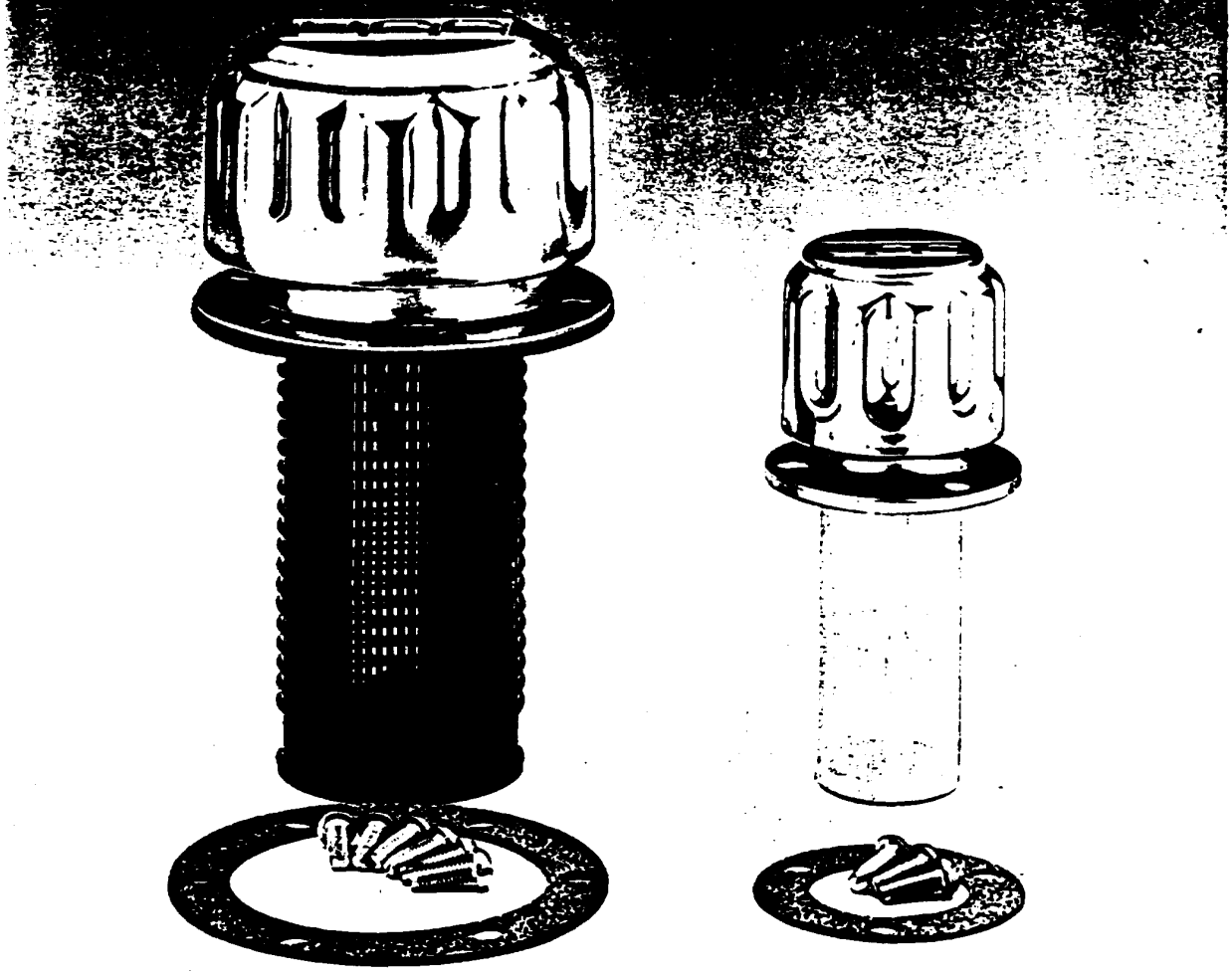
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	10
Quantity Required:	One
Description:	Filler/Breather Cap
Manufacturer:	UCC
Part Number:	UC-AB-1163-40
Source:	N L Rucker Products N L Industries, Inc. 15401 W. Vantage Parkway, Suite 120 Houston, Texas 77032
Tele #:	1-713-987-2117

UCC

Filler Breather Filters



UCC Filler Breather Filters are combination units for filtering the displacement of air into the fluid reservoir and also for straining oil when filling the reservoir. 10 and 40 micron air filtration units are available as standard.

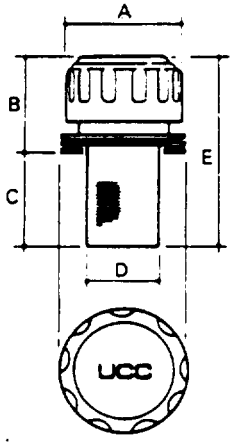
They are designed for all types of industrial, mobile, marine and agricultural applications. Units are manufactured complete for immediate installation. They are finished in Nickel Chrome to withstand adverse environmental conditions.

Air inlet to the Breather is situated on the underside of the cap assembly to prevent ingress of heavy contaminants and help lengthen periods between servicing.

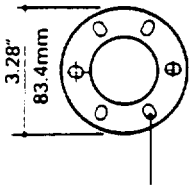
Dipstick and/or locking lu are available to special order.

NOTE: Care should be taken to ensure that Air Flow rate through Breather does not create unacceptably high pressures. C on Air Flow/Pressure loss characteristics available on request.

Air Breather Filter Flange Type

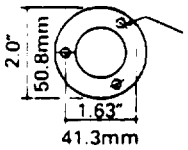


UC – AB – 1163 – 40
UC – AB – 1163 – 10



6 slotted holes equally spaced to suit 10 – 32 diameter thread cutting screws on 2.76" or 2.87" pitch circle diameter. Hole size as specified.

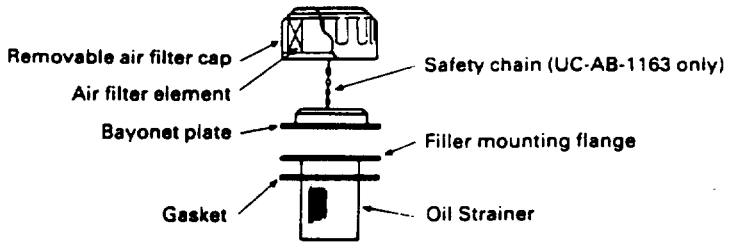
UC – AB – 1380 – 40
UC – AB – 1380 – 10



3 off holes equally spaced on 1.63" p.c.d for 10-32 self tapping screws. Hole size as specified below.

Sheet Thickness (Mild Steel) ins (mm)	Hole Size ins (mm)
0.063 (1.6)	0.165 (4.2)
0.094 (2.4)	0.165 (4.2)
0.125 (3.2)	0.169 (4.3)
0.187 (4.8)	0.177 (4.5)
0.250 (6.4)	0.181 (4.6)

Part Number	Displacement gpm	Displacement l/min	Rating Micron	Air Flow Scfm (m^3/min)	A ins (mm)	B ins (mm)	C ins (mm)	D ins (mm)	E ins (mm)	Weight lb (kg)
[redacted]	192	720	40	26 (0.75)	3.0 (76.2)	2.38 (60.5)	3.66 (93)	1.94 (49.2)	6.05 (153.5)	0.53 (0.24)
UC-AB-1163-10	114	430	10	16 (0.45)	3.0 (76.2)	2.38 (60.5)	3.66 (93)	1.94 (49.2)	6.05 (153.5)	0.53 (0.24)
UC-AB-1380-40	72	270	40	10 (0.30)	1.75 (44.5)	1.91 (48.5)	2.42 (61.5)	1.10 (28)	4.33 (110)	0.15 (0.07)
UC-AB-1380-10	36	135	10	5 (0.15)	1.75 (44.5)	1.91 (48.5)	2.42 (61.5)	1.10 (28)	4.33 (110)	0.15 (0.07)



DECKMASTER

WINCH MODEL NO. WHR-102-12525

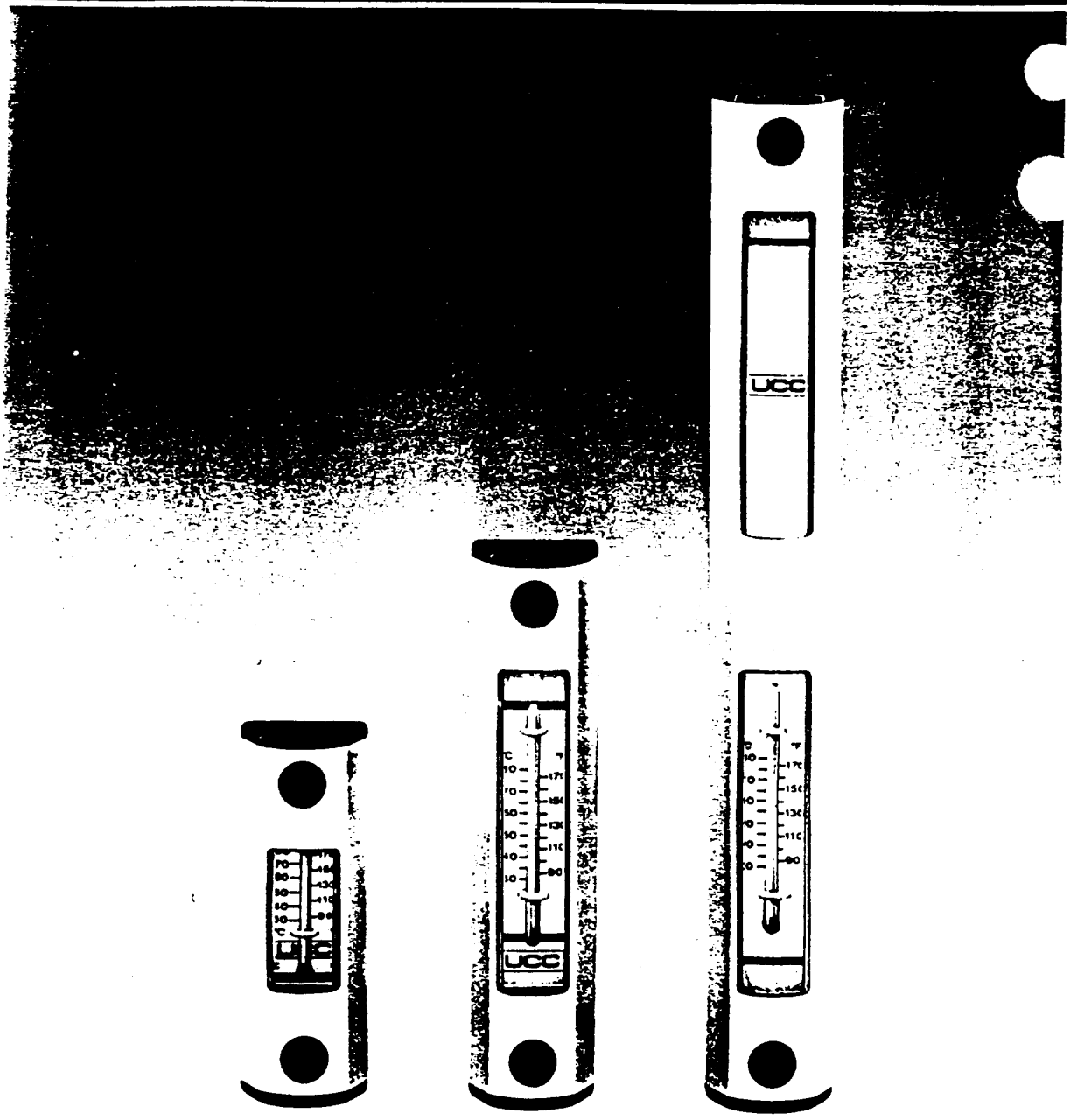
and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	11
Quantity Required:	One
Description:	Oil Level Sight Gauge
Manufacturer:	UCC
Part Number:	UC-FLT-31322
Source:	N L Rucker Products N L Industries, Inc. 15401 W. Vantage Parkway, Suite 120 Houston, Texas 77032
Tele #:	1-713-987-2117

UCC Fluid Level and Temperature Gauges



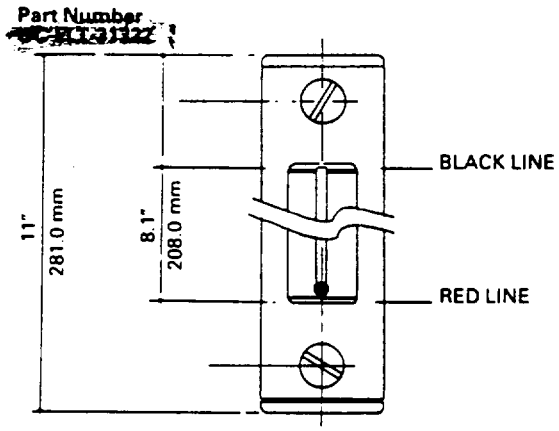
These highly attractive Fluid Level/ Temperature Gauges are designed to add improved style and efficiency to your equipment. They are simple to install with highly visible readings.

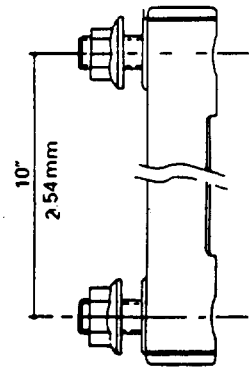
Constructed from high strength materials throughout, they are suitable for use on pressurised tanks and will stand up well to arduous industrial conditions.

The universal fixing arrangement is designed for either front or rear fixing, just two holes in the tank (Threaded for front fixing) and you are ready to install. After positioning the gauge the bolts are simply tightened to provide a secure seal. There is no fear of leakage with the generous square section seals and the two point mounting system eliminates problems with tank distortion.

The large visual area gives accurate and clear oil level indication. The lens is shatter-proof and uses Trogamid, a new material providing vastly improved ultra violet light stability. And is further protected by an attractive anodised aluminium shroud. The gauges are available in three sizes.

DECKMASTER





General Information
Max Working Pressure. 15 psi (1 bar)
Max Working Temperature. 170°F (80°C)
Thermometer Scale Range. 90°F to 170°F (30°C to 80°C)
Indicator. Red Alcohol

Installation Data
Mounting Holes ½" dia (13 mm) Maximum
7/16" dia (11 mm) Preferred
Tightening Torque 11-15lbf. ft (15-20 Nm) Maximum
Locate seals in mounting boss before fitting.

DECKIASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

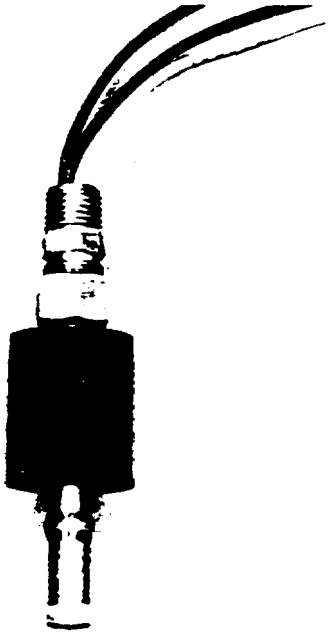
Reference Item No.:	12
Quantity Required:	One
Description:	Level/Temperature Switch-
Manufacturer:	Approved Purification
Part Number:	TL-008S-180S-45
Source:	APPROVED PURIFICATION CORP. 581 Hope Street Stanford, Conn. 06907
Tele #:	1-203-357-0141

DECKMASTER

Part Number:	TL-008S-180S-45	
	Low Temp. Switch:	open below 45° F closed above 45° F
	High Temp. Switch:	closed below 180° F open above 180° F
	Level Switch:	normally closed-with float in up position

DECKMASTER

TEMPERATURE & LEVEL SENSOR
"NEW" HIGHER RATING



"LEVEL" CONTACT RATING - NON INDUCTIVE

CARRY	-	3.0 AMPS MAX. @ 110 VAC - DC 300 WATTS @ 110 VAC - DC
BREAK	-	1.1 AMP MAX. @ 110 VAC - DC 3.0 AMPS ON MODELS "LH"
VOLTAGE	-	5V TO 220 V, AC OR DC

"TEMPERATURE" CONTACT RATING -
NON INDUCTIVE NORM. OPEN OR CLOSED

CARRY	-	12 AMPS
MAKE OR BREAK	-	6 AMPS
AUTO RE-SET	-	WITHIN 3 C.
TEMP.SETTINGS	-	35 C. (95 F.) TO 115 C. (239 F.) in 5 C. INCRIMENTS
TEMP.OPTION	-	TO TURN ON A "HEATER" IN COLD
"LL" MODEL	-	WEATHER USE (5 C.) 38 F. SETTING

FOR SEPARATE INDICATION OF "TEMPERATURE" AND "LEVEL" CONNECT WIRES IN PARALLEL AS SHOWN.

FOR SINGLE INDICATION OF BOTH "TEMPERATURE" AND, "LEVEL", - CONNECT IN SERIES AS SHOWN.

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	13
Quantity Required:	One
Description:	Oil Heater
Manufacturer:	GAU4ER
Part Number:	A2Z3N25M4-LT
Source:	Gaumer Co., Inc. 13600 Hempstead Rd. Houston, Texas 77040
Tele #:	1-713-460-5200
TELEX #:	77-5111

Screw-Plug Heaters

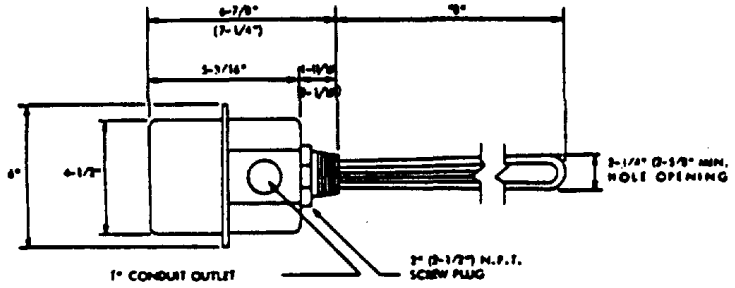
2″ and 2½″ NPT

23 Watts/Sq. In. with Thermostat

STANDARD FEATURES: Thermostat 50-250°F Temperature Range - Incoloy Sheath, .475 In. Diameter - Solid Steel Screw Plug - Potted Terminals - General Purpose Terminal Enclosure

OPTIONS:

- -ER Explosion Resistant Enclosure
- ➤ -LT Moisture Resistant Enclosure
- -1 0-100°F ThermostatTemperature Range
- -3 150-550°F Thermostat Temperature Range
- -TCO Integrally Mounted Thermal Cut-Out (Specify Maximum Operating Temperature



➤ LT MOISTURE RESISTANT ENCLOSURE

Immersed Length "B"	KW	Volts	Phase	Gaumer Catalog No.
2 Inch NPT Steel Screw Plug, 3 Elements				
13-1/2	2.2	120	1	A2Z3N13M1
13-1/2	2.2	240	1, 3	A2Z3N13M2
13-1/2	2.2	480	1, 3	A2Z3N13M4
17-1/2	3.0	240	1, 3	A2Z3N17M2
17-1/2	3.0	480	1, 3	A2Z3N17M4
20-1/2	3.7	240	1, 3	A2Z3N20M2
20-1/2	3.7	480	1, 3	A2Z3N20M4
25	4.5	240	1, 3	A2Z3N25M2
➤ 25	4.5	480	1, 3	A2Z3N25M4
32-1/2	6.0	240	1, 3	A2Z3N32M2
32-1/2	6.0	480	1, 3	A2Z3N32M4
40	7.5	240	1, 3	A2Z3N40M2
40	7.5	480	1, 3	A2Z3N40M4
47-1/2	9.0	240	1, 3	A2Z3N47M2
47-1/2	9.0	480	1, 3	A2Z3N47M4
64	12.5	240	1, 3	A2Z3N64M2
64	12.5	480	1, 3	A2Z3N64M4
76-1/2	15.0	240	1, 3	A2Z3N76M2
76-1/2	15.0	480	1, 3	A2Z3N76M4

DECKMASTER

WINCH MODEL NO. WHR-102-12525

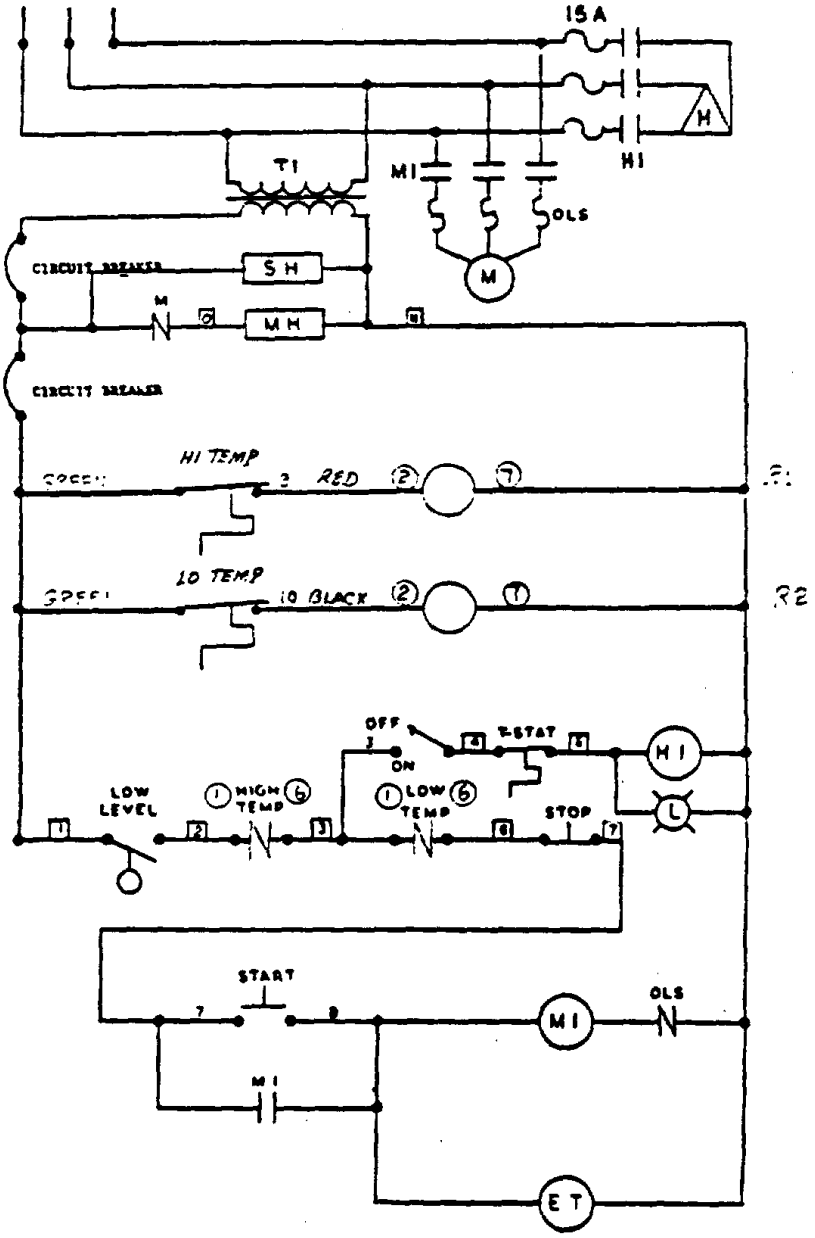
and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

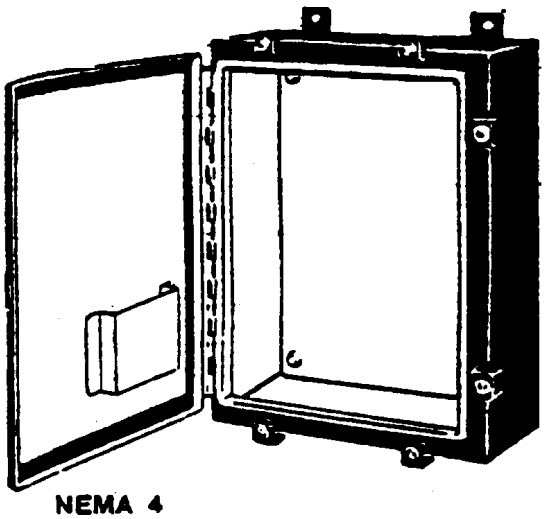
Reference Item No.:	14
Quantity .Required:	As Per Schematic
Description:	Motor/Heater Control
Manufacturer:	Special
Part Number:	N/A
Source:	Brancart Development Corp. 17150 Butte Creek, Suite 219 Houston, Texas 77090
Tele #:	1-713-440-4661

460 VAC 3 Phase



T1 - TRANSFORMER
SH - SPACE HERTER 120 VAC
MH - MOTOR HEATER 120 VAC
L - HEATER "ON" LIGHT
M - MOTOR 30 HP @ 460 VAC 3 PHASE
H - IMMERSION HEATER 460 VAC 3 PHASE
ET - ELAPSE TIME CLOCK
H1 - HEATER CONTACTOR
M1 - MOTOR STARTER
□ - REMOTE TERMINAL NUMBERS

NEMA 4 ENCLOSURE STN. STEEL SINGLE DOOR



NEMA 4
SINGLE DOOR

APPLICATION: Tanco Nema Type 4 single door stainless steel enclosures are designed to house electrical controls, terminals, instruments and any other devices in areas which may be exposed to frequent water splashes. These enclosures are designed for use in highly corrosive environment and thus suitable for use in refineries, chemical & fertilizer plants as well as in food industry, breweries and similar installations.

CONSTRUCTION: These enclosures are fabricated from 14 gauge type 304 stainless steel. All seams are continuously welded and ground smooth. A rolled lip is provided around all sides of the enclosure opening. The doors have a rolled lip around three sides and is attached to the enclosure body by means of a continuous hinge. Neoprene gasket is glued on inside of the door and retained by a metal retainer which insures a water tight seal. All external removable hardware is fabricated from heavy gauge stainless steel which clamps the door to the enclosure body. The enclosure is provided with a hasp & a staple for padlocking. A print pocket is installed on inside of the door. Stainless steel shoulder studs are provided for mounting an optional panel. Large enclosures have door & body stiffeners for extra rigidity. There are no holes or knock-outs in these enclosures.

FINISHES: The doors of these enclosures are grained for smooth finish. The rest of the enclosure has a standard, unpainted finish.

OPTIONAL ACCESSORIES
PANELS: Fabricated from 12 gauge stainless steel. Panels are not painted and have a standard unpainted finish. Panels must be ordered separately. See Specification #J-1.

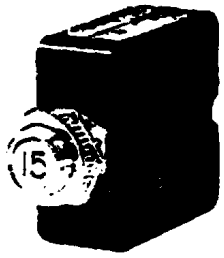
FLOOR STAND KIT: Fabricated from 12 gauge stainless steel with 10 gauge bottom plate. Standard kits in 6", 12", 18" and 24" heights are available upon request. See Specification #K-1 for comparison. Call factory for pricing information.

MODIFICATIONS: These enclosures can be supplied with holes, hubs, cut-outs. Electrical & pneumatic mounting and wiring-tubing work can be furnished upon request. Special enclosure sizes can also be furnished upon request.

Enclosure Catalog Number	Enclosure Size A x B x C	Optional Panel Number	Panel Size
T-16H12A-SS	16x12x 6	T-16P12*	13x 9
T-20H16A-SS	20x16x 6	T-20P16	17x13
T-20H20A-SS	20x20x 6	T-20P20	17x17
T-24H12A-SS	24x12x 6	T-12P24	9x21
T-24H20A-SS	24x20x 6	T-24P20	21x17
T-24H24A-SS	24x24x 6	T-24P24	21x21
T-30H20A-SS	30x20x 6	T-30P20	27x17
T-30H24A-SS	30x24x 6	T-30P24	27x21
T-36H24A-SS	36x24x 6	T-36P24	33x21
T-16H12B-SS	16x12x 8	T-16P12*	13x 9
T-20H16B-SS	20x16x 8	T-20P16	17x13
T-20H20B-SS	20x20x 8	T-20P20	17x17
T-24H20B-SS	24x20x 8	T-24P20	21x17
T-24H24B-SS	24x24x 8	T-24P24	21x21
T-30H20B-SS	30x20x 8	T-30P20	27x17

POTTER & BRUMFIELD CIRCUIT BREAKERS

Thermal Recessed Button W58 Series



"W" Series breakers are UL 1077 Recognized as Supplementary Protectors, File E69543, and CSA Certified as Appliance Component Protectors, File LR30671.

GENERAL INFORMATION

W58 series comprise single pole, thermal type circuit breakers that feature a recessed reset button which cannot be manually pulled out to disconnect the circuit. When an overload occurs and the breaker opens, the reset button extends, allowing a red band to appear for visible trip indication. The breaker contains a trip-free feature which allows its contacts to open even if the breaker is manually held in the reset position against an overload.

ENGINEERING INFORMATION

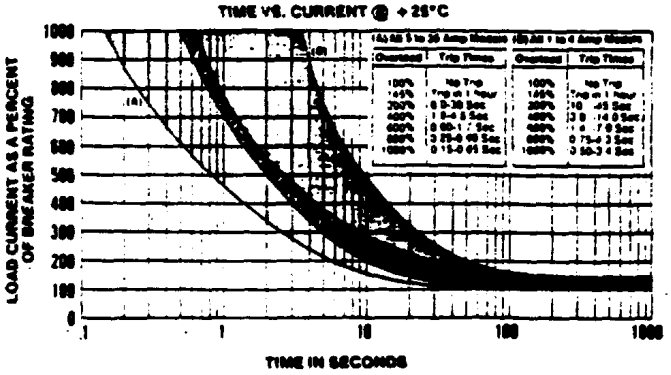
Calibration: Breaker will continuously carry 100% of rated load. It may trip between 101% and 144% of rated load, but must trip at 145% at 25°C.

MAX. RESISTANCE vs. CURRENT RATING @ +25°C

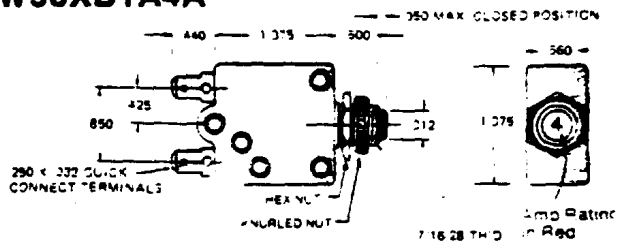
Current Rating	Max Resistance In Ohms	Current Rating	Max. Resistance In Ohms
1	1.35	10	0.014
2	0.32	12	0.010
3	0.18	15	0.010
4	0.10	20	0.006
5	0.026	25	0.005
7	0.020	30	0.004
8	0.020	35	0.004

Dielectric Strength: Over 1,500 volts RMS.
Max. Operating Voltages: 50V DC, 250V AC
Interrupt Capacity: 2000 amps at 50V DC (1-35 amp models).
1000 amps at 250V AC (1-35 amp models).
Shock: Withstands 10 g.
Endurance Cycling: Over 1,000 cycles at 200% of rated load.
Vibration: Withstands to 10 g at 10-55 Hz.
Weight: Less than 1½ oz.
Mounting: Threaded bushing.

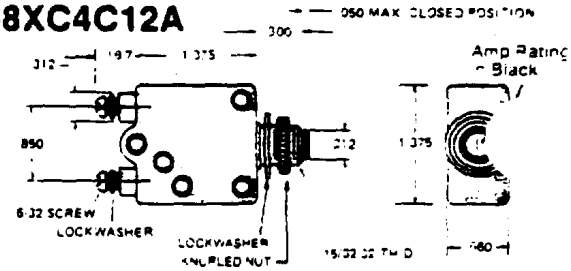
TIME VS. CURRENT @ +25°C



W58XB1A4A



W58XC4C12A



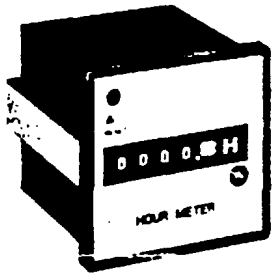
Model	Rating In Amps	Trip Time @200% of Rating	Sugg. Resale Price
W58XB1A4A-1	1•*		$4.54
W58XB1A4A-2	2•*	10–45	4.54
W58XB1A4A-3	3•*	sec.	4.54
W58XB1A4A-4	4•*		4.54
W58XB1A4A-5	5•*		2.92
W58XB1A4A-6	6•*		2.92
W58XB1A4A-7	7•*		2.92
W58XB1A4A-8	8•*		2.92
W58XB1A4A-10	10•*		2.92
W58XB1A4A-12	12•*	6.0–30	2.92
W58XB1A4A-15	15•*	sec.	2.92
W58XB1A4A-20	20•*		2.92
W58XB1A4A-25	25		2.92
W58XB1A4A-30	30		2.92
W58XB1A4A-35	35		2.92
W58XC4C12A-1	1•*		6.55
W58XC4C12A-2	2•*	10–45	6.55
W58XC4C12A-3	3•*	sec.	6.55
W58XC4C12A-4	4•*		6
W58XC4C12A-5	5•*		4
W58XC4C12A-6	6•*		4.9
W58XC4C12A-7	7•*		4.93
W58XC4C12A-8	8•*		4.93
W58XC4C12A-10	10•*		4.93
W58XC4C12A-12	12•*	6.0–30	4.93
W58XC4C12A-15	15•*	sec.	4.9
W58XC4C12A-20	20•*		4.9
W58XC4C12A-25	25		4.93
W58XC4C12A-30	30		4.93
W58XC4C12A-35	35		4.93

DECKMASTER

SERIES

atc 5703/4 ET

MINIATURE ELAPSED TIME INDICATO
PANEL MOUNTE



PRODUCT HIGHLIGHTS

SAVE 40% IN PANEL SPACE AND COST
A compact instrument that requires only a 47 mm² panel cutout, the 5703/4 takes about 40% less panel space — and costs about 40% less — than conventional hour meters.

APPROVALS
UL

RUNNING INDICATOR
An integral indicator generates an easily detected revolving pattern when the monitored equipment is energized.

EASY INSTALLATION
No tools are required for front-of-panel installation in a cutout.

OPERATION

When the 5703/4 is wired in parallel with electrical equipment, it accumulates running time and its indicator rotates when the monitored equipment is energized. The 5703 non-reset version provides a tamper-proof indication of total running time, continuously adding running time measurement to the previously accumulated total. The 5704 reset version starts a new running time total each time the reset button is pushed.

SPECIFICATIONS

MODEL
Choice of two:
~~5703 non-reset~~
5704 pushbutton reset

RANGES
5703: 99,999.9 hours
5704: 9,999.9 hours

READOUT
White digit on black background

ACCURACY
As accurate as line frequency

TEMPERATURE RATING
– 10°C to 50°C (14°F to 122°F)

OPERATING VOLTAGE
Choice of:
24V AC, 60 Hz
~~120V AC, 50 Hz~~
~~120V AC, 60 Hz~~
240V AC, 50 Hz
240V Ac, 60 Hz

TERMINALS
Integral flat-blade plug terminals: accept 3/16" female push-ons or solder connections.

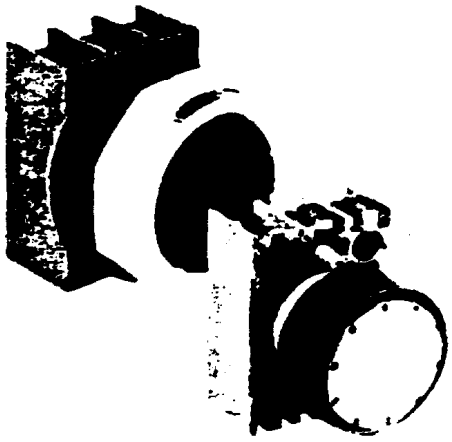
WEIGHT
NET: 5 oz.
SHIPPING: 8 oz.

SIEMENS-ALLIS

Control Products Division

Features and Benefits

P30 & P22 Pilot Devices



Designed to make the job a snap!

- The P30 (30mm standard diameter) & P22 (22mm miniature diameter) line of pilot devices includes:
  - Flush & extended pushbuttons
  - Illuminated pushbuttons
  - Press-to-test buttons
  - Pilot lights
  - 2 & 3 position selector switches (including non-illuminated & illuminated)
  - Key operated switches
  - Mushroom operators
- Heavy duty A600 rating
- NEMA 4, 12 & 13 for all industrial applications
- 2½" low profile mounting with 5 NO & 5 NC contacts behind panel
- All contact blocks snap in place — no mounting screws required
- Climate proof
- Meets U.S. and International standards
- Available in 128 countries
- Interchangeability of many components
- Standard distributor or OEM packaging available

CONTACT BLOCKS①

TYPE	CIRCUIT	CATALOG NO.
	1 N.O.	P30CB10
	1 N.C.	P30CB01

PUSHBUTTON OPERATOR with CAP

OPERATOR	COLOR	CATALOG NO.
 EXTENDED	RED	P30PBER
	GREEN	P30PBEG
	BLACK	P30PBEB
	BLUE	P30PBEE
	BROWN	P30PBEN
	YELLOW	P30PBEY
	WHITE	P30PBEW
	GRAY	P30PBEK
	ORANGE	P30PBEO

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2 POSITION OPERATORS

TYPE [1]	COLOR	2 POS. MAINTAIN CATALOG NO
 KNOB OPERATOR	GREEN	P30S2MKG
	~~BLACK~~	~~P30S2MKB~~
	RED	P30S2MKR
	WHITE	P30S2MKW
	YELLOW	P30S2MKY
	BLUE	P30S2MKE
	BROWN	P30S2MKN
	ORANGE	P30S2MKO

PILOT LIGHT (Less Lens)

TYPE [3]	VOLTS	LAMP	CATALOG NO.
 STANDARD FULL VOLTAGE AC or DC [2]	6	6V	P30PLSFA
	12	12V	P30PLSFB
	24	24V	P30PLSFC
	48	48V	P30PLSFD
	~~120~~	~~120V~~	~~P30PLSF1~~

LENS CAP

TYPE	COLOR	CATALOG NO.
 STANDARD	~~RED~~	~~P30PLSLR~~
	GREEN	P30PLSLG
	BLUE	P30PLSLE
	YELLOW	P30PLSLY
	WHITE	P30PLSLW
	CLEAR	P30PLSLC

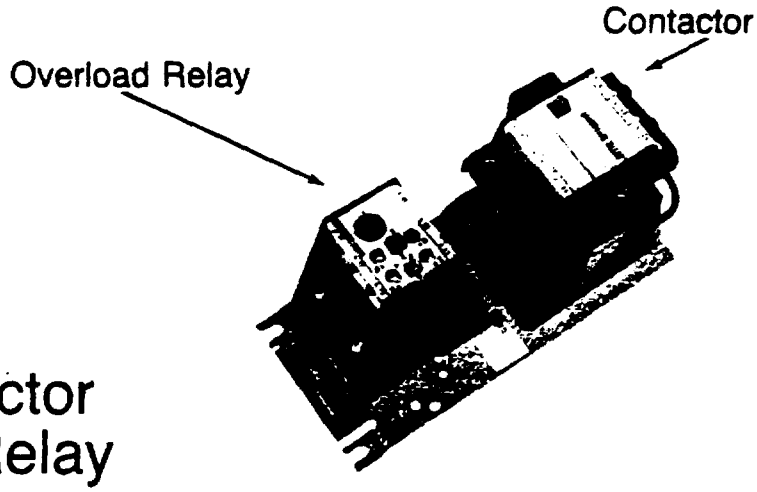
DECKMASTER

SIEMENS-ALLIS **RQ21 Starters**

Control Products
Division **Features and Benefits**

RQ21® Starters

Consist of a Contactor and an Overload Relay



RQ21 Starters offer the combined features of both!

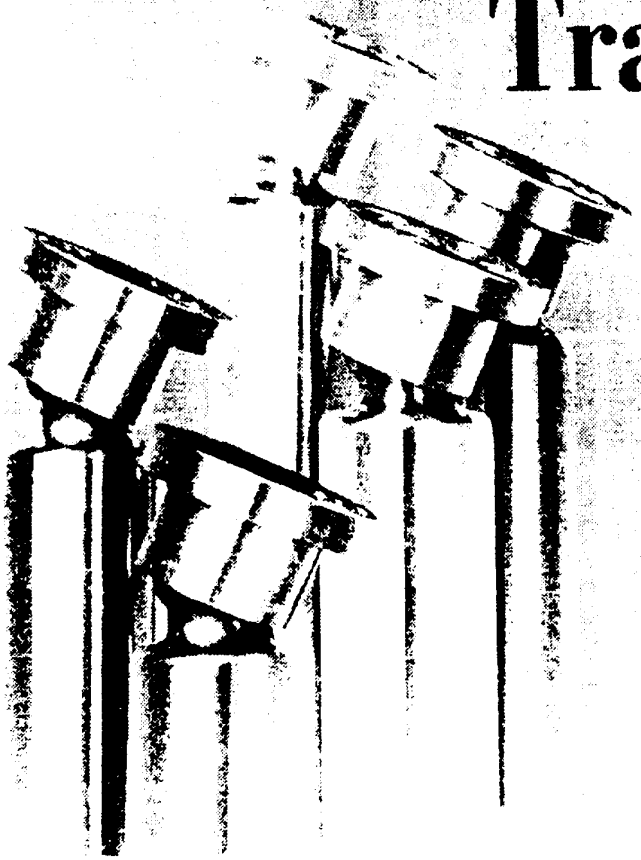
Contactor
- Compact size requiring less panel space.
- Low power consumption.
- Same coil used on Sizes 00, 0, & 1.
- Long mechanical life:
  15 million operations — Size 00
  10 million operations — Size 0-51/2
- Long electrical life.
- Easy to maintain — Parts requiring replacement are readily accessible and available.
- Available in 128 countries around the world.
- Dual frequency coil — 50/60 Hz.
- Meets or Exceeds NEMA, UL, CSA, VDE, IEC and other major standards.
- Auxiliary interlocks as standard:
  1 NO & 1 NC — Size 00
  1 NO & 1 NC — Size 0-51/2
- Heavy duty ValueLine available, Sizes 5 thru 9.

Overload Relay
- Positive protection against unbalanced load conditions such as single phasing.
- Meets NEMA Class 10 tripping characteristics. (Trips in less than 10 seconds at 600% of the motor current rating.)
- Ambient temperature compensation on all R021 thermal overload relays from - 20°C to + 50°C.
- Block type design with factory installed and calibrated directly heated and sealed bimetal elements assuring maximum tripping accuracy.
- Desired tripping current setting range easily set with adjustable dial,
- Trip-free reset feature, convertible from manual automatic reset.
- Normally open contact for alarm circuit.
- Test button, trip indicator and snap-on cover (for relays up to 45 amps only).
- B600 rated contacts.

Bulletin 9630
Rev. E
October, 1980

SUNDSTRAND Service

for Heavy Duty Transmissions



Sundstrand Hydro-Transmission
AMES, IOWA 50010
a unit of Sundstrand Corporation

INTRODUCTION

The purpose of this manual is to provide Information necessary for the normal servicing of the Sundstrand Heavy Duty (20-27 Series) family of hydrostatic transmissions. This Includes unit and component description, as well as function, troubleshooting, control adjustments, and minor repair procedures. This servicing may be performed, following the procedures in this manual without affecting the unit warranty.

A Sundstrand transmission does occasionally require servicing and your transmission has been designed with this in mind. Many of the parts on the heavy duty transmissions are Interchangeable throughout the entire 20 Series family. This includes such items as the controls, charge system and manifold components. In addition, many repairs or adjustments can be accomplished without the necessity of removing the unit from the vehicle provided the unit is accessible and can be thoroughly cleaned before beginning any procedures. Since dirt or contamination is the greatest enemy of any type of hydraulics, the greatest possible cleanliness is desirable.

Sundstrand Hydro-Transmission provides a complete repair service for its products. The specifics of this service are included in Sundstrand Bulletin 9614.

The torque values, pressure settings and dimensions used throughout this manual are given in English measurements. A metric conversion chart for all pressures and torque values is provided at the back of the manual.

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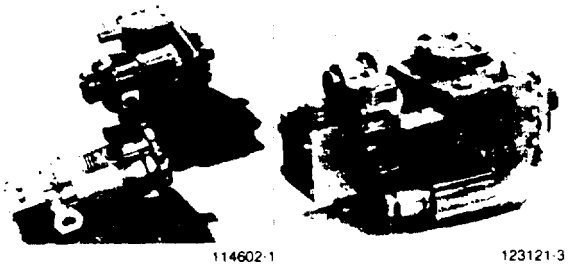

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SPECIFICATIONS

Model	Displacement		Maximum Recommended Working Pressure*		Max Speed @ Max Disp
	IN3:REV	CC REV	PSI	BAR	(RPM)
20	2 03	33.2	5,000	345	3,800
21	3.15	51.6	5,000	345	3,500
22	4.26	69.8	5.000	345	3,200
23	5 43	89	5.000	345	2,900
24	7 24	118.6	5,000	345	2,700
25	10 12	165.8	5.000	345	2,400
26	13.87	227.3	5.000	345	2,100
27	20.36	333.6	5.000	345	1,900

*6,000 PSI (414 BAR) maximum working pressure with written approval.

Heavy Duty Series and Types

The Heavy Duty Family of units consists of eight (8) different frame sizes (20 through 27 Series). Pumps and motors of different series (displacements) can be combined to meet the requirements of a variety of applications.

Within each series of the Heavy Duty Family of units there are three (3) configurations available: Variable Displacement Pumps. Fixed Displacement Motors, and Variable Displacement Motors.

The Variable Displacement Pump can be operated with fixed or variable input speeds and provides an infinitely variable output flow between 0 and maximum flow in either direction. A variety of controls are available for the Variable Displacement Pumps and Motors which are described on the following pages.

The Fixed Displacement Motor can be operated in either direction of rotation with infinitely variable output speeds between its 0 and maximum speed.

The Variable Displacement Motor provides a means for varying the motor output speed and torque range. Decreasing displacement results in higher output speed and lower output torque.

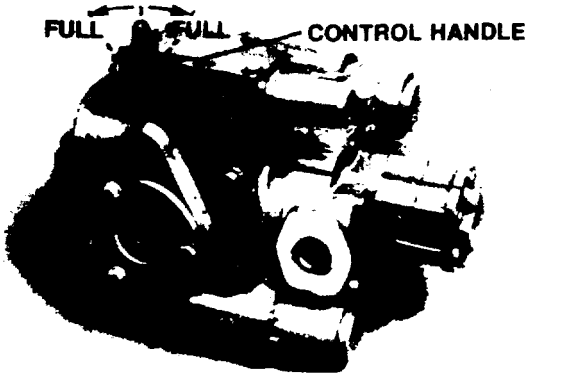
Specifications and Requirements Sundstrand Heavy Duty Hydrostatic transmissions have certain pressures that must be maintained as well as some requirements and limitations which must be observed.

SYSTEM REQUIREMENTS

Charge Pressure * (Neutral)	190 - 210 PSI	13 - 15 BAR
Charge Pressure * (Forward or Rev)	160- 180 PSI	11 - 12.5 BAR
Case Pressure	40 PSIG Max.	3 BAR Max.
Inlet Vacuum**	10 in. Hg. Max.	254 mm Hg Max.
Inlet Filtration	10 Micron Nominal No Bypass	

* Above case pressure. Some units may have special charge pressure settings. Consult Machine specifications.

**Measured at charge pump inlet. (May be exceeded during cold weather start up).



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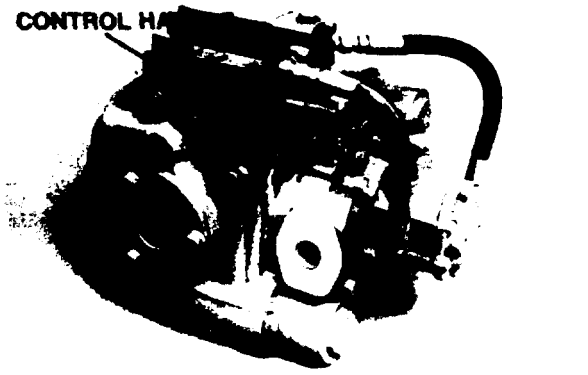

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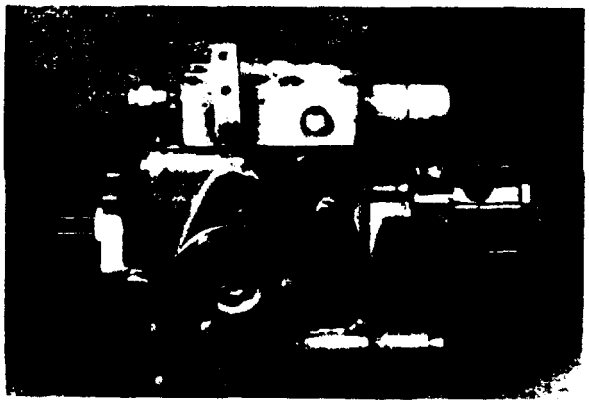

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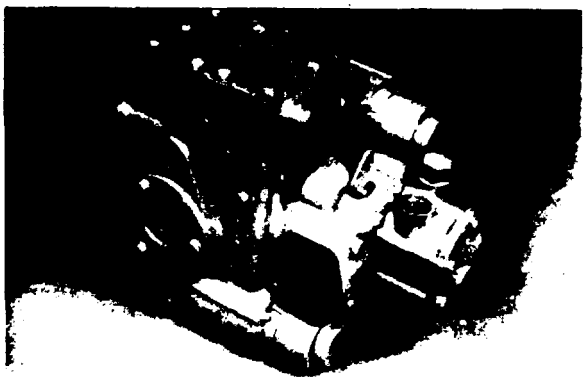

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Manual Displacement Control

The Standard Displacement Control provides a pump output flow (displacement), in either direction, that is approximately proportional to the angular movement of the control handle. The control will return to neutral if the control handle is released. **The internal centering mechanism is not sufficient to overcome external control linkage friction.**

This control has an orifice for controlling maximum acceleration or deceleration (control response). The orifice is available in various sizes for matching the control to the system.

CAUTION

Torque on the Control handle shaft must not exceed 150 in. lbs.

Manual Displacement Control With Pressure Override

A Pressure Override can be added to the Standard Displacement Control to provide overload protection. This override will automatically destroke the pump once the desired maximum system pressure (load) is reached It will maintain that system pressure so the load can be held This prevents operation of the system relief valves for prolonged periods and helps reduce heat build up in the transmission.

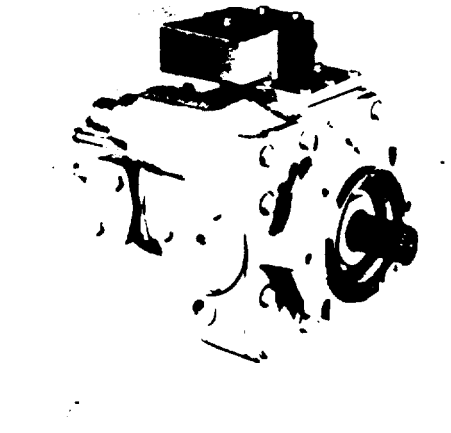
Neutral Start Switch

A Manual Displacement Control is available with a Neutral Start Switch which can be used to help insure that the prime mover is started only when the control is in neutral (O flow) position. The switch provides an electrical interrupt of the starting circuit unless the control is positioned in neutral.

Hydraulic Displacement Control

A Hydraulic Displacement Control is available which provides a pump output flow (displacement), in either direction, that is approximately proportional to an input pressure signal. This control is not available with a pressure override feature

The Hydraulic Displacement Control also has an orifice (different sizes available) for controlling maximum acceleration or deceleration. A displacement indicator is an optional feature on this control.



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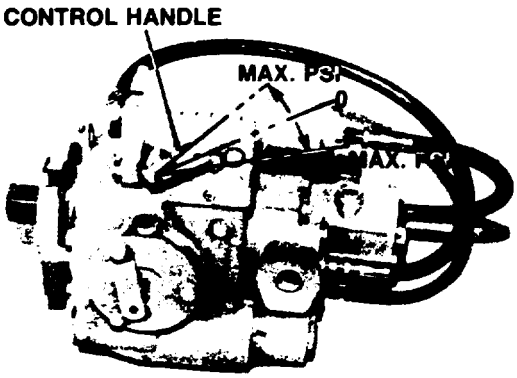

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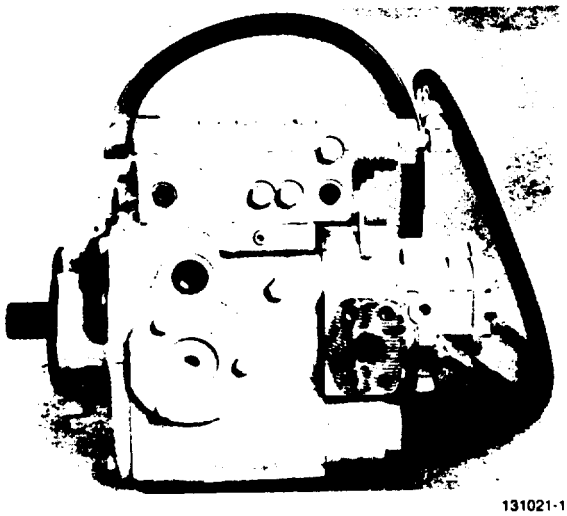

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Electric Displacement Control

Electric Displacement Controls are available that provide pump output flow (displacement) in either direction that is approximately proportional to an electrical input signal.
The Electric Displacement Control is available with a pressure override feature.

The control does not include the system necessary for providing the input signal. Sundstrand does not manufacture this control, but works with the manufacturer to provide this option.

Manual Variable Pressure Control

The Variable Pressure Control is designed to provide a differential system pressure that is approximately proportional to the angular movement of the control handle. This control can be used for high inertia loads. Pressure is used to start the load moving (control handle rotated in one direction), then shut off (handle to neutral) allowing the load to coast. Applying pressure against the load (control handle rotated in opposite direction) will stop the load. The control will return to neutral if the control handle is released. **The internal centering spring is not sufficient to overcome external control linkage friction.**

CAUTION

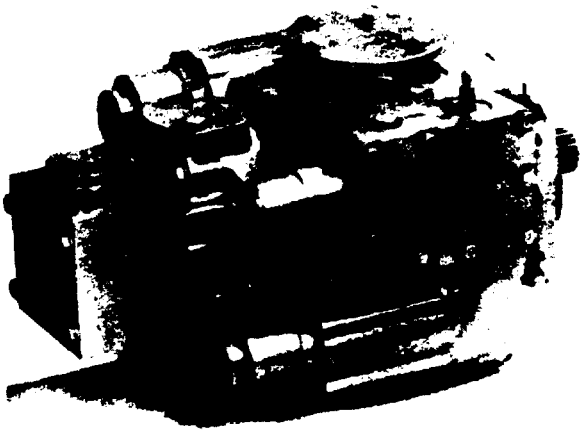
Torque on the control handle shaft must not exceed 150 in. lbs.

Hydraulic Variable Pressure Control

The Hydraulic Variable Pressure Control is designed to operate in a similar manner to the manually operated Variable Pressure Control except that the system pressure is proportional to a hydraulic command signal. This allows for remote machine control from a hydraulic source and eliminates mechanical linkage.

Torque (pressure) is used to start the load moving and the load is then allowed to continue movement due to its own inertia. Applying pressure in the opposite direction will stop the load.

The control is available in five different command signal ranges with all five versions being field adjustable to 5000 psi maximum system pressure.



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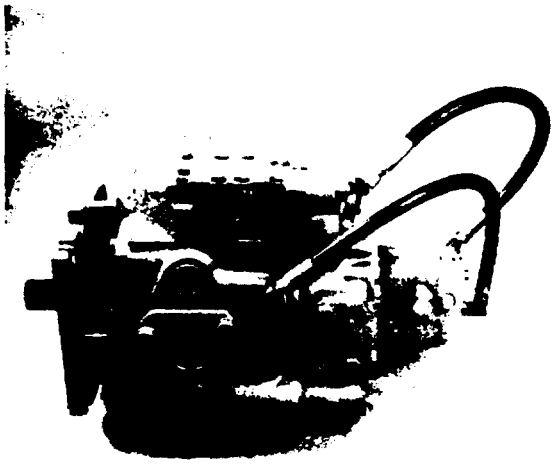

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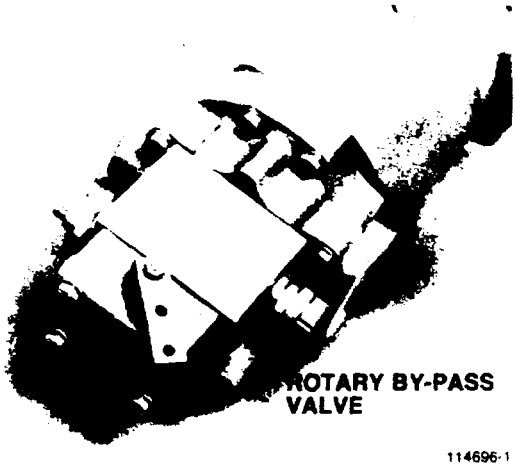

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Manual Displacement Motor Control

A Standard Displacement Control is also used on Variable Displacement Motors. This motor control will provide output speed or torque (displacement) in relation to the angular movement of the control handle between the maximum and minimum displacements of the motor. Release of the control handle results in the motor returning to its maximum displacement. **The internal spring mechanism not sufficient to overcome external control linkage friction.**

CAUTION

Torque on the control handle shaft must not exceed 150 in. lbs.

Motor Pressure Compensator Control

A Motor Pressure Compensator Control is available for the Variable Displacement Motor. The control is designed to keep the displacement of the motor at a minimum under light load conditions thereby maintaining motor output RPM's at a maximum. When a heavy load is induced on the motor, the control shifts the swashplate to maximum displacement. This reduces the motor speed but increases the torque to produce a greater load capacity. The "shift" in the position of the swashplate is made automatically at a pre-selected shift pressure.

Rotary By-Pass-Valve

The rotary by-pass valve is a two (2) way, two position valve mounted on the motor manifold. During normal operation, the valve remains in the closed position which does not allow any fluid to be by-passed. In the open position, the main flow is by-passed from the motor to the down stream side of the main circuit. The by-pass valve is designed for use with all heavy duty motors and provides the capability of disconnecting the power train for safety purposes or moving the vehicle in case of machine malfunction.

Fluids

The hydraulic fluids used with Sundstrand products should be carefully selected following the guidelines presented in the "Hydraulic Fluid Requirements" bulletin, F-00.01 and in the original equipment manufacturer's specifications.

Start Up Procedure

Prior to installing both pump and motor, inspect the units for damage incurred during shipping and handling. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with-fluid. Fill the reservoir with recommended hydraulic fluid which should be passed through a 10 micron (nominal no bypass) filter prior to entering the reservoir. Never reuse fluid.

The inlet line leading from the reservoir to the pump must be filled prior to start up. Check inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.

Be certain to fill the main pump and motor housing with clean hydraulic fluid prior to start up by pouring filtered oil in the uppermost case drain port.

Install a pressure gauge (500 PSI) in the Charge Pressure Gauge Port (Ref: Troubleshooting Section). It is recommended the external control linkage be left disconnected until after initial start up to allow pump to remain in neutral.
Start the prime mover and run at lowest possible RPM until charge Pressure has been established. Air can be bled from the high pressure lines by using the high pressure gauge ports on the motor manifold.

CAUTION

Do not start prime mover unless pump is in neutral (0 swashplate angle). Take safety precautions to prevent machine movement in case pump is actuated during initial start up.

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be at 190- 210 PSI minimum. If charge pressure is not at proper value, shut down and determine cause (Ref: Troubleshooting Section).

Shut down prime mover and connect external control linkage. Start prime mover, checking to be certain pump remains in neutral. With prime mover at normal operating speed, slowly check for forward and reverse machine operation.

CAUTION

Take necessary safety precautions before moving machine.

Charge pressure should remain at 160-180 PSI minimum during forward or reverse operation. Continue to cycle slowly from forward to reverse for five (5) minutes.

Shut down prime mover, remove gauges and plug ports. Check reservoir level and add fluid if necessary.

The transmission is now ready for operation.

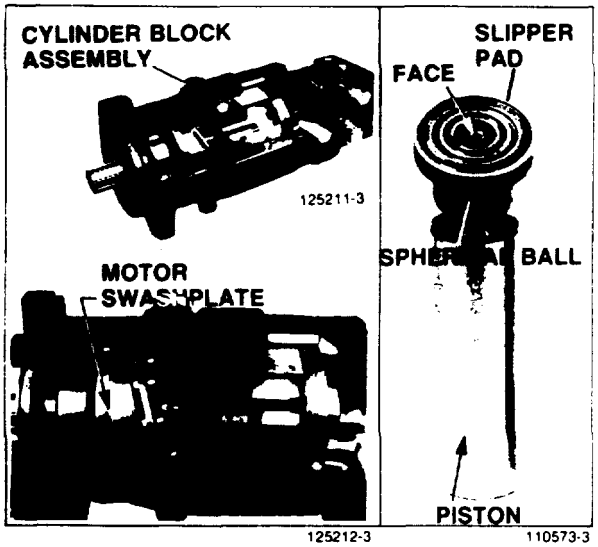
System Maintenance

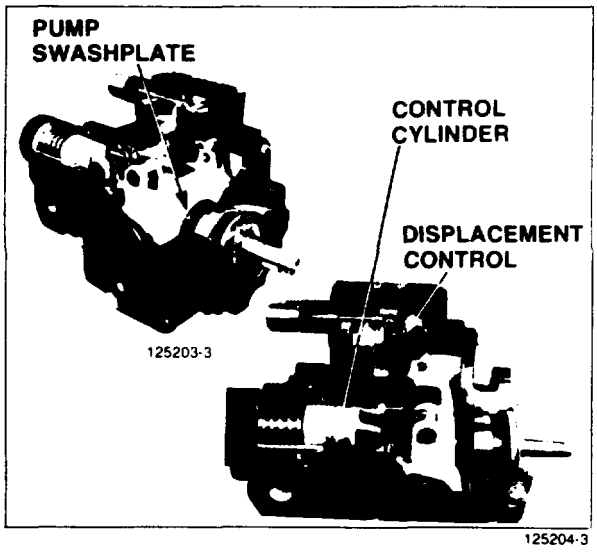
For satisfactory service, regular maintenance of fluid and filters must be performed. The following are recommended intervals for changing these items.

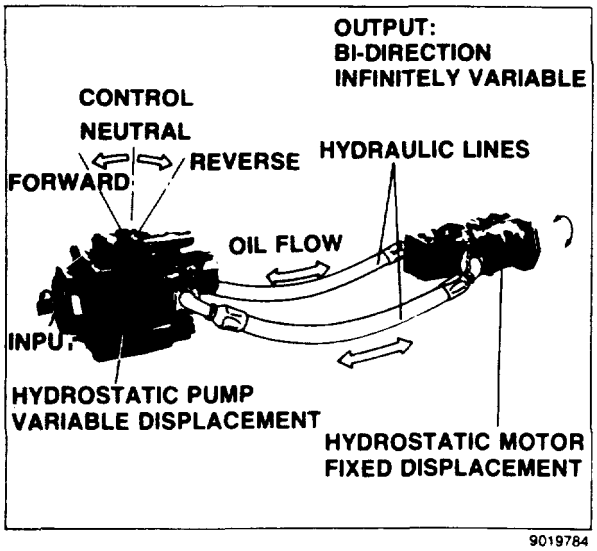
Sealed Type Reservoir:	2000 hrs.
Air Breathing Type Reservoir	500 hrs.

Check fluid level daily. Change fluid more often if it becomes contaminated with any foreign matter (dirt, water, grease, etc.).

Change inlet filter whenever fluid is changed and whenever filter indicator shows a change is necessary. Replace all fluid lost during filter change.







Axial Piston, Slipper Pad Design

Sundstrand hydrostatic pumps and motors are an axial piston, slipper pad design. There are nine (9) pistons mounted in the cylinder block. As the cylinder block rotates, these pistons are forced in and out of their bores by the angle of the swashplate. This results in a specific amount of fluid being displaced for every revolution of the cylinder block. In a pump, the fluid is forced out as the angle of the swashplate pushes the pistons into the bores. In a motor, system pressure against the piston causes it to slide down the inclined face of the swashplate resulting in output rotation.

The slipper pad attaches to a spherical ball on the end of the piston forming a ball and socket joint. This allows the slipper pad to tilt at any angle and make contact with the swashplate. The face of the slipper pad slides on a hydrostatic fluid film which uses fluid pressure to balance internal forces.

Variable Pump Tilting Swashplate

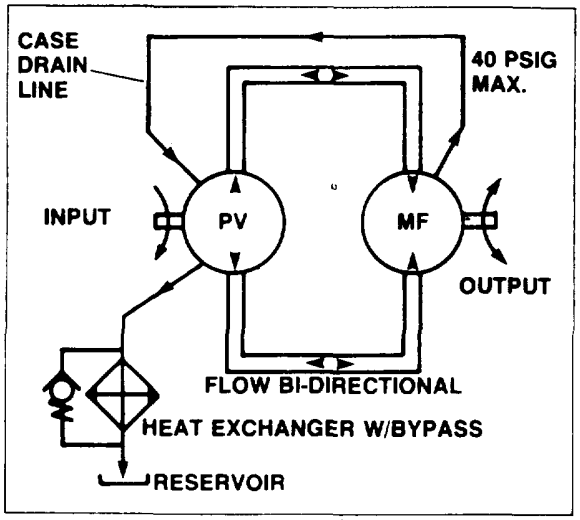
The variable displacement pumps use a tiltable swashplate to vary displacement (output flow). The swashplate is mounted on trunnion bearings and is connected to hydraulic control (servo) cylinders. The control directs fluid to and from the servo cylinders causing the swashplate to tilt and change displacement of the pump. The swashplate can be tilted in either direction from 0 angle and provide pump flow in either direction.

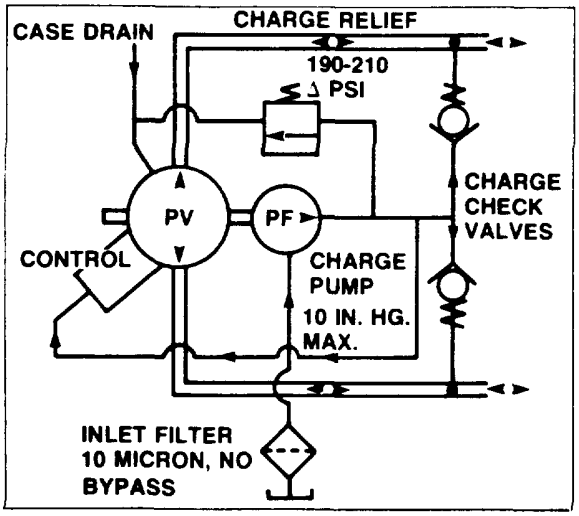
Since the angle of the swashplate causes the pistons to stroke in and out of the cylinder block bores as it is rotated, changing this angle varies the piston stroke and, therefore, the amount of fluid being displaced (pumped) to the motor. This results in a change in the output speed of the motor. Tilting the swashplate in the opposite direction reverses fluid flow to the motor and its direction of rotation. Since each servo control cylinder is spring loaded, loss of control pressure or charge pressure will cause the swashplate to return to neutral position.

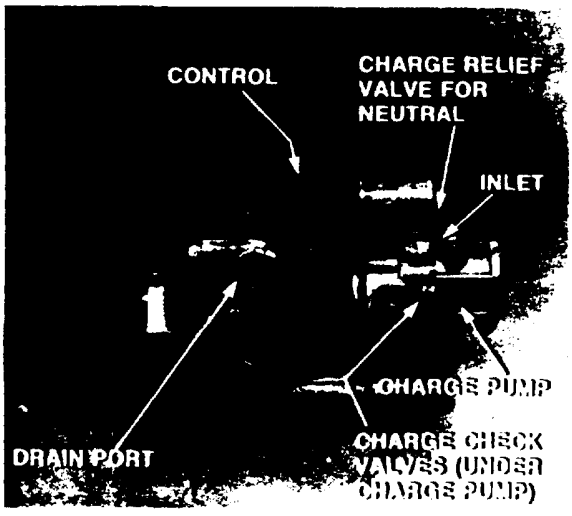
Hydrostatic Transmission

The hydrostatic transmission consists of a variable displacement pump connected by hydraulic lines to either a fixed or variable displacement motor. The pump rotates in one direction and requires a change of internal parts to rotate in the opposite direction. The motor rotates in either direction.

With the hydrostatic transmission. machine control can be achieved with a single operator control which provides smooth, stepless speed and direction changes. Placing the control in neutral (0 swashplate angle) stops transmission (motor) output which usually eliminates the need for clutching mechanisms. **This feature, however, does not eliminate the need for a service brake or parking brake.**







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The Sundstrand hydrostatic transmission is easy to install requiring no adjustments and few auxiliary components. It has its own hydraulic support system which is discussed in this section.

Basic Closed Circuit

The main ports of the pump are connected by hydraulic lines to the main ports of the motor. Fluid flows, in either direction, from the pump to the motor then back to the pump in this closed circuit. Either of the hydraulic lines can be under high pressure. The position of the swashplate determines which line is high pressure as well as the direction of fluid flow.

Case Drain and Heat Exchanger

The pump and motor require case drain lines to remove hot fluid from the system. The motor should be drained from its topmost drain port to insure the case remains full of fluid. The motor case drain is then connected to the lower drain port on the pump housing and out the upper port.

A heat exchanger, with a bypass valve, is required to cool the case drain fluid before it returns to the reservoir.

CAUTION
Case pressure should not exceed 40 PSIG.

Charge System and Inlet Filter

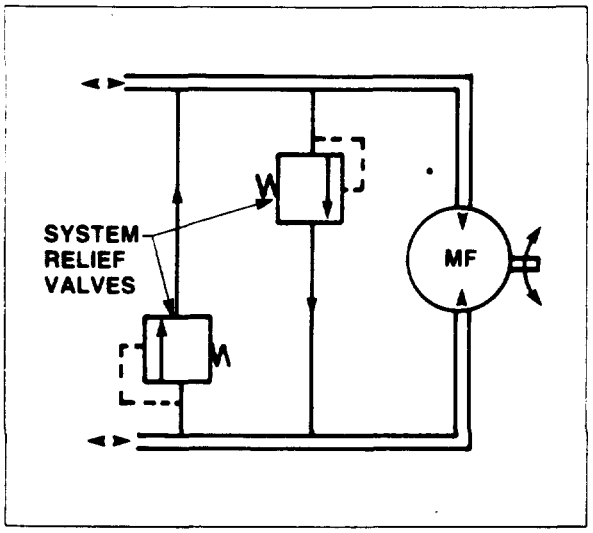
A fixed displacement (gear type) charge pump is mounted on the variable displacement pump and driven off the main pump shaft. The charge pump supplies cool fluid to the system, keeps the system charged and supplies fluid to operate the control system. Charge pressure, with the pump in neutral (O flow), is limited by a relief valve which is normally factory set for 190-210 ΔPSI (above case pressure).

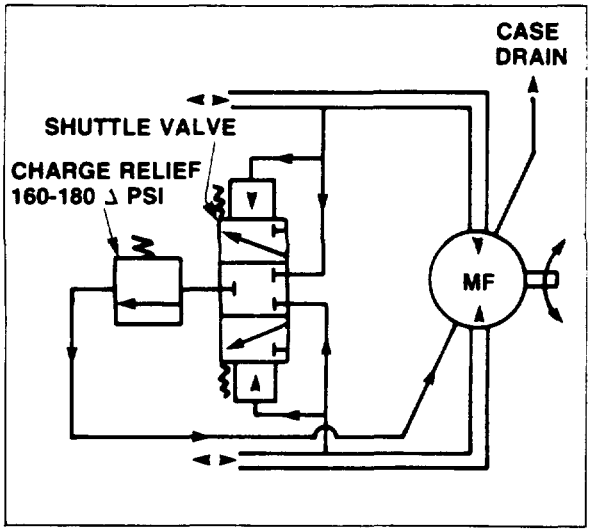
Since either of the main hydraulic lines can be high pressure. two (2) charge check valves are used to direct the charge supply into the low pressure line. The check valves are contained in the pump end cap beneath the charge pump.

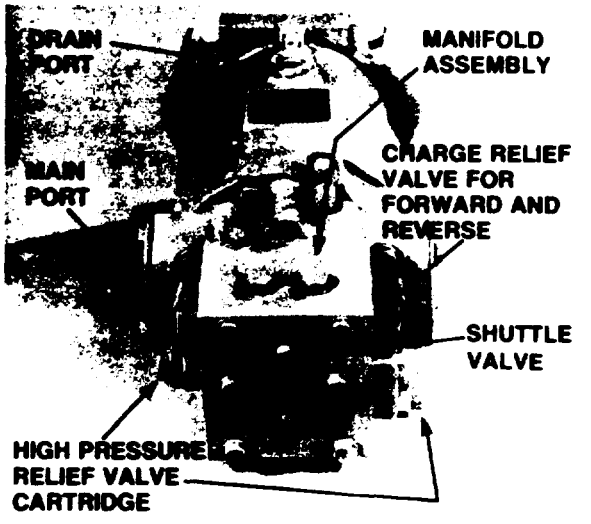
The charge pump draws the fluid from the reservoir. An inlet filter is required to insure that only clean fluid enters the system. This filter should have a 10 micron (nominal) rating and should not have a bypass.

CAUTION
The inlet vacuum, measured at the charge pump inlet should not exceed 10 in. hg. except during cold starts.

BASIC OPERATION: HYDRAULIC SUPPORT SYSTEM







System Relief Valves

Two (2) System Relief Valves are provided for overload protection and are located in the Manifold Assembly mounted on the motor. These relief valves are factory set and are of the pilot operated, cartridge type. Changing the setting of these relief valves can be accomplished by installing cartridges with the desired setting. The first two (2) digits of the pressure setting are stamped on the end of the relief valve cartridge.

CAUTION

The relief valves are factory set and should not be tampered with except to replace the entire cartridge.

Cooling Circuit

A Shuttle Valve and a second Charge Relief Valve are included in the Manifold Assembly. The Shuttle Valve provides a circuit between the low pressure hydraulic line of the closed circuit to the second Charge Relief Valve. This Charge Relief Valve is set at a lower pressure (160-180 A PSI) than the relief valve located in the Charge Pump. This Charge Relief Valve limits Charge Pressure when the pump is in forward or reverse (swashplate stroked out of neutral).

This system provides a means of removing hot fluid from the main closed circuit so that cooler fluid entering from the charge pump can be used to help reduce heat build-up.

The Shuttle Valve is spring centered to the closed position so that during the transition of reversing pressures in the main hydraulic lines, no high pressure fluid is lost from the closed circuit.

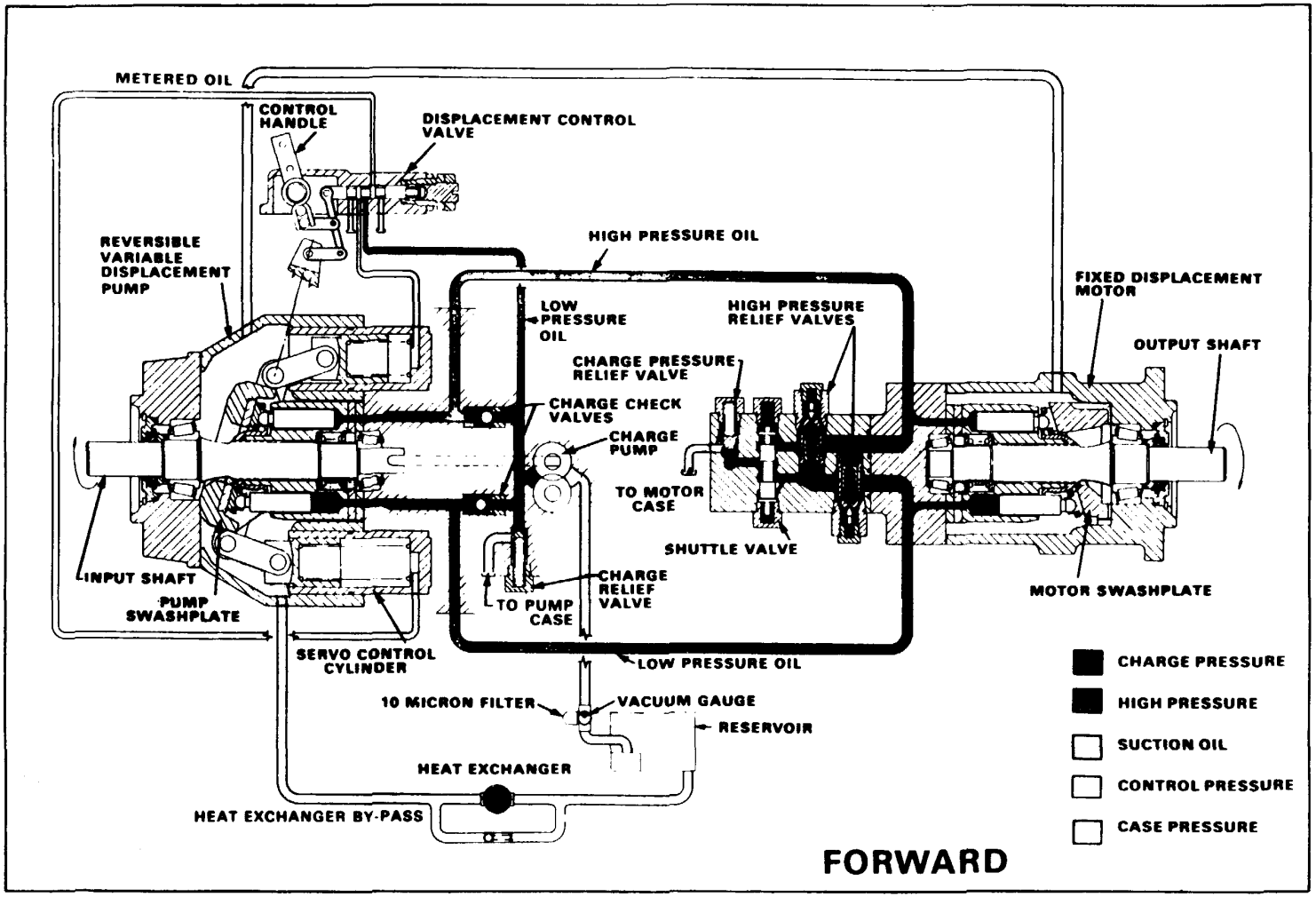
Charge Pressure

When the pump is in neutral (0 swashplate angle) the Charge Pressure should be at 190-210 a PSI (above case pressure). When the pump is in forward or reverse (other than 0 swashplate angle) the Charge Pressure should be at 160-180 APSI (above case pressure).

CAUTION

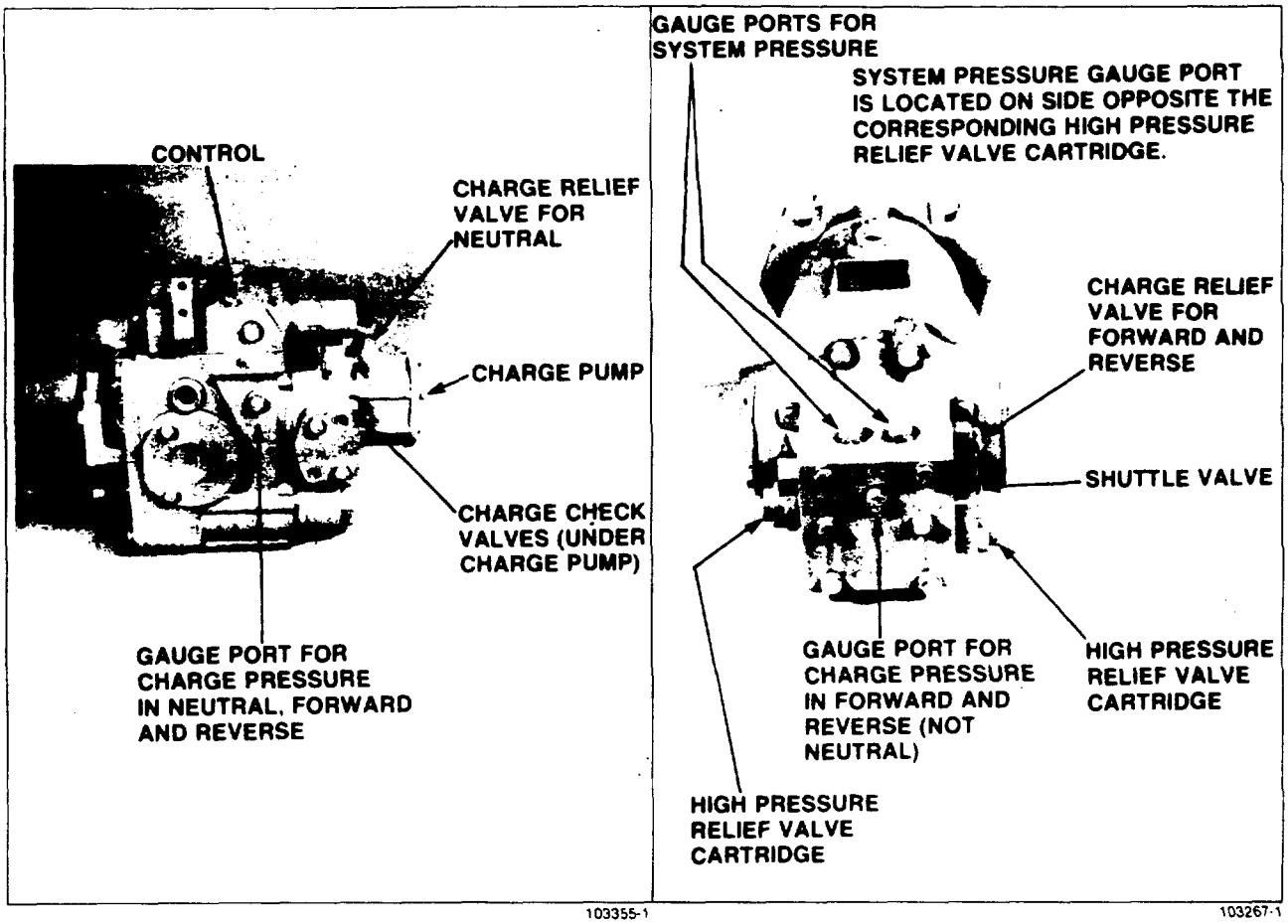
Charge Pressure must not be less than 160 DPSI for satisfactory operation.

TYPICAL HEAVY DUTY VARIABLE PUMP-FIXED MOTOR TRANSMISSION SCHEMATIC



Sundstrand Hydro-Transmission

BULLETIN 9522-A



Instructions

The areas indicated in these troubleshooting procedures may be inspected, adjusted or replaced, following the procedures in this manual, without voiding the warranty. For specific instructions on adjustments, removal and replacement, refer to the appropriate sections in this manual.

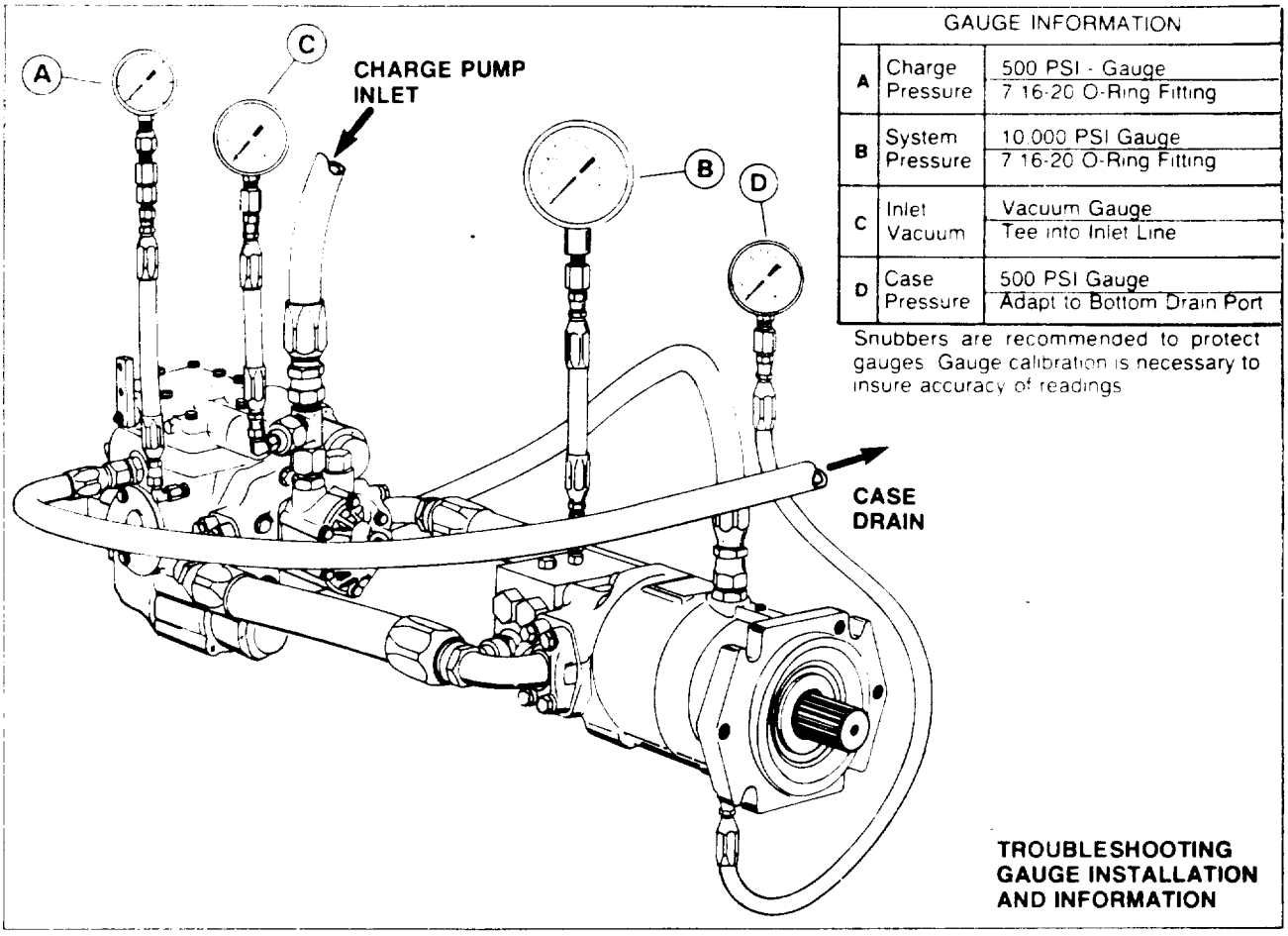
The information contained in this section provides a guide for troubleshooting the Sundstrand Heavy Duty hydrostatic transmissions. It is a problem solving tool aimed at eliminating unnecessary machine downtime. Following the fault-logic approach should result in the expedient correction of transmission problems.

Our experience shows that there are five (5) problem statements that cover the majority of problems encountered with these transmissions. These problem statements have been set up in fault-logic diagrams on the following pages.

Following the fault-logic diagrams are descriptions of some of the action steps shown in the diagrams. Where applicable, a number for this description appears in the action block of the diagram.

Cleanliness is a primary means of insuring satisfactory transmission life, on either new or repaired units. Cleaning parts by using a solvent wash and air drying is adequate, providing clean solvent is used. As with any precision equipment, the internal mechanism and related items must be kept free of foreign materials and chemicals.

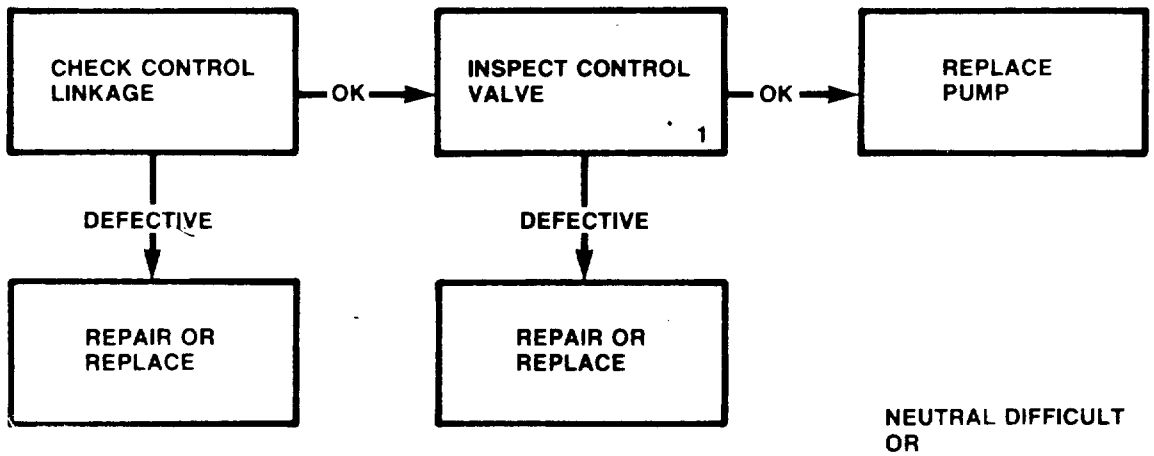
Protect all exposed sealing surfaces and open cavities from damage and foreign material.



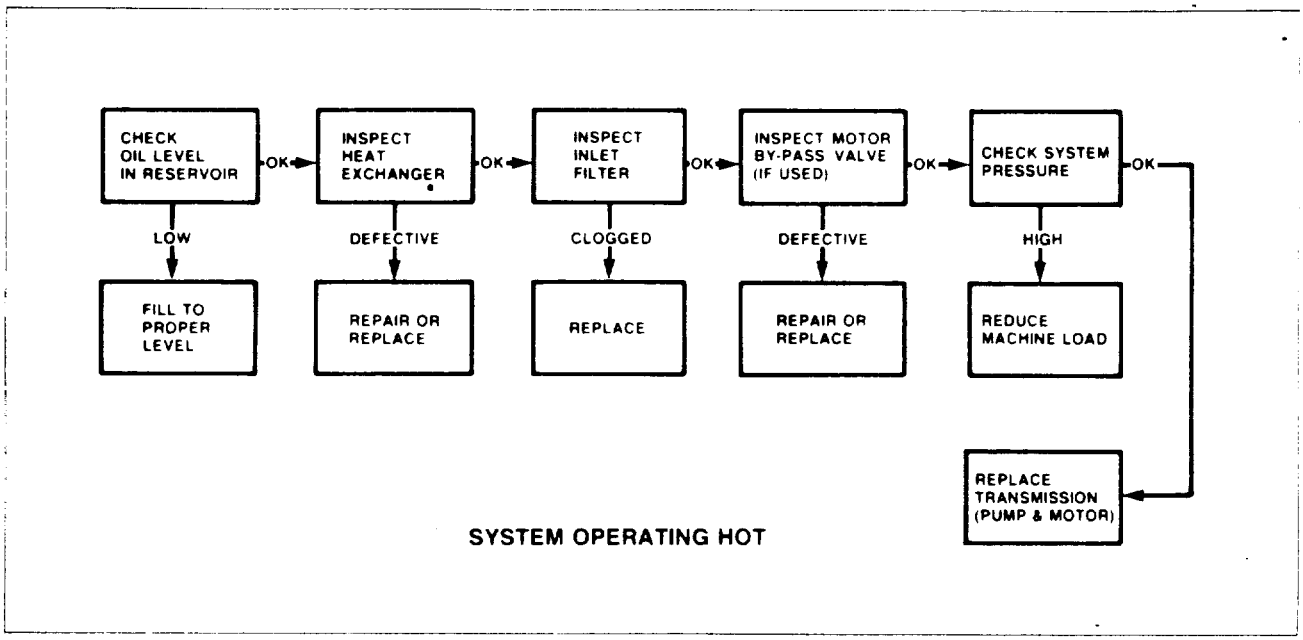
GAUGE INFORMATION		
A	Charge Pressure	500 PSI - Gauge 7 16-20 O-Ring Fitting
B	System Pressure	10,000 PSI Gauge 7 16-20 O-Ring Fitting
C	Inlet Vacuum	Vacuum Gauge Tee into Inlet Line
D	Case Pressure	500 PSI Gauge Adapt to Bottom Drain Port

Snubbers are recommended to protect gauges. Gauge calibration is necessary to insure accuracy of readings.

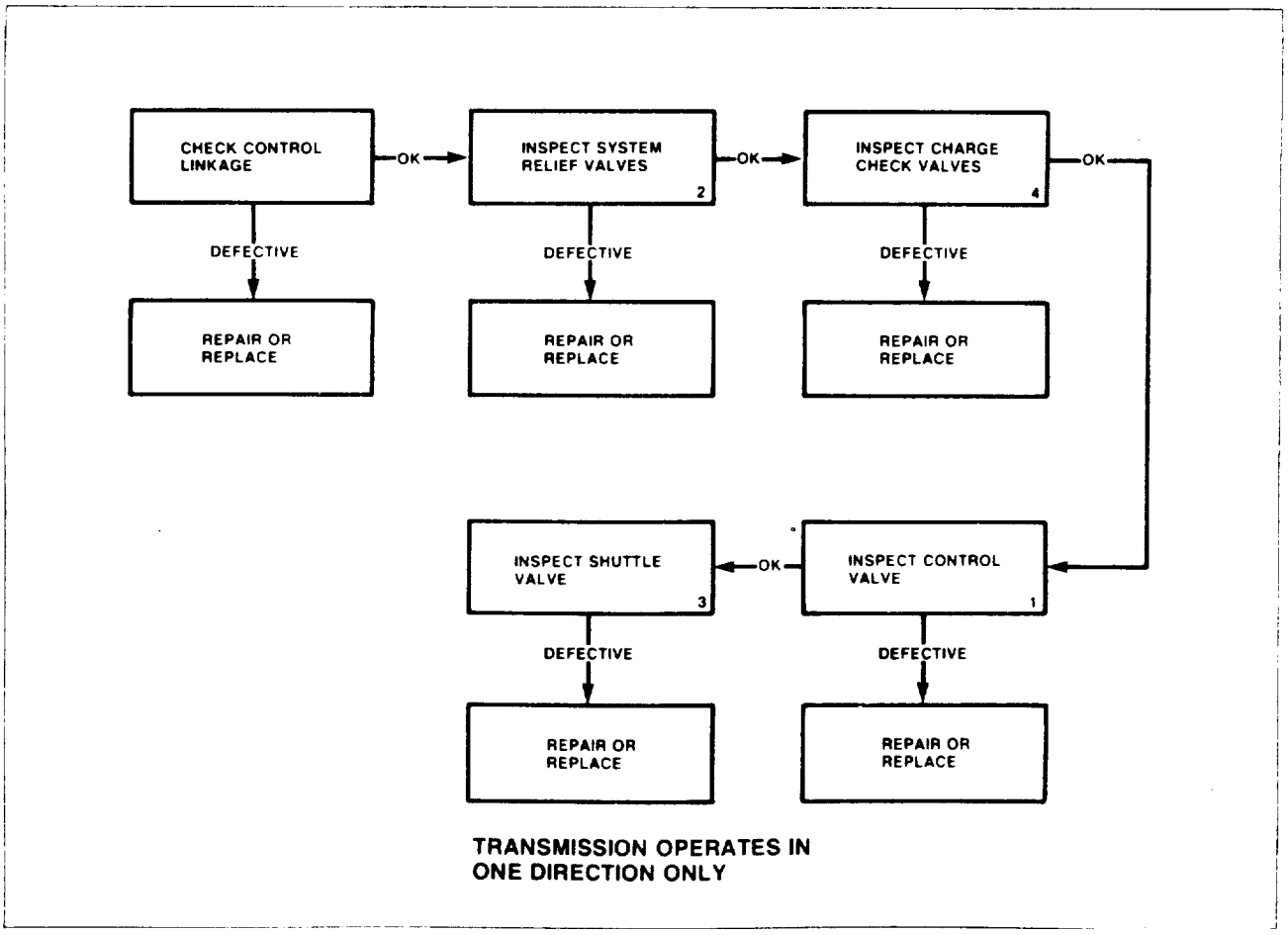
TROUBLESHOOTING GAUGE INSTALLATION AND INFORMATION



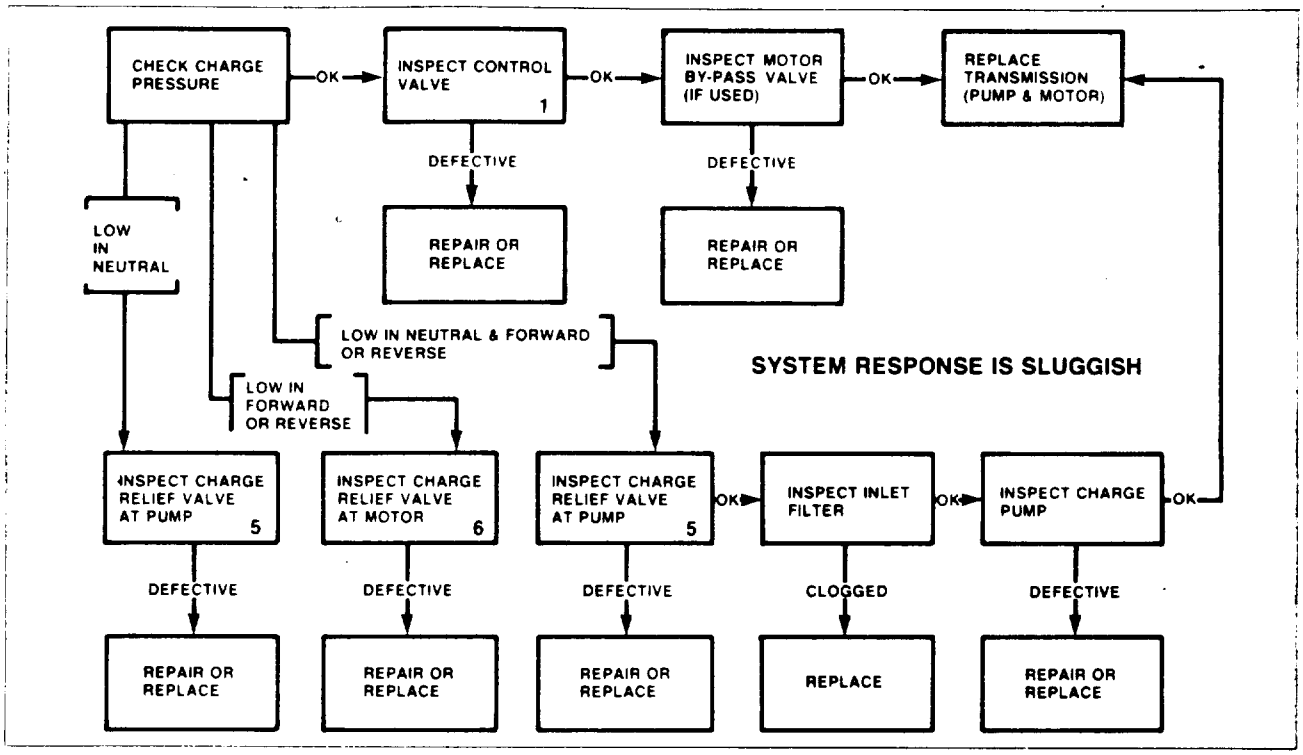
NEUTRAL DIFFICULT OR IMPOSSIBLE TO FIND

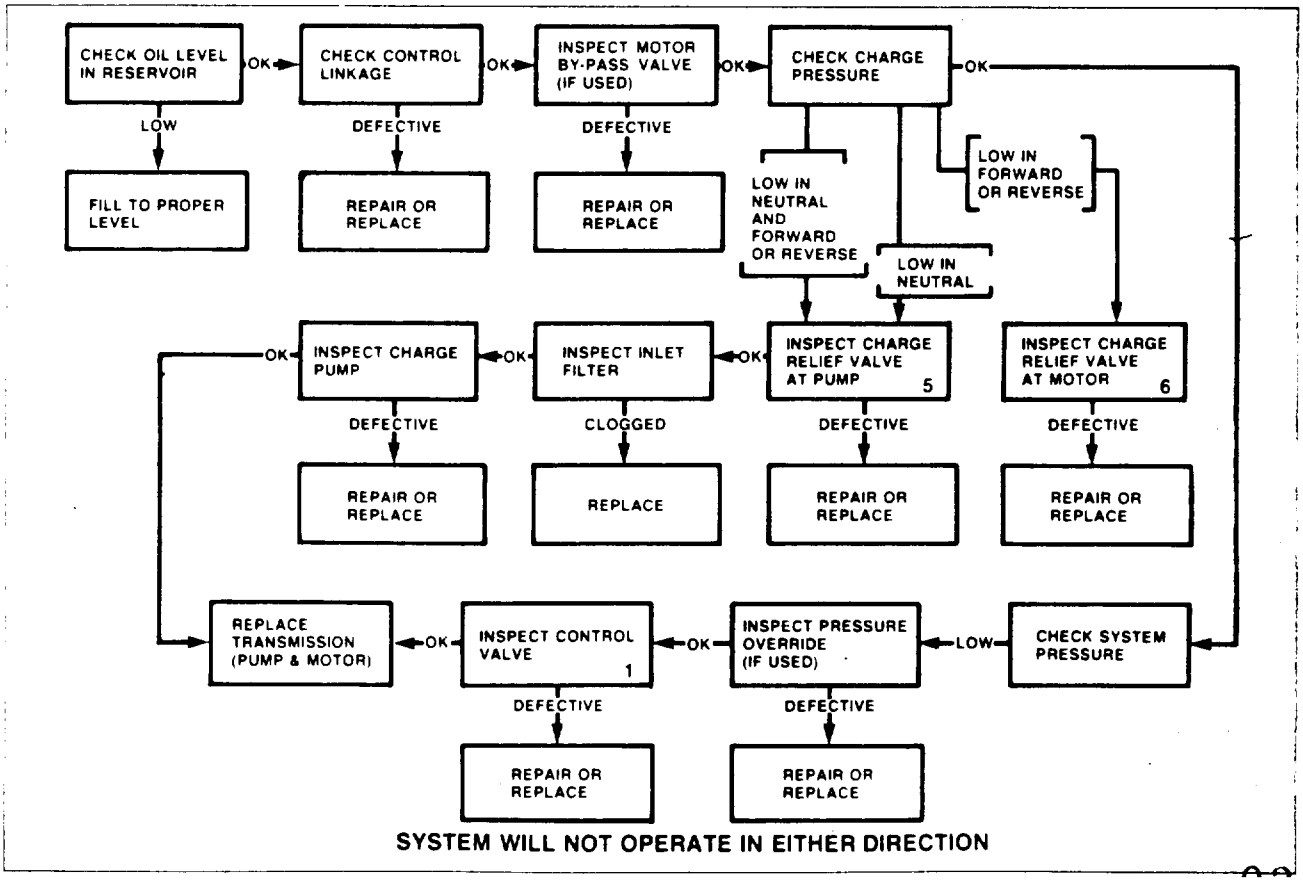


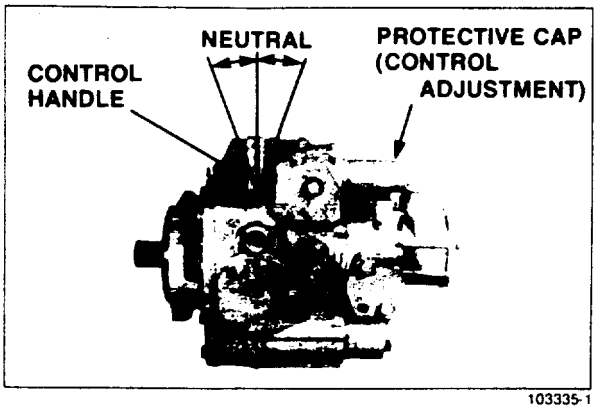
SYSTEM OPERATING HOT



TRANSMISSION OPERATES IN ONE DIRECTION ONLY


CHECK CHARGE PRESSURE
OK
INSPECT CONTROL VALVE 1
OK
INSPECT MOTOR BY-PASS VALVE (IF USED)
OK
REPLACE TRANSMISSION (PUMP & MOTOR)
DEFECTIVE
REPAIR OR REPLACE
DEFECTIVE
REPAIR OR REPLACE
LOW IN NEUTRAL
LOW IN NEUTRAL & FORWARD OR REVERSE
LOW IN FORWARD OR REVERSE
SYSTEM RESPONSE IS SLUGGISH
INSPECT CHARGE RELIEF VALVE AT PUMP 5
INSPECT CHARGE RELIEF VALVE AT MOTOR 6
INSPECT CHARGE RELIEF VALVE AT PUMP 5
OK
INSPECT INLET FILTER
OK
INSPECT CHARGE PUMP
OK
DEFECTIVE
DEFECTIVE
DEFECTIVE
CLOGGED
DEFECTIVE
REPAIR OR REPLACE
REPAIR OR REPLACE
REPAIR OR REPLACE
REPLACE
REPAIR OR REPLACE


CHECK OIL LEVEL IN RESERVOIR
OK
CHECK CONTROL LINKAGE
OK
INSPECT MOTOR BY-PASS VALVE (IF USED)
OK
CHECK CHARGE PRESSURE
OK
LOW
DEFECTIVE
DEFECTIVE
FILL TO PROPER LEVEL
REPAIR OR REPLACE
REPAIR OR REPLACE
LOW IN NEUTRAL AND FORWARD OR REVERSE
LOW IN FORWARD OR REVERSE
LOW IN NEUTRAL
OK
INSPECT CHARGE PUMP
OK
INSPECT INLET FILTER
OK
INSPECT CHARGE RELIEF VALVE AT PUMP 5
INSPECT CHARGE RELIEF VALVE AT MOTOR 6
DEFECTIVE
CLOGGED
DEFECTIVE
DEFECTIVE
REPAIR OR REPLACE
REPLACE
REPAIR OR REPLACE
REPAIR OR REPLACE
REPLACE TRANSMISSION (PUMP & MOTOR)
OK
INSPECT CONTROL VALVE 1
OK
INSPECT PRESSURE OVERRIDE (IF USED)
LOW
CHECK SYSTEM PRESSURE
DEFECTIVE
DEFECTIVE
REPAIR OR REPLACE
REPAIR OR REPLACE
SYSTEM WILL NOT OPERATE IN EITHER DIRECTION



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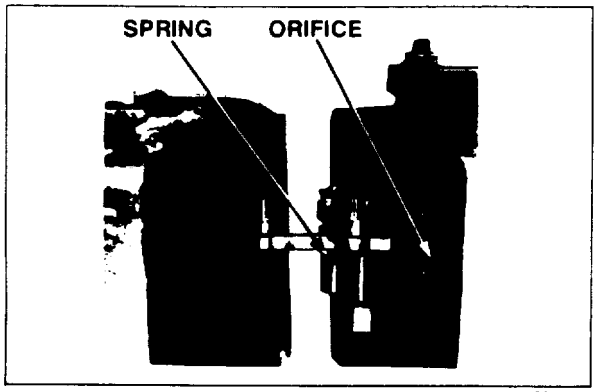

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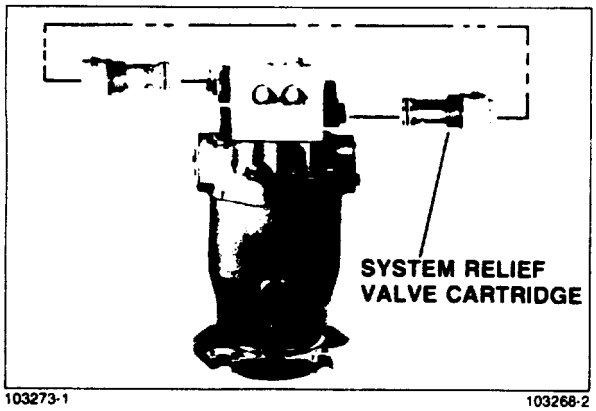

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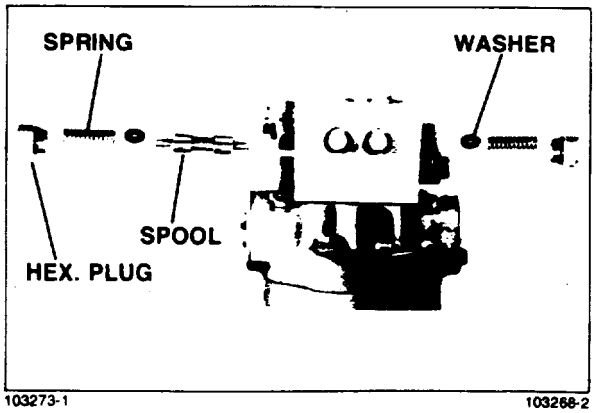


103273-1 103268-2

1. Inspect Manual Displacement Control

Disconnect the external control linkage from the control handle and check for neutral operating with control handle. Releasing control handle should allow the pump to return to neutral. If operation is satisfactory with external control linkage disconnected, the problem is not in the hydrostatic transmission.

If operation is not satisfactory with external control linkage disconnected from control handle, the control may be misadjusted. Adjustment procedures are contained in this manual.

NOTE

Before preceding with control adjustment the following inspection is recommended.

Remove the cap screws holding the control in place, and swing it away from housing and remove. Inspect visible linkages, torsion spring, and O-rings. Inspect for missing, plugged, or improper orifice.

2. Inspect System Relief Valves

When the problem occurs in one direction only, interchange the relief valve cartridges to see if the problem changes to the other direction. If so, one relief valve cartridge is either malfunctioning or does not have the proper setting. The first two (2) digits of the pressure setting are stamped on the end of the cartridge. Compare to machine specification.

CAUTION

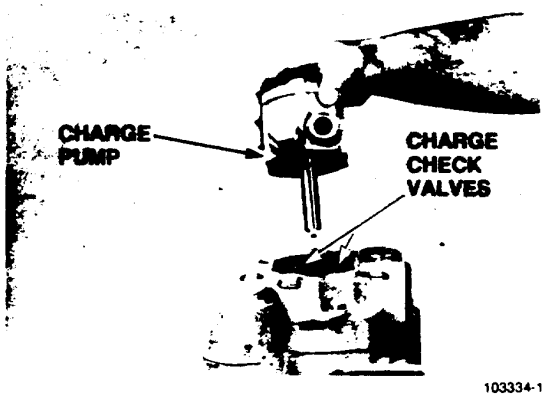
The relief valves are factory set and should not be disassembled further.

3. Inspect Shuttle Valve

Remove the two (2) hex plugs and the shuttle valve parts. Inspect for broken or damaged parts and proper orientation. Washers must go between spool and springs. Inspect to see if spool moves smoothly in its bore.

NOTE:

The spool and manifold are matched and cannot be replaced separately.



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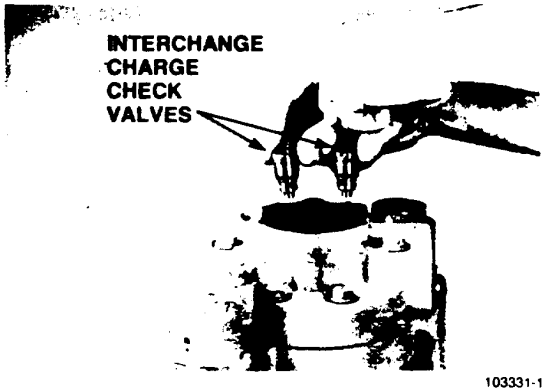

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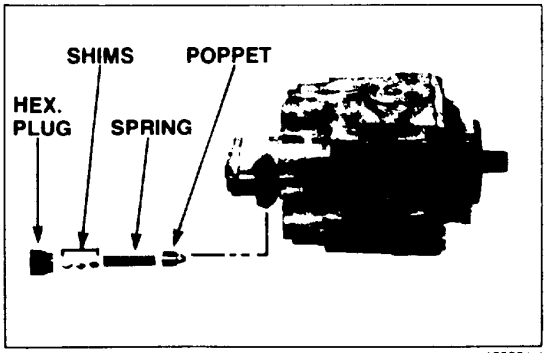

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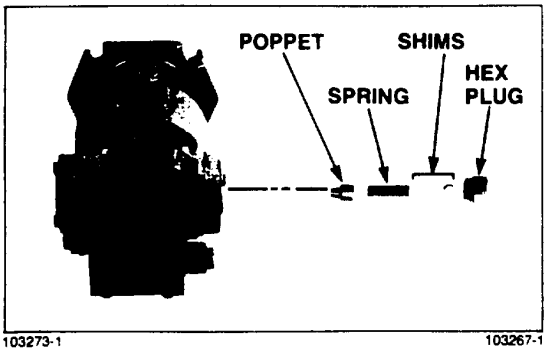

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4. Inspect Charge Check Valves

The Charge Check Valves are located in the pump end cap, under the Charge Pump. Following the procedures in the Minor Repair Section of this manual, remove the Charge Pump. Remove both Charge Check Valves and keep in same relation to the end cap.

CAUTION

Protect exposed cavities into pump from foreign material.

Inspect the check valve for spring loading by pushing against the internal ball. A slight resistance should be felt as the ball is pushed off its seat. The internal spring should return the ball to its seat when force is removed. Check for any foreign material inside valve.

When the problem occurs in one direction only, interchange the check valves and see if the problem changes to the other direction. If so, one check-valve is malfunctioning and should be replaced.

5. Inspect Pump Charge Relief Valve

If Charge Pressure is low (below 190 A PSI) in neutral only (okay in forward and reverse), the Charge Relief Valve located in the Charge Pump should be inspected. Remove the hex plug and relief valve parts. Inspect for foreign material holding poppet open, and for galling or wear on poppet and seat in the charge pump.

Adjustment of Charge Pressure in Neutral is accomplished by changing the shims behind the spring.

6. Inspect Motor Charge Relief Valve

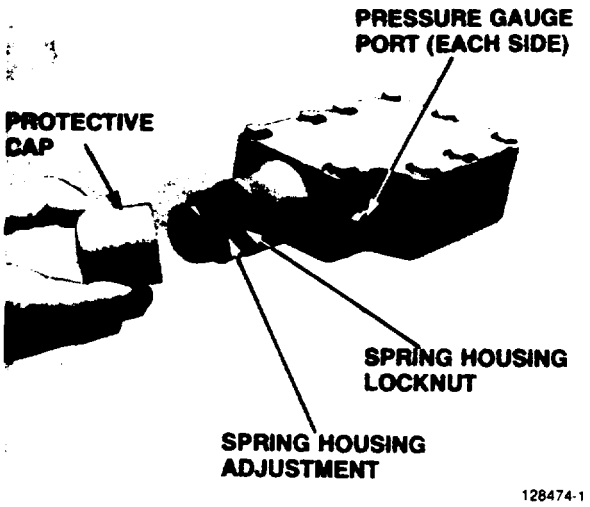
If Charge Pressure is low (below 160 A PSI) in forward and reverse (okay in neutral), the Charge Relief Valve located in the motor manifold should be inspected. Remove the hex plug and relief valve parts. Inspect for foreign material holding poppet open, and for galling or wear on poppet and seat in the manifold.

Adjustment of Charge Pressure in forward and reverse is accomplished by changing the shims behind the spring.

CAUTION

Make certain the pressure setting of the motor charge relief valve is below the pressure setting of the pump charge relief valve. Otherwise the cooling circuit will not function properly.

103355-1



128474-1

Manual Displacement Control

Spool Centering

CAUTION

The following procedure requires that steps be taken to disable the machine in the event the pump should go into stroke (raise drive wheels off ground, etc.)

1. Remove the external control linkage from the control handle.
2. Install two 300 PSI gauges into the pressure gauge ports on either side of the control (7/16-12 str. thd O-ring).
3. Start the prime mover and operate at normal speed.
4. Remove the protective cap. Loosen the spring housing locknut. Turn the spring housing adjustment CW or CCW until the two gauges read the same pressure. This equal pressure will be the "base" pressure.
5. Turn the spring housing adjustment CW until one of the gauges begins to raise above the "base" pressure. Note the amount of adjustment rotation.
6. Keeping track of the amount of rotation, turn the adjustment CCW until the other gauge begins to raise above the 'base" pressure.
7. Note the amount of rotation from the previous adjustment position (amount turned CCW in Step 6). Turn the adjustment CW by one-half (1/2) that amount.
8. Holding the adjustment in place, tighten the spring housing locknut to 60-100 ft. lbs.
9. If the pump consistently returns to neutral. after cycling the control several times. the neutral adjustment is complete 10. If the pump does not consistently return to neutral, stop the prime mover and refer to the procedure on the following page.
11. Stop the prime mover. install protective cap. remove the two (2) pressure gauges and install the pressure port plugs. Torque to 10-20 ft. lbs.

Install and adjust, if necessary. the external directional control linkage.

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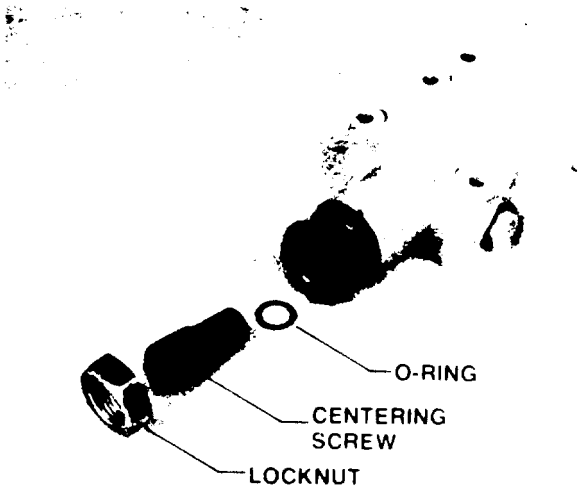

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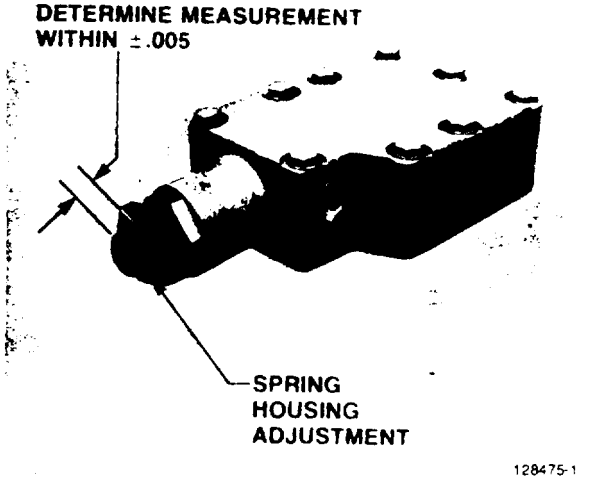


128475-1

Centering Spring

12. Holding the spring housing adjustment in place, loosen and remove the centering screw locknut. Remove the centering screw.
13. Remove the O-ring from centering screw and discard.
14. Install the centering screw, back into the control, until it just contacts the internal centering mechanism.

CAUTION

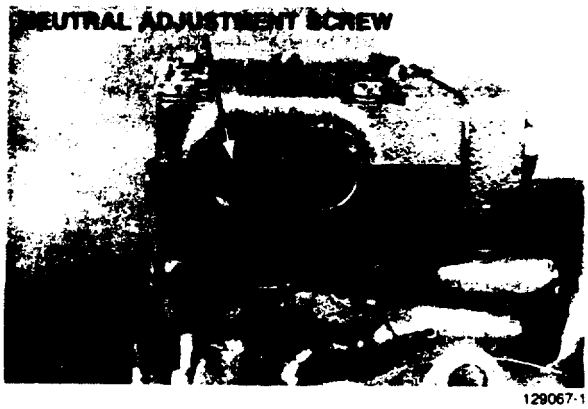
Care must be taken not to compress the internal centering spring. The centering screw should just make contact.

15. Measure accurately the distance the centering screw extends beyond the end of the spring housing adjustment.

CAUTION
Measurement must be accurate to ±.005".

16. Remove the centering screw and install a new O-ring.
17. Re-install the centering screw to the depth measured in Step 5. Install and torque centering screw locknut to 30-50 ft. lbs.
18. Repeat Steps 3 through 11 to complete the adjustment procedure.

129066



129067-1

129068-1

Hydraulic Displacement Control

The adjustment of the control may be accomplished following these procedures without voiding the pump warranty.

1. Install a 300 psi gauge into the charge pressure gauge port.
2. Using a 1" wrench, remove the neutral adjustment plug on the neck of the control.
3. Make certain the command signal console is in the neutral position (O psi command signal).

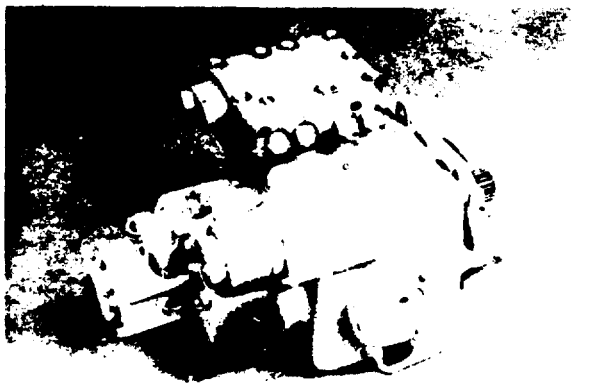
CAUTION

To adjust neutral requires operating the pump. Take necessary safety precautions. Maximum system pressure may. occur on start up. Machine may move.

4. Start prime mover and run at low idle.
5. Bleed air from the system by loosening a fitting, preferably at the highest possible point of the control system.
6. Slowly increase prime mover speed to rated RPM.
7. If transmission operates while command signal console is in neutral, reduce speed to idle. Using a 1/8" internal hex wrench, slowly turn the neutral adjustment screw clockwise (CW) or counterclockwise (CCW) until transmission does not operate. Repeat Step 6.

NOTE

Charge pressure should be approximately 200 PSI when the control is in the neutral position but will drop to approximately 180 PSI where it is in forward or reverse due to the shifting of the shuttle valve in the motor manifold.

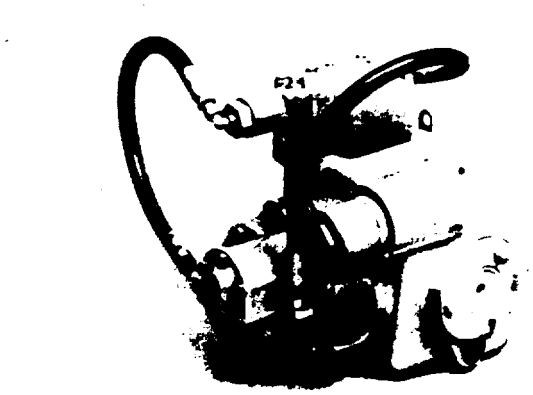


129055-1

8. With a 1/8" internal hex wrench, slowly turn the neutral adjustment screw CW until charge pressure begins to decrease. Then slowly turn the adjustment screw CCW, while counting the turns. until charge pressure decreases again (charge pressure will rise in neutral and drop when going into stroke).
9. Turn the Adjustment screw CW half the amount of turns counted. This should be the approximate center of neutral.
10. Install the hex head plug assembly and torque to 30-40 ft. lbs.

NOTE

If a motor is used which does not have a manifold, adjust neutral (Steps 8-10) by observing the motor output shaft rotation without load.



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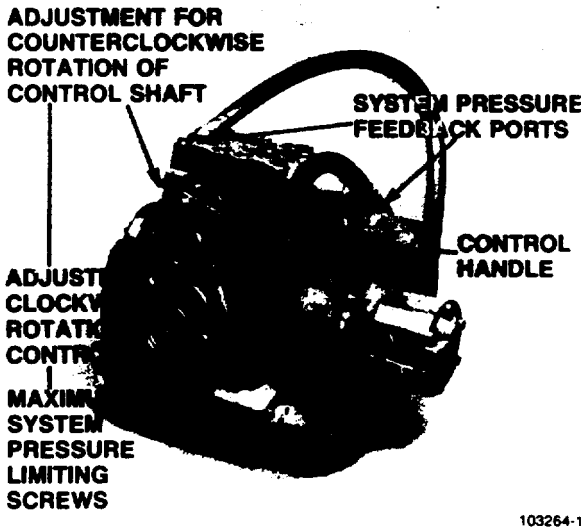

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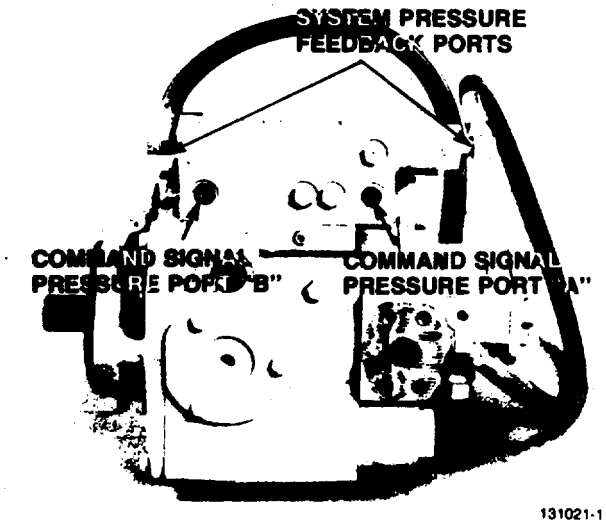

131021-1

Manual Variable Pressure Control
Maximum Pressure Adjustment

CAUTION

The following procedure requires the ability to induce a sufficient load to create maximum system pressures. Take the necessary safety precautions for your application.

1. Using appropriate adapters, tee two 10,000 PSI gauges into the system pressure feedback ports of the control.
2. Start the prime mover and slowly accelerate to rated rpm.

CAUTION

Due to linkage bias, etc. there may be system pressure created immediately upon starting the prime mover. Take the necessary safety precautions for your application.

3. Stroke the control in one direction and, using a 1/8" internal hex wrench, adjust the maximum pressure limiting screw clockwise for less pressure or , counterclockwise for more pressure until the desired pressure reading is achieved. The adjustment range is 3,000 to 5,000 PSI. Consult machine specifications for proper pressure setting. Lock the adjustment screw in place with the 7/16" hex lock nut; torque to 8-11 ft. lbs.
4. Stroke the control in the opposite direction and adjust the other maximum pressure limiting screw to achieve the desired pressure reading. Lock the adjustment screw in place.
5. Stop the prime mover, remove the gauges and adapters, and reconnect hoses to their original locations.

Hydraulic Variable Pressure Control
Maximum Pressure Adjustment

CAUTION

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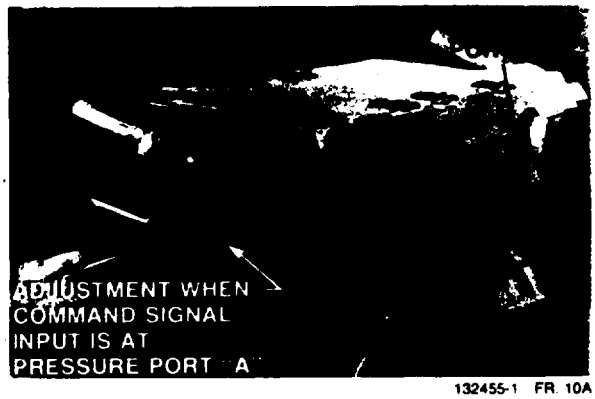
1. Using appropriate adapters, tee two 10,000 PSI gauges into the system pressure feedback ports of the control.
2. Start the prime mover and slowly accelerate to rated RPM.



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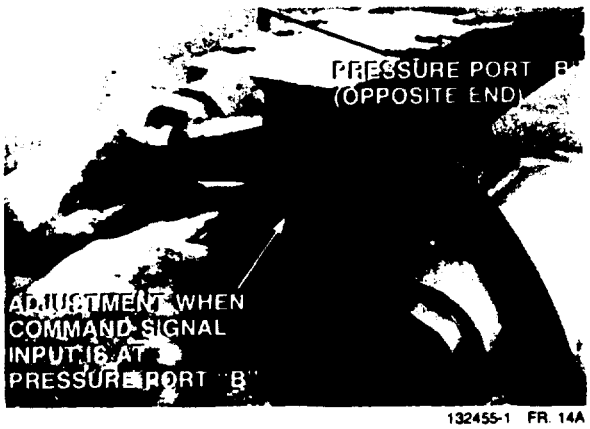

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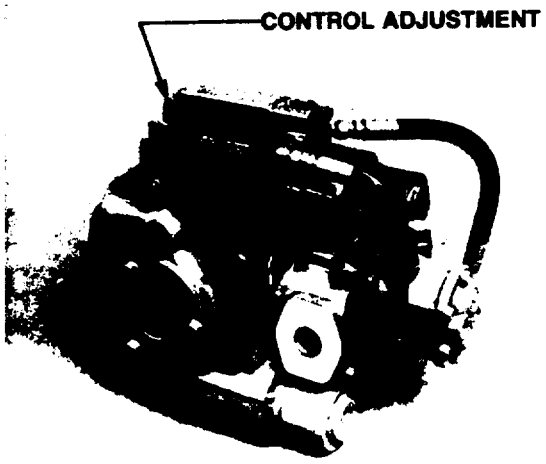


114700-3

3. Stroke the command console in the direction which supplies the command signal to port "A" on the control (see photo). Stroking the command console will activate the control and stroke the pump to create system pressure.
4. Note the pressure gauge reading. Refer to machine specifications for proper pressure setting.
5. Using a 7/16" wrench and 1/8" internal hex wrench, loosen the locknut and turn adjusting screw CW to decrease setting or CCW to increase setting. (See photo with command signal to port "A").
6. Once desired setting (shown on the pressure gauge) is obtained hold adjustment screw in place and tighten locknut.
7. To adjust the maximum pressure for the opposite direction slowly stroke the command console in the direction which supplies the command signal to port "B" on the control.
8. Follow Steps 4 through 6 above, but this time turn the adjustment screw on the opposite end of the control (see photo with command signal to port "B").
9. After adjustments have been completed, remove all gauges.

Pressure Override
Maximum Pressure Adjustment

CAUTION

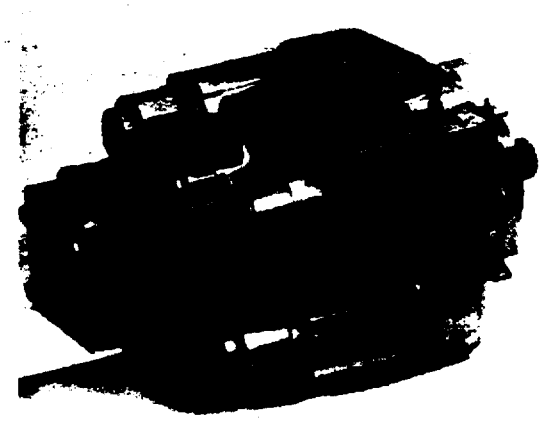
The following procedure requires the ability to induce a sufficient load to create maximum system pressures.
Take the necessary safety precautions for your application.

1. Install pressure gauge (10,000 PSI) in the system pressure gauge port located in the motor manifold (Ref.
   Troubleshooting Section). Consult machine' specifications for correct pressure setting.
2. Holding the adjustment screw in place with a 3/16" internal hex wrench, loosen the locknut (use 9/16" wrench).
3. Start the prime mover and load the system. Turn adjustment screw until desired setting is reached. The setting will vary approximately 1000 PSI per turn of screw.

NOTE

System Relief Valves in motor manifold must be set at least 1000 PSI above Pressure Override Setting.

4. Hold adjusting screw in place and torque locknut to 6-10 ft. lbs.



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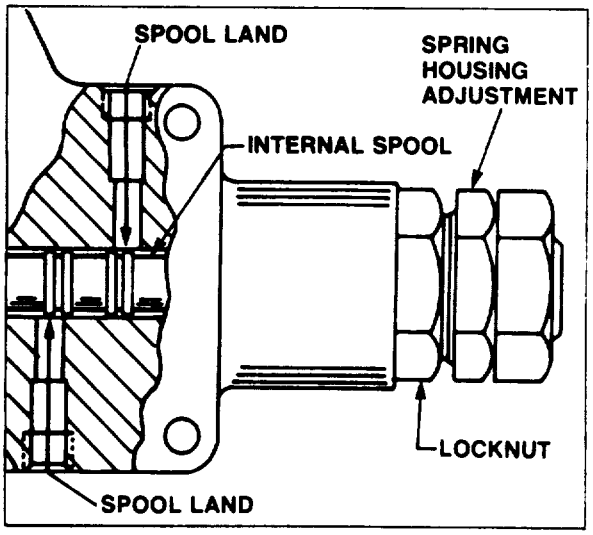


Manual Displacement Motor Control

Control Adjustment

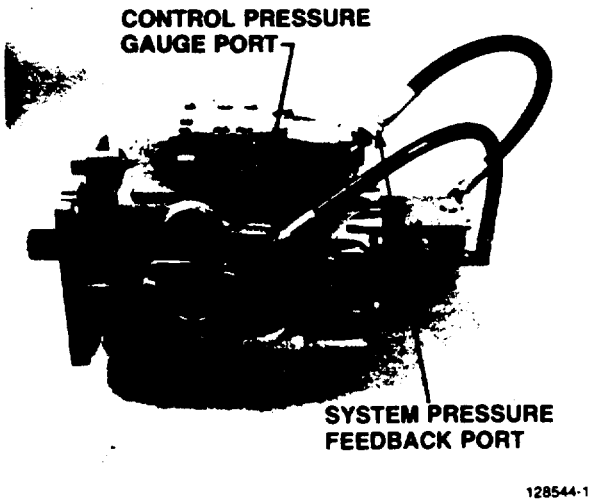
The prime mover must not be operating during the initial adjustment steps.

1. Remove the two (2) gauge port plugs and the protective cap from the control. The spool lands on the internal spool can be observed through the exposed gauge ports. Remove the external control linkage from the control handle.
2. Using a 1" wrench, loosen the spring housing locknut.

   Turn the spring housing adjustment (CW and/or CCW) until the areas between the spool lands and the ports are equal (turning this adjustment moves the spool).
3. After adjusting the spool lands in the gauge ports, turn the spring housing adjustment 900 + 150 in a CW direction.
4. Holding the adjustment in place, torque the spring housing locknut to 60-100 ft. lbs. Install two (2) gauge port plugs and torque to 10-20 ft. lbs.
5 Start the prime mover and operate at normal speed. When operating the machine, the motor should be at full displacement when the control handle is released.
6. If the control functions satisfactorily, stop the prime mover, install the protective cap and re-install (adjust if necessary) the external control linkage.
7. If the control does not function properly, follow Steps 12 through 17 from the procedure for Neutral Adjustment, Variable Displacement Pump. Then repeat Steps 1 through 6 of this procedure.

Conversion of a Pump Displacement Control for Motor Use

To convert a pump displacement control, which is properly adjusted, for use on a motor; loosen the spring housing locknut and turn the spring housing adjustment 900 + 150 in a CW direction. Hold adjustment in place and torque locknut to 60-100 ft. lbs.



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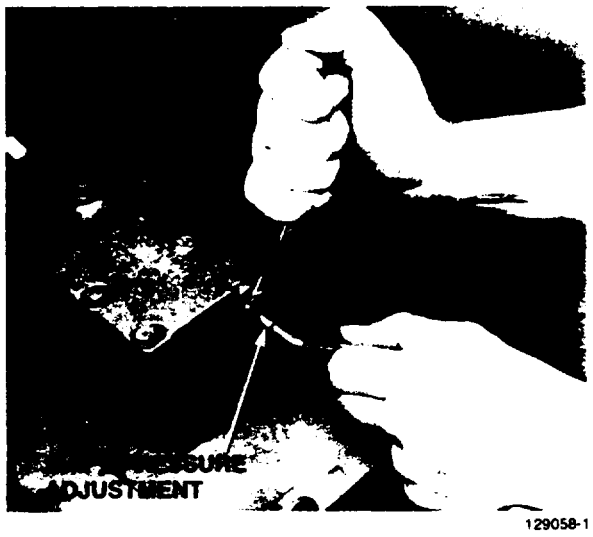


129058-1

Motor Pressure Compensator Control

Shift Pressure Adjustment

CAUTION

The following procedure requires the ability to induce a sufficient load to create maximum system pressures. Take the necessary safety precautions for your application.

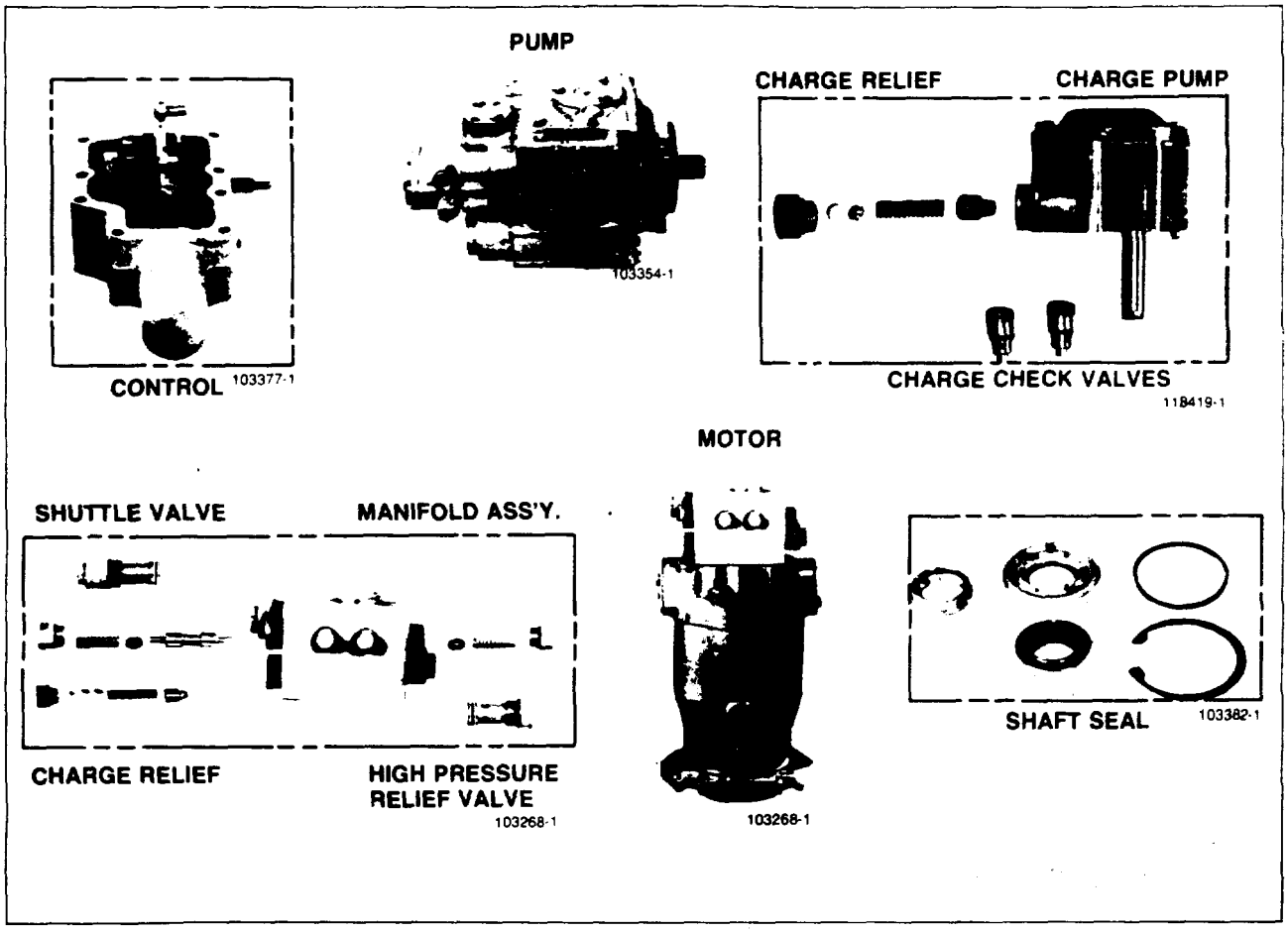
Refer to machine specifications for proper pressure setting and how to induce load.

1. Using an appropriate adapter, tee a 10,000 PSI gauge into the system pressure feedback port.
2. Install a 0-300 PSI gauge into the control pressure gauge port.
3. Start prime mover and slowly accelerate to rated RPM while leaving the pump in neutral.

CAUTION

Due to control adjustment setting bias etc., there may be system pressure created immediately upon starting the prime mover. Take the necessary safety precautions for your application.

4. The control pressure and system pressure should be reading approximately 200 PSI (charge pressure).
5. Stroke the pump control and slowly induce load on the motor to raise system pressure to the desired "shift" pressure (refer to machine specifications for proper shift pressure).
6. The control pressure should drop to a minimum pressure (approximately 25-75 PSI) at the same time the desired "shift" pressure is reached.
7. If the control pressure drops before the desired shift pressure is obtained, loosen the adjustment screw locknut with a 1/2" wrench and using a 5/32" internal hex wrench, turn the adjustment screw CW to obtain desired shift pressure.
8. If desired shift pressure is obtained before control pressure drops, turn the adjustment screw CCW to obtain desired proper shift pressure.
9. Stop the prime mover, remove the gauges and adaptors, and reconnect the feedback hose to the original location.



Introduction

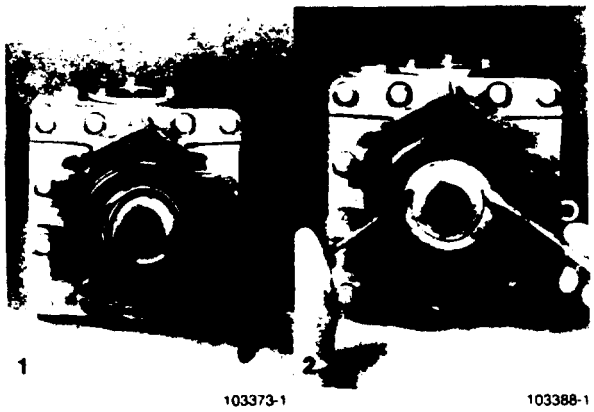
The areas of repair indicated are classed as minor repairs and may be performed, following the procedures in this section, without voiding the unit warranty. Although specific units are illustrated, these procedures apply to all series and types of units in the Heavy Duty Family.

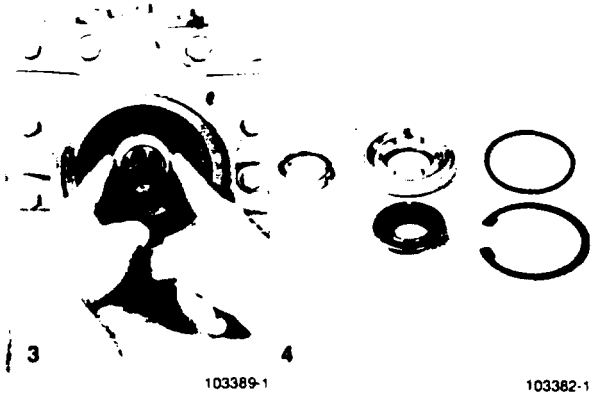
General

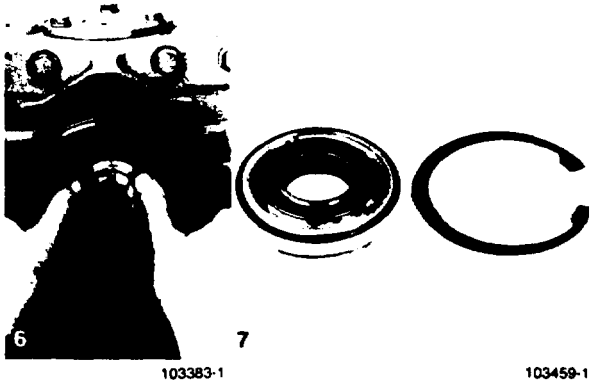
Cleanliness is a primary means of insuring satisfactory transmission life, on either new or repaired units. Cleaning parts by using a solvent wash and air drying is adequate, providing clean solvent is used. As with any precision equipment, the internal mechanism and related items must be kept free of foreign materials and chemicals.

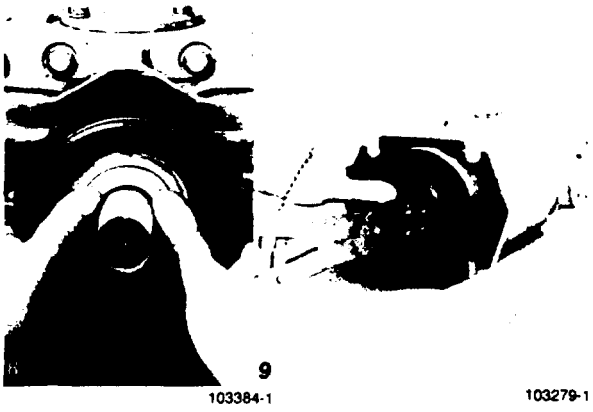
Protect all exposed sealing surfaces and open cavities from damage and foreign material.

It is recommended that all gaskets and O-rings be replaced. All gasket sealing surfaces must be cleaned prior to installing new gasket. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.









Shaft Seal

It is recommended that all shaft seal parts be replaced. If parts are to be reused, they must be protected from being damaged by the shaft during removal.

1. Remove the large retaining ring (Truarc #7 Retaining Ring Pliers) located on the shaft end of the unit. Remove side opposite the tangs from the groove first.
2. The aluminum housing is removed next. It is held in place by the friction of the O-ring on its O.D. Pry the housing toward the end of the shaft until the O-ring is free.
3. The bronze sealing ring is also held in place by internal O-ring friction. Using hand force only, work this part free and carefully slide it over the shaft.

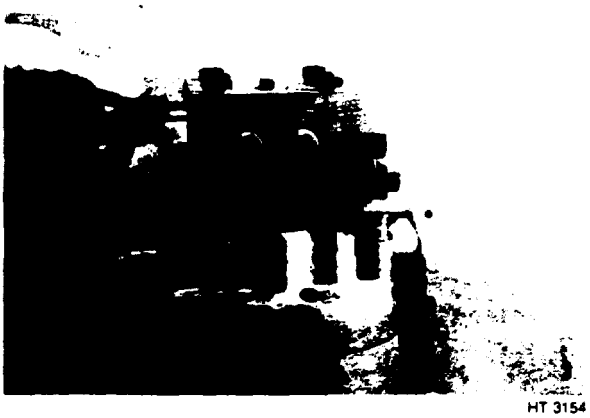
CAUTION

This part is easily damaged. Use care in handling.

4. Each part should be inspected separately if parts are to be reused. Always replace the three (3) O-rings.
5. Prior to assembly, lubricate the small O-ring with petroleum jelly and insert into the I.D. of the bronze sealing ring. Insert the other small 0-ring (lubricate) and insert into the aluminum housing.
6. Slide the bronze sealing ring over the shaft and onto the shaft pilot diameter with the O-ring facing the unit. Work the O-ring into place using hand force only until it snaps into place.

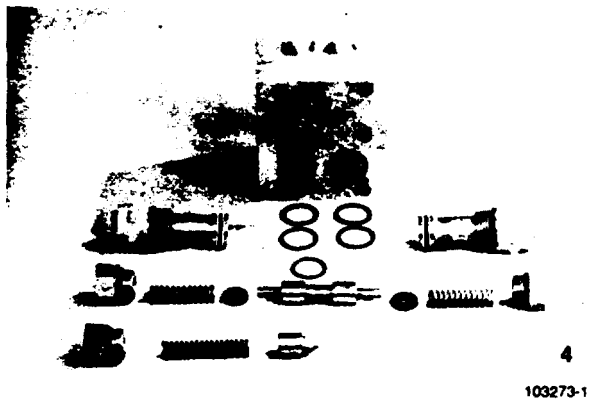
CAUTION
Protect parts from damage by the shaft.

7. Insert the stationary seal pilot into the aluminum housing, locating the notch in the stationary seal over the pin in the housing. Lubricate the large O-ring and place on the housing. The stationary seal should have a slight spring load due to the springs in the housing. Make certain all six (6) springs are in place in the aluminum housing before sliding it into position.
8. Slide the aluminum housing into place against the bronze sealing ring using hand force only.
9. Compress the aluminum housing to expose the retaining ring groove. Install the retaining ring, with the beveled side out, putting the side opposite the tangs into the groove first. Be certain that the retaining ring has snapped into its groove completely.


HT 3154


HT 3153


HT 3158



103273-1

Manifold Assembly Components

System Relief Valve

1. The System Relief Valves are cartridges that can be removed from the manifold (using 1 3/8" wrench) for inspection or replacement. These valves are interchangeable in either side of the manifold, providing the pressure settings are the same. The first two (2) digits of the pressure setting are stamped on the end of the valve.

CAUTION

The relief valves are factory set and should not be disassembled further.

When replacing, torque the cartridge to 30- 70 ft. lbs.

Shuttle Valve

2. The Shuttle Valve can be removed for inspection by removing the two (2) hex plugs (using 1" wrench) and sliding out the springs, spacers. and spool. These parts are interchangeable and can be installed from either side. When assembling be certain the spacers are placed between the spool and springs. Torque the hex plugs to 60-100 ft. lbs.

NOTE:

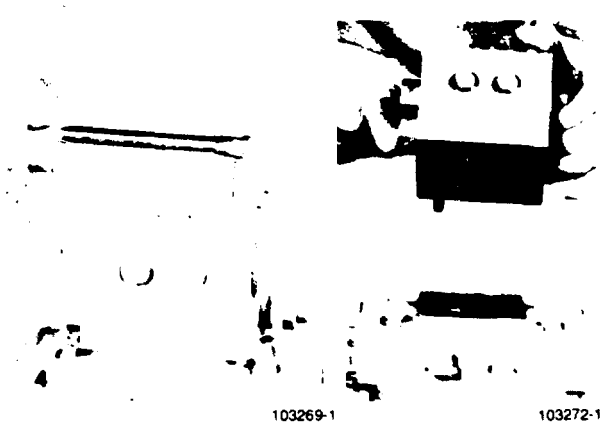
The spool and manifold are matched and cannot be replaced separately.

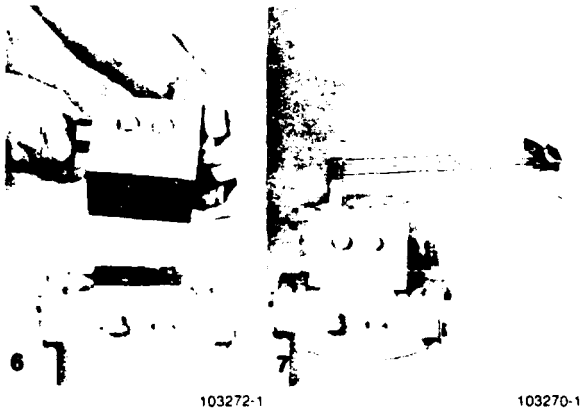
Charge Relief Valve

3. To inspect or replace the Charge Relief Valve, remove the hex plug (use 1" wrench) and the spring and poppet.

   Remove the shims from the counter bore of the plug. Do not alter these shims unless new parts are used, in which case adjusting the valve setting, by shimming, is necessary. To install, insert the poppet, spring, shims and plug. Be certain the shims are in place in the plug.

   Torque to 60-100 ft. lbs.





Motor Manifold

Manifold Removal

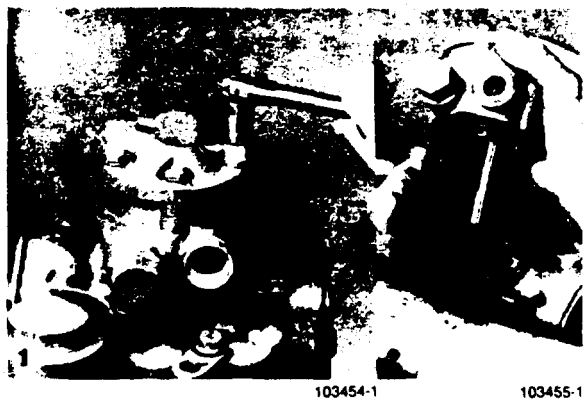
4. Remove the six (6) cap screws (use 1/2" wrench).
5. Lift the manifold off the motor end cap. The three (3) ports are sealed with O-rings. The two (2) ports adjacent to each other also have back-up rings on top of the O-rings. These back-up rings have a rectangular cross section and are slightly cupped where they mate with the O-rings.

Manifold Installation

6. Place the O-ring in the port with the full counter bore. The O-rings and back-up rings fit in the ports with machined grooves. The O-rings should be installed first and then the back-up rings with the cupped side toward the O-ring.
7. Install manifold on end cap being certain the O-rings and back-up rings remain in place. Torque cap screws to 16-21 ft. lbs.

Charge Pump and Charge Check Valves

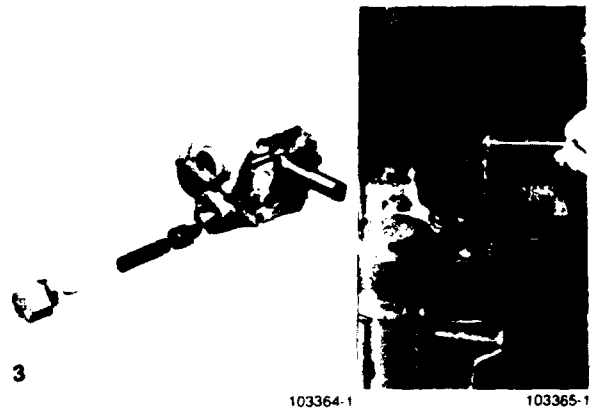
Removal

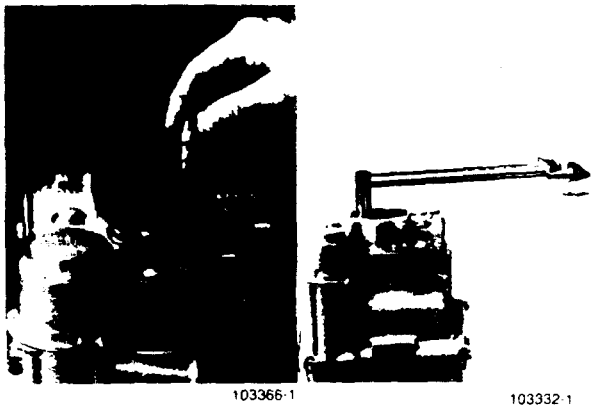


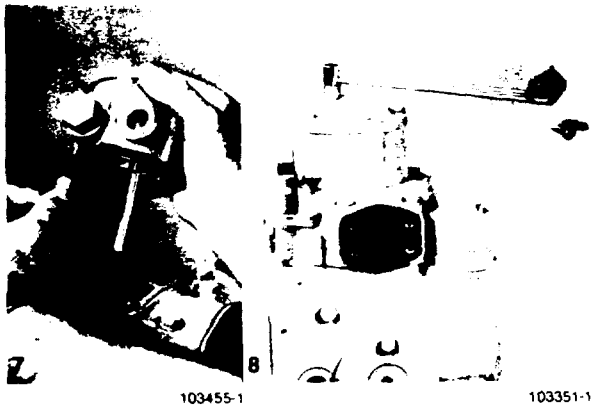
1. To remove the Charge Pump, loosen the four (4) cap screws that form a rectangular pattern. Do not remove the screws at the top and bottom as these hold the segments of the pump together.

CAUTION
Protect exposed surfaces and cavities from damage and foreign material.

2. Lift the Charge Pump off the pump end cap. There is a spacer in the idler shaft bore that can slip out as the pump is removed. Do not allow it to fall into the main pump. There is a gasket between the Charge Pump and end cap that should be discarded.







3. To inspect or replace the Charge Relief Valve, use a 1" wrench to remove the hex plug and the spring and poppet. Remove the shims from the counter bore of the plug. Do not alter these shims unless new parts are used, in which case adjusting the valve setting, by shimming. is necessary To install. insert poppet. spring, shims and plug Be certain shims are in place in plug. Torque to 30-60 ft. lbs.

4. The removal of the Charge Check Valves requires the use of a draglink socket These check valves are cartridges which are threaded into the end cap.

Installation

5. The Charge Check Valves are interchangeable with each other. It is suggested that they be replaced in pairs. Use caution when installing these valves to prevent damage to the O-ring on the cartridge as it is inserted past the threads in the end cap.

6. After assembly, be certain the check valves are below the surface of the end cap. Torque check valves as follows:

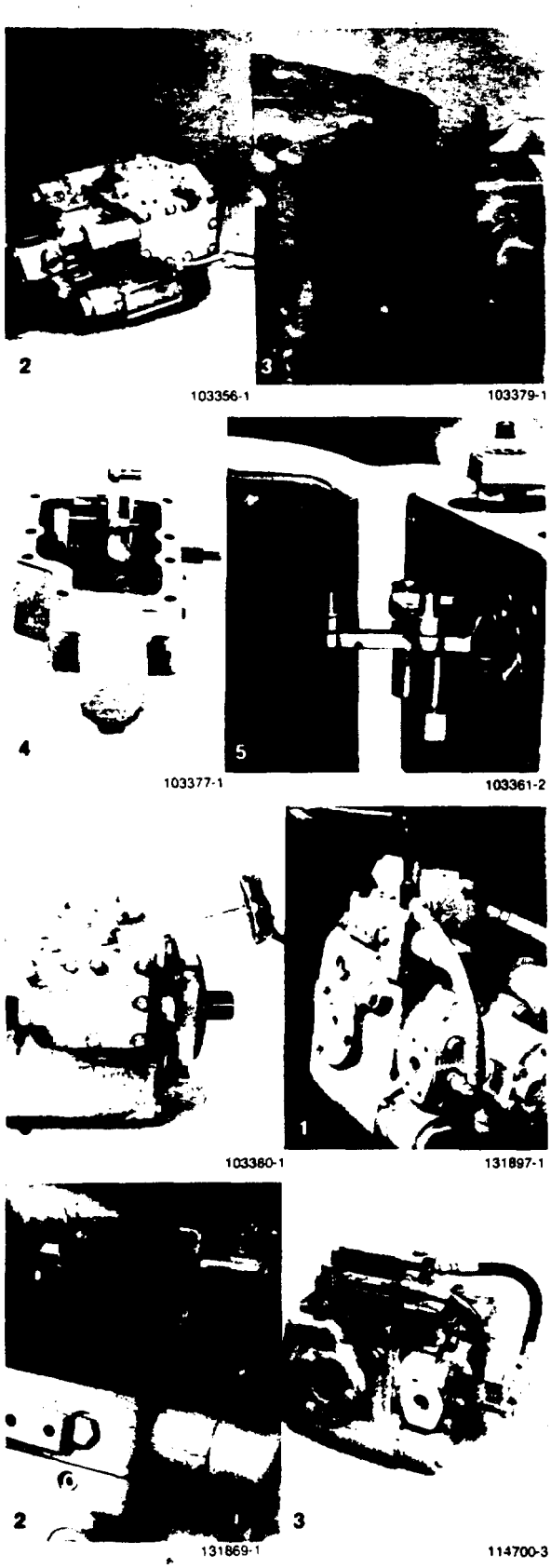
   20-23 Series to 30-40 ft lbs
   24 Series to 80-90 ft. lbs.
   25-27 Series to 125-135 ft lbs

7. When installing the Charge Pump, align the new gasket so that the small relief valve port is open. Be certain the port in the charge pump and the end cap are aligned. Rotate the charge pump shaft so its tang aligns approximately with the slot in the end of the main pump drive shaft Hold the idler spacer in place and install the charge pump onto the end cap. Rotate the pump slightly until the tang and slot on the shafts engage and the pump is solidly on the end cap.
8. Insert the four (4) cap screws and torque to these values:

   20-23 Series to 10-11 ft. lbs.
   24-27 Series 27-37 ft. lbs.

CAUTION

When reinstalling the vacuum inlet hose on the charge pump, do not tighten to more than 14 to 21 ft. lbs. torque.



Control
Removal

1. Thoroughly clean external surfaces with steam or clean solvent and blow dry.
2. Remove the nine (9) cap screws (using 7/16" wrench) and swing control away from housing.

CAUTION

Protect exposed surfaces and cavities from damage and foreign material. Use caution so that the rings and orifice plate remain in place and do not fall into the pump housing.

3. Slip the pin on control linkage out of the link attached to the swashplate and remove control. The area is seated with both a gasket and three (3) O-rings. The Variable Pressure Control does not have a linkage to disengage.

Installation

4. In preparation for installing the control, place a new gasket on the housing. Insert the orifice plate and three (3) O-rings into the control ports.
5. Engage the pin on the control linkage in the mating hole in the link attached to the swashplate. Use caution so that the O-rings and orifice plate remain in place and do not fall into the pump housing.
6. Swing the control into place against the pump housing. Install cap screws and torque to 10-11 ft. lbs.

IMPORTANT: If the control being removed or replaced is equipped with a .neutral start switch, accomplish the "Neutral Start Switch Check procedure on page 33 following control installation.

Pressure Override
Removal

1. If a Pressure Override is mounted on top of the Manual Displacement Control, it can be removed by disconnecting the two (2) hose lines and removing its six (6) cap screws (use 7 16" wrench). Lift the Pressure Override from the control. This will expose the three (3) remaining cap screws which hold the Standard Displacement Control in place.
2. The Pressure Override seals with four (4) O-rings. Protect the exposed surfaces.

Installation

3. With the four (4) O-rings in place. install the Pressure Override on the control valve. Insert the six (6) cap screws and torque to 10-1I1 ft. lbs. Connect and tighten the two (2) hose fittings.

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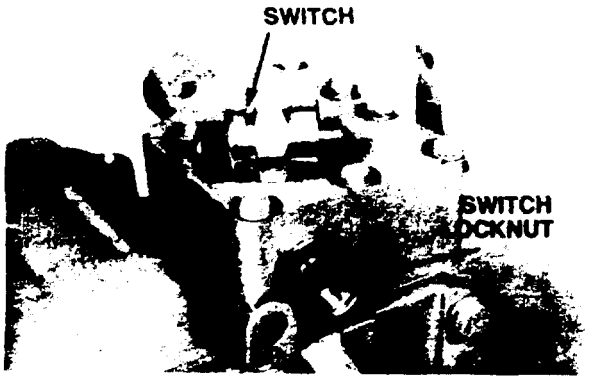

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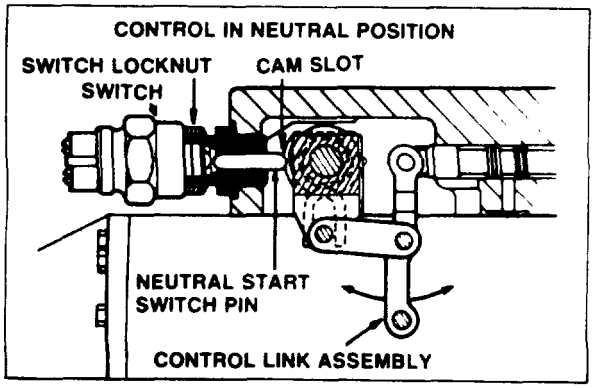

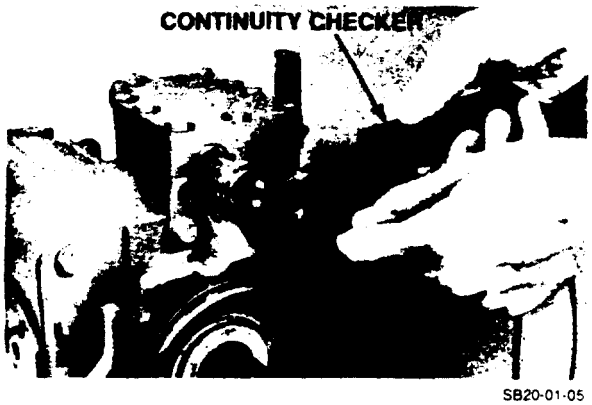

SB20-01-05

Neutral Start Switch Replacement

Removal/Installation

Replacement of the neutral start switch may be accomplished with the control on the machine providing a space of .38 in. (9.65 mm) is available for switch removal.

CAUTION

Do not disturb any locknuts or adjustments on the Neutral Start Switch other than those described in these procedures. Disturbing other components may result in the prime mover starting In other than the neutral (0 flow) position. If other adjustments are disturbed during replacement, accomplish the "Neutral Start Switch Check" procedure on the following page.

1. Holding the switch in place with a 1/Be" wrench, loosen the locknut with a 7/9" wrench.

CAUTION

Do not turn the switch when loosening the locknut. Turning the switch may change other critical switch adjustments.

2. After the locknut is loose, remove the switch by turning the switch CCW.
3. Install the new switch by turning the switch clockwise until finger tight. Leave the locknut loose.

Switch Adjustment

1. Make certain control is in the neutral position. If the switch is being replaced with the control removed from the unit, neutral can be verified by rotating the control link assembly until the Neutral Start Switch pin is engaged in the slot on the cam assembly.
2. Attach a continuity checker to the two screws on the end of the switch.
3. With the control in the neutral position, turn the switch CCW until electrical continuity is obtained. Turn switch CCW an additional 1/8 turn after continuity has been obtained.
4. Holding the switch in place with a 1 1/8" wrench, tighten the locknut with a 7/8" wrench.
5. With the continuity checker attached to the switch, rotate the control lever (or the control link) in each direction to assure continuity is broken when the control is not in the neutral position.

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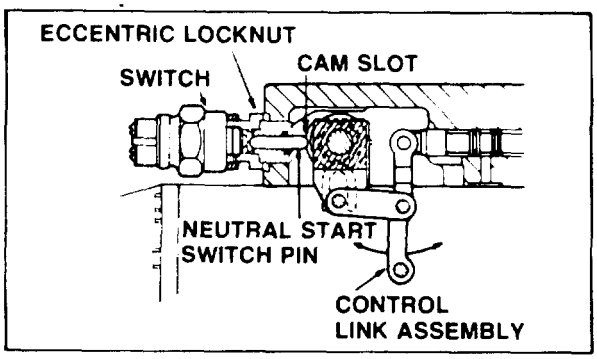
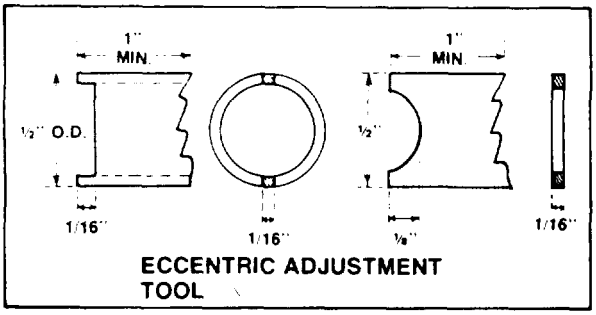
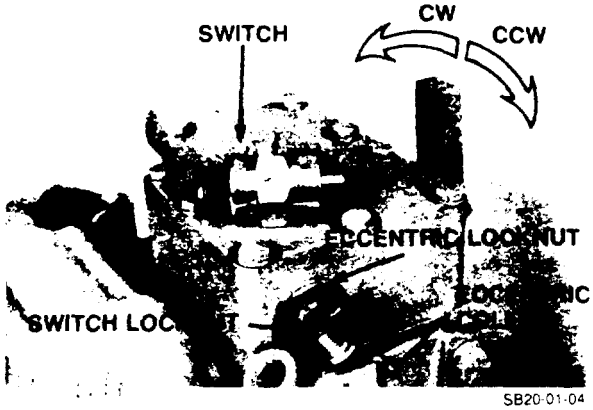






SB20-01-04

NEUTRAL START SWITCH CHECK

Proper switch operation must be checked prior to installing the external control linkage.

1. Install a 300 PSI gauge into the pressure gauge port on each side of the control 7/16"-12 str. thd. O-ring).
2. Connect a continuity checker to the screws on the end of the neutral start switch.
3. Make certain the control is in neutral (zero flow) position. Electrical continuity should now be attained; verify by observing the continuity checker.

   For the switch to operate properly and continuity to be established, a pin located in the switch mounting collar must engage in a cam slot in the internal control mechanism. When the control handle is moved in either direction, the pin comes out of the slot and actuates the switch to interrupt the circuit. The continuity should be interrupted with an equal amount of handle rotation in both directions. If the continuity is attained in neutral and satisfactorily interrupted in each direction, proceed to step 8.

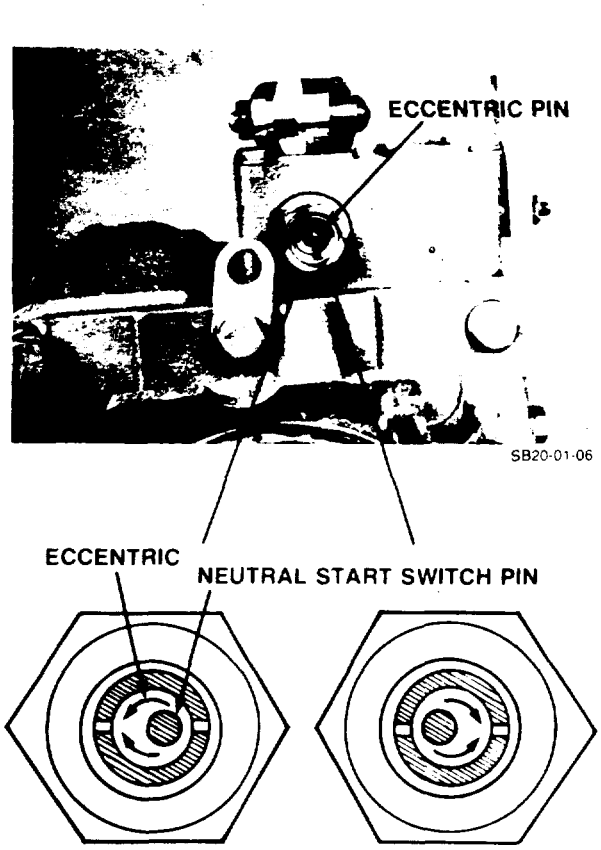
4. If continuity can not be verified in neutral, determine the direction of handle rotation (CW or CCW) necessary to establish continuity.

   The pin which engages in the slot is mounted in an eccentric which allows for adjustment. It is recommended that an adjustment tool be constructed to the dimensions shown at left for rotation of the eccentric.

   While holding the switch, loosen the switch locknut and remove the neutral start switch. Note the slotted eccentric adjustment within the switch collar. Loosen the eccentric locknut while holding the eccentric in place with the adjustment tool.

CAUTION

Do not start the prime mover while the neutral start switch is removed from the control. Damage to the control will result.



Adjust eccentric to move pin toward pump or away from pump as required.

5. If it was necessary to rotate the control handle clockwise to obtain continuity, turn the eccentric adjustment to move the pin down (or toward the pump). If a counterclockwise rotation of the handle was necessary to obtain continuity, rotate the eccentric to move the pin up (or away from the pump). Only a small amount of adjustment in either direction is needed to center the pin in the internal mechanism cam slot.

   Turn the eccentric a maximum of 14 of a turn while frequently stopping to check maximum pin depth into the eccentric collar. In most cases it can be determined that the pin has engaged in the slot, either by feel or depth gauge. within the first 1/4 turn.

6. While holding the eccentric in place, tighten eccentric locknut to 20-35 ft. lbs. Reinstall the switch as outlined in the Neutral Start Switch replacement and adjustment portion of this manual.

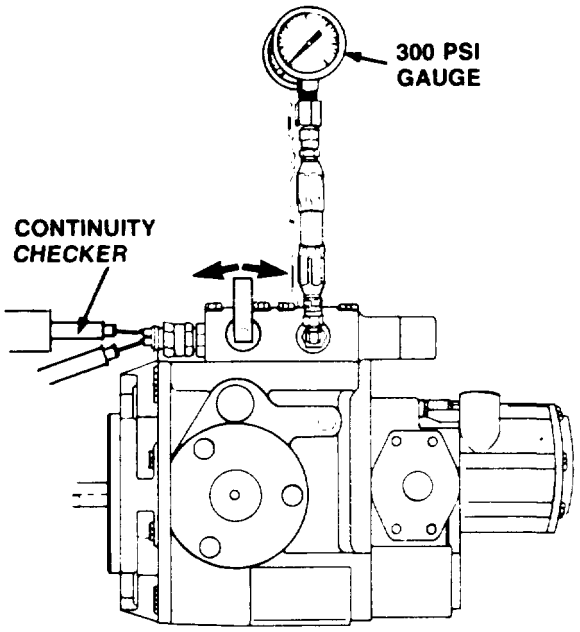
7. Repeat steps 3 and 4 to determine whether additional adjustment of the eccentric is necessary.

   If further adjustment is required, continue rotation up to 1,4 additional turn.

CAUTION

Do not exceed 1/2 turn total or 1800 from the initial pin position. Doing so will turn the eccentric into or out of the housing beyond specifications.

If too much adjustment was made, turn the eccentric 1/8 turn in the opposite direction.
Again, install the switch and check for continuity.



CAUTION

The following procedure requires that steps be taken to disable the machine in the event the pump should go into stroke (raise drive wheels off ground, etc.).

8. Connect the electrical leads from the machine starter relay to the electrical connections on the switch.

9. Start the prime mover and operate at normal speed.

10. Note pressure reading on the gauges at this time. The reading should be noted as base pressure.

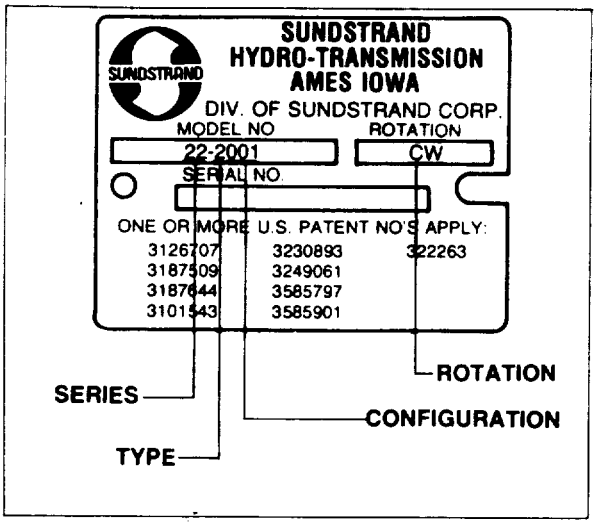
11. Slowly move the control handle in one direction while observing the pressure gauge and the continuity checker. Continuity must be broken before the gauge pressure increases more than 12 PSI from the base pressure obtained at neutral.

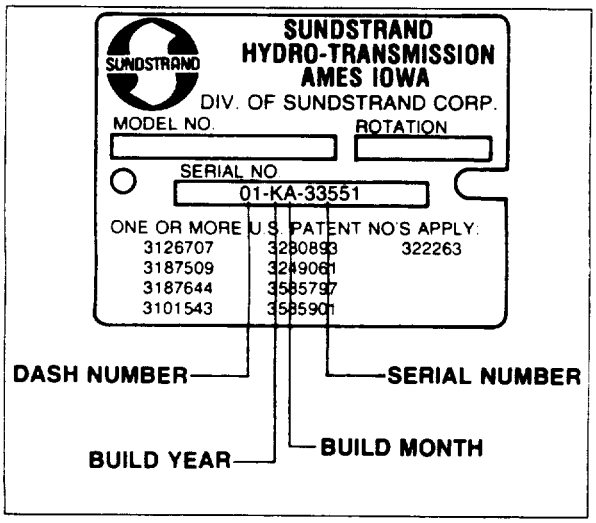
12. Slowly move the control handle in the opposite direction. Again, continuity must be broken before the gauge pressure increases more than 12 PSI from base pressure.

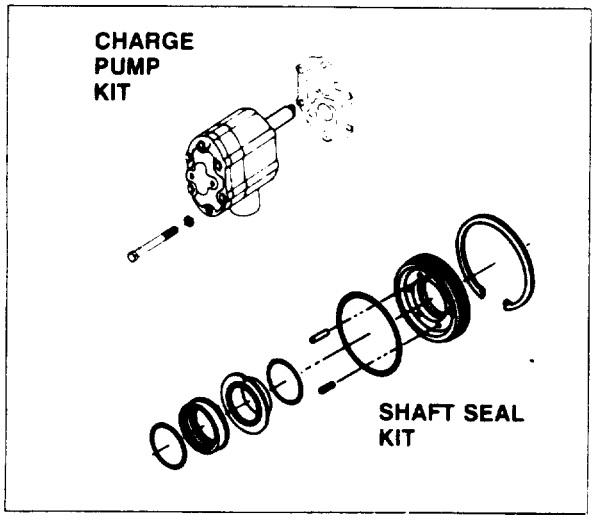
13. Continuity must again be verified when the control is returned to neutral.

    If continuity is not broken at base pressure +0-12 PSI in either direction, stop the prime mover and readjust the eccentric as described in step 5. If the pressure difference is equal in each direction but greater than 12 PSI loosen the switch locknut and turn the switch in 1/16 of a turn to increase the sensitivity. Retighten the locknut and recheck pressure differences and continuity.

14. After verifying proper control and switch operation, stop the prime mover. Remove the continuity checker and pressure gauges. Install pressure port plugs and torque to 10-20 ft. lbs. Install and adjust, if necessary, the external control linkage.







Model Number

The Sundstrand Model Number is necessary for identification of the specific unit. The Model Number must be used when ordering Parts Lists which contain specific part numbers.

The first two (2) digits identify the series (20 through 27 Series).

The next digit identifies the unit type.

2 = Variable Displacement Pump
3 = Fixed Displacement Motor
4 = Variable Displacement Motor

The last three (3) digits specifically identify such items as control, shaft, pressure settings, rotation, etc., in the records maintained by Sundstrand.

Serial Number

The Sundstrand Serial Number can be used to identify design configuration, build date, and units sequence in build.

The first two (2) digits are termed the dash number and are used to identify significant configuration changes (product improvements, etc.). Changes which affect interchangeability of parts are identified with a dash number change.
The Serial Number provides Sundstrand with a tool to further identify a unit and should be included in communications regarding the servicing of the unit.

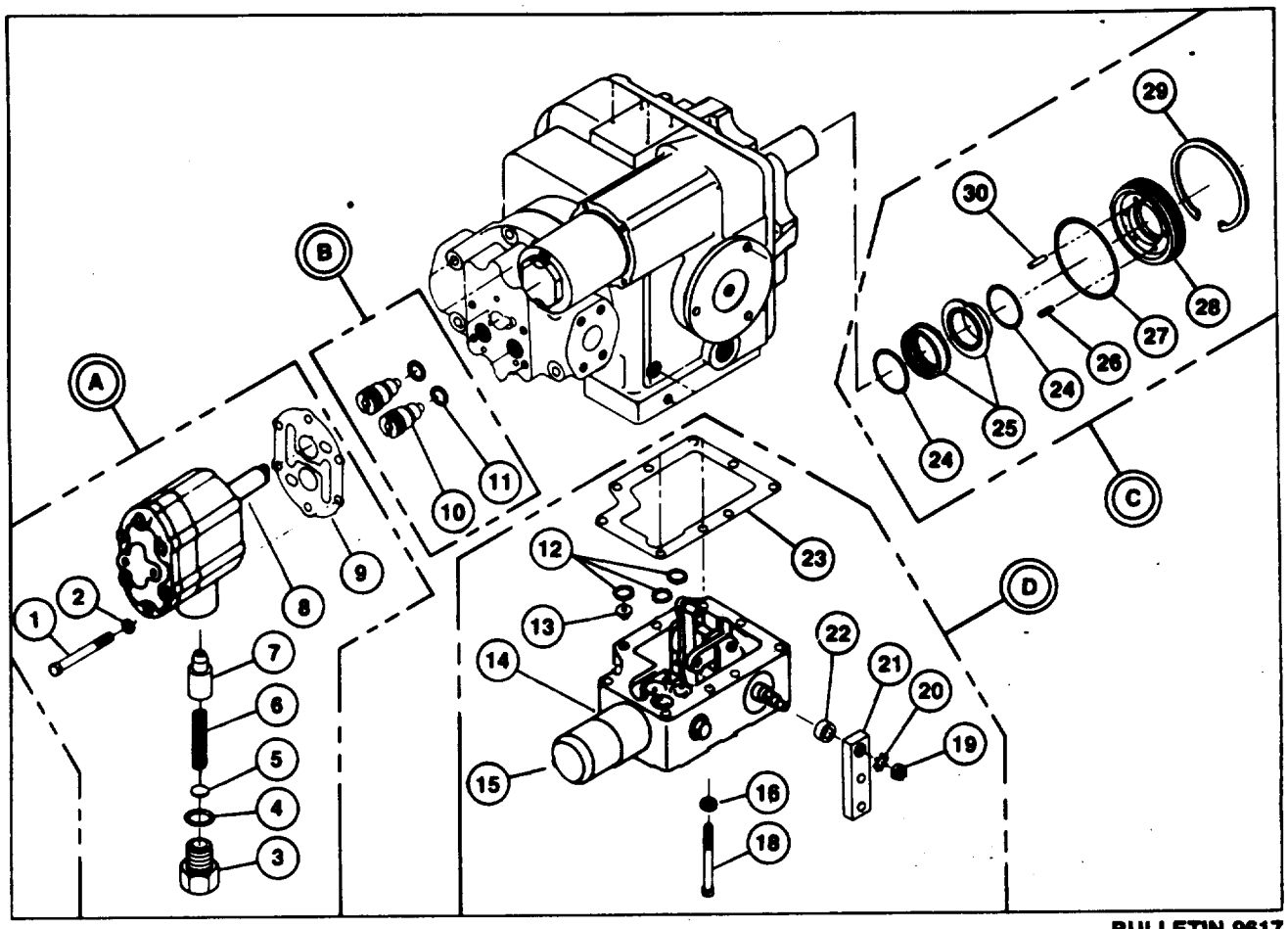
Parts Kits

Parts kits are available from Sundstrand which contain all the parts necessary for replacement. The following kits are available, see parts list for specific model parts lists for kit numbers.

Charge Pump	Manifold
Shaft Seal	Control

Other kits are available on specific models.

Sundstrand Hydro-Transmission
AMES, IOWA, USA 50010
unit of Sundstrand Corporation

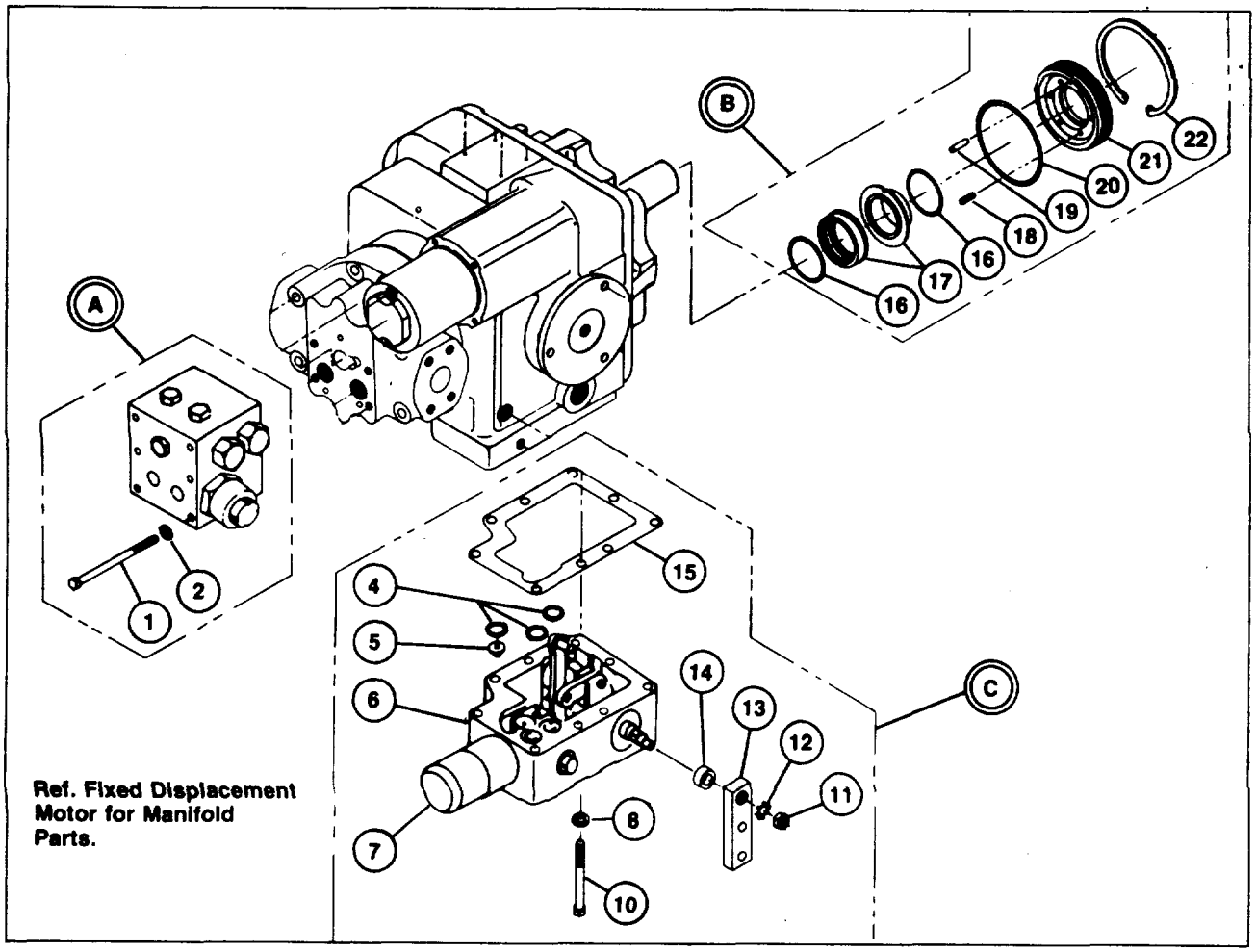


BULLETIN 9617

This information is for general parts identification only.
For part numbers consult Parts List for specific model number.

Variable Displacement Pump

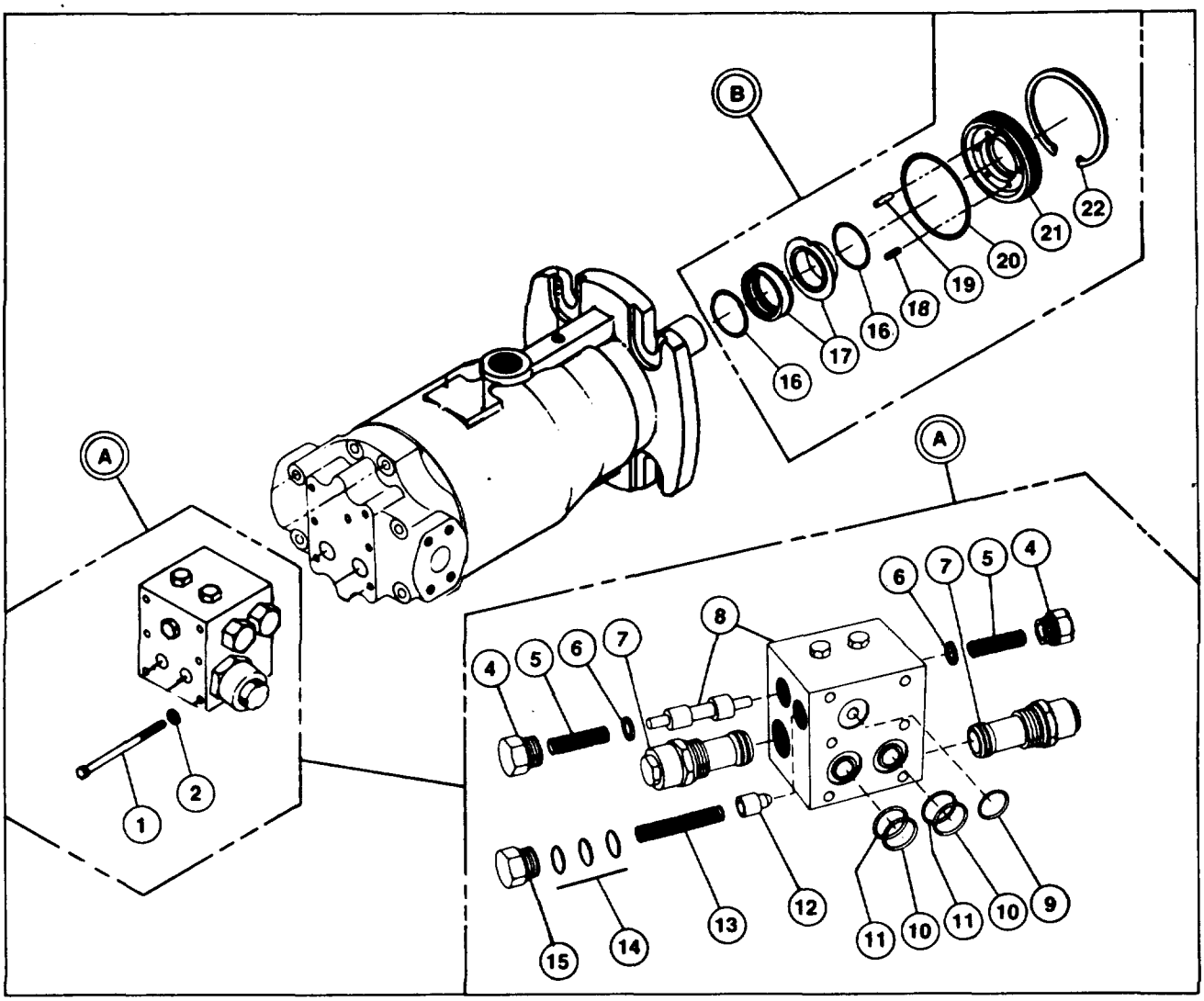
NO/LTR	DESCRIPTION	QTY	NO/LTR	DESCRIPTION	QTY
A	Charge Pump Kit	1	14	Control	1
B	Charge Check Valve Kit (2 Valves)	1	15	Protective Cap	1
C	Shaft Seal Kit	1	16	Washer - Lock	9
D	Control Kit	4	18	Screw - Hex. Hd. Cap	
1	Screw - Hex. Hd. Cap	4	19	Nut - Hex.	1
2	Washer - Lock	1	20	Washer- Lock	1
3	Plug - Hex	1	21	Control Handle	1
4	O-ring	1	22	Spacer	1
5	Shim Package	1	23	Gasket	1
6	Spring	1	24	O-Ring	2
7	Poppet	1	25	Sealing Ring and Stationary Seal	1
8	Charge Pump	1	26	Spring	6
9	Gasket	2	27	O-Ring	1
10	Charge Check Valve	2	28	Aluminum Housing	1
11	O-Ring	3	29	Retaining Ring	1
12	O-Ring	1	30	Spring Pin	1
13	Orifice				



This information is for general parts identification only.
For part numbers consult Parts List for specific model number.

Variable Displacement Motor

NO/LTR	DESCRIPTION	QTY	NO/LTR	DESCRIPTION	QTY
A	Manifold Kit	1	12	Nut - Hex	1
B	Shaft Seal Kit	1	13	Control Handle	1
C	Control Kit	1	14	Spacer	1
1	Screw - Hed. Hd. Cap	6	15	Gasket	1
2	Washer - Lock	6	16	O-Ring	2
4	O-Ring	3	17	Sealing Ring &	
5	Orifice	1		Stationary Seal	1
6	Control	1	18	Spring	6
7	Protective Cap	1	19	Spring Pin	1
8	Washer- Lock	9	20	O-Ring	1
10	Screw - Hex. Hd. Cap		21	Aluminum Housing	1
11	Screw - Hex. Hd. Cap	1	22	Retaining Ring	1



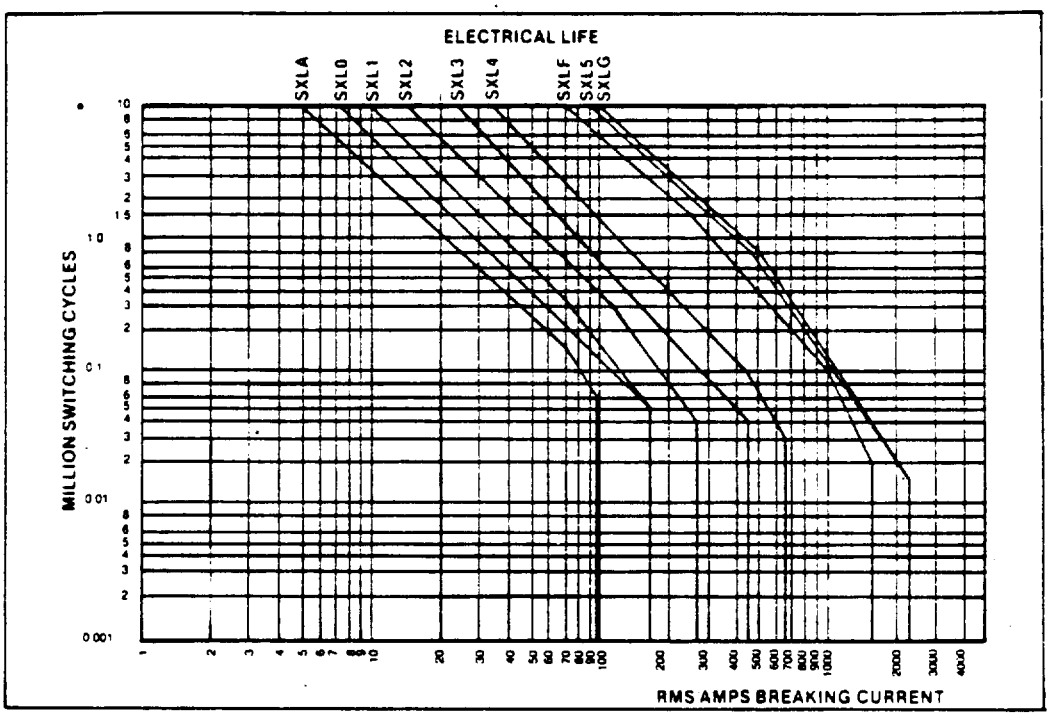
This information is for general parts identification only.
For part numbers consult Parts List for specific model number.

Fixed Displacement Motor

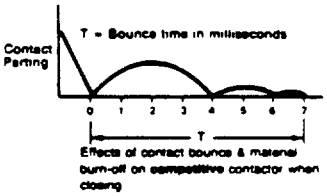
NO/LTR	DESCRIPTION	QTY	NO/LTR	DESCRIPTION	QTY
A	Manifold Kit	1	11	O-Ring	2
B	Shaft Seal Kit	1	12	Poppet	1
1	Screw- Hex. Hd. Cap	6	13	Spring	1
2	Washer - Lock	6	14	Shim Package	1
4	Hex. Plug (w/O-Ring)	2	15	Hex. Plug (w/O-Ring)	1
5	Spring	2	16	O-Ring	2
6	Spacer	2	17	Sealing Ring & Stationary Seal	1
7	System Relief Valve	2	18	Spring	6
8	Housing & Shuttle Valve Spool	1	19	Spring Pin	1
9	O-Ring	1	20	O-Ring	1
10	Back-up Ring	2	21	Aluminum Housing	1
			22	Retaining Ring	1

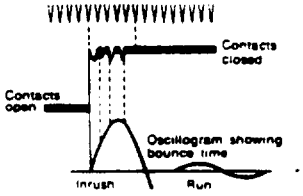
TORQUE VALUES			PRESSURES (Pressure Settings and Troubleshooting Gauges)		
150 in. lbs.	-	17 N•m			
	-		25-75 PSI	-	1.7-5 BAR
6-10 ft. lbs.	-	8-13.5 N•m	40 PSI	-	2.7 BAR
8-11 ft. lbs.	-	11-15 N•m	160 PSI	-	11 BAR
10-11 ft. lbs.	-	13.5-15 N•m	180 PSI	-	12.5 BAR
10-20 ft. lbs.	-	13.5-27 N•m	190 PSI	-	13 BAR
16-21ft. lbs.	-	22-28 N•m	200 PSI	-	14 BAR
20-30 ft. lbs.	-	27-40 N•m	210 PSI	-	15 BAR
27-37 ft. lbs.	-	36-50 N•m	300 PSI	-	20 BAR
30-40 ft. lbs.	-	40-54 N•m	500 PSI	-	35 BAR
30-50 ft. lbs.	-	40-68 N•m	1000 PSI	-	69 BAR
60-100 ft. lbs.	-	81-136 N•m	3000 PSI	-	207 BAR
80-90 ft. lbs.	-	108-122 N•m	5000 PSI	-	345 BAR
125-135 ft. lbs.	-	169-183 N•m	10,000 PSI	-	690 BAR

Contactor Information

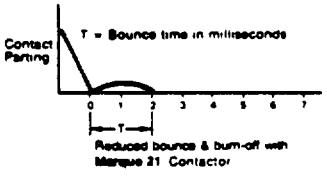


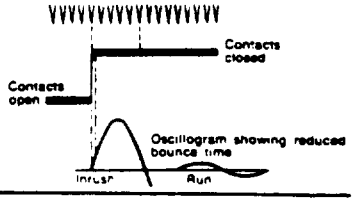
COMPETITIVE BOUNCE TIME





RQ21 BOUNCE TIME

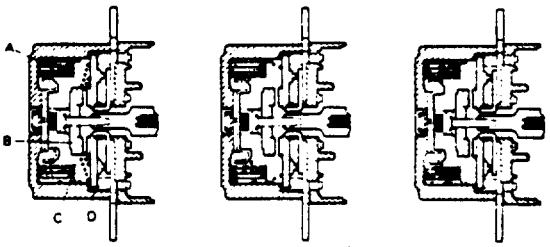




RQ21 ARC QUENCHING

Showing arc quenching. The unique shape of the contact carries the arc from the contact tips to the arc splitter size 3 and larger

A. Splitter plates
B. Movable contact bridge
C. Arcing contact
D. Stationary contact carrier

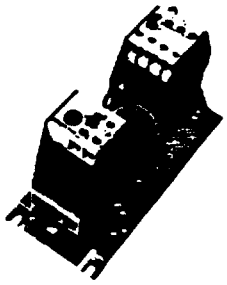


NEMA SIZE		00	0	1	2	3		4½
Mechanical Life in Operations		15 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil
Power Consumption of Coil	Inrush VA	76	76	76	194	365	530	1060
	Sealed VA	10.5	10.5	10.5	21	35	40	79
Ambient Temp Range °C		-25 + 50C	-25 + 50C	-25 + 50C	-25 + 50C	-25 + 50C	-25 + 50C	-25 + 50C
Terminal Wire Size		14-8 AWG	14-6 AWG	14-6 AWG	10-4 AWG	8-3/0	8-3/0	(1) 500 MCM

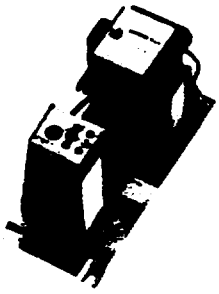
RQ21 Non-Reversing Starters

Sizes 00-5 1//2

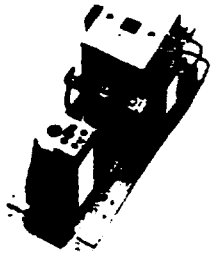
Ordering Information



SIZE 00
CLOSE COUPLED OLR AVAILABLE



SIZE 1
CLOSE COUPLED OLR AVAILABLE



SIZE 2

STARTER DATA		MOTOR DATA		OLR TYPE INTEGRALLY HEATED OVERLOAD RELAYS ② ④ — LIST PRICE INCLUDES HEATERS							
				OPEN TYPE		NEMA 1 ENCLOSED		NEMA 4 ENCLOSED		NEMA 12 ENCLOSED	
SIZE ② ③	COIL ⑨ VOLTAGE	MAX H P	MOTOR VOLTAGE	CATALOG NO	LIST PRICE	CATALOG NO	LIST PRICE	CATALOG NO	LIST PRICE	CATALOG NO	LIST PRICE
	120			SXLA01★		SXLA11★					
	208	1½	200	SXLA0G★		SXLA1G★					
00	240	1½	230	SXLA02★	$ 128	SXLA12★	$ 134	USE SIZE 0	—	USE SIZE 0	—
①	480	2	460	SXLA04★		SXLA14★					
	600	2	575	SXLA05★		SXLA15★					
	120			SXL001★		SXL011★		SXL041★		SXL021★	
	208	3	200	SXL00G★		SXL01G★		SXL04G★		SXL02G★	
0	240	3	230	SXL002★	154	SXL012★	162	SXL042★	$ 302	SXL022★	$ 210
①	480	5	460	SXL004★		SXL014★		SXL044★		SXL024★	
	600	5	575	SXL005★		SXL015★		SXL045★		SXL025★	
	120			SXL101★		SXL111★		SXL141★		SXL121★	
	208	7½	200	SXL10G★		SXL11G★		SXL14G★		SXL12G★	
1	240	7½	230	SXL102★	174	SXL112★	182	SXL142★	326	SXL122★	230
①	480	10	460	SXL104★		SXL114★		SXL144★		SXL124★	
	600	10	575	SXL105★		SXL115★		SXL145★		SXL125★	
	120			SXL201★		SXL211★		SXL241★		SXL221	
	208	10	200	SXL20G★		SXL21G★		SXL24G★		SXL22(	
2	240	15	230	SXL202★	302	SXL212★	342	SXL242★	630	SXL222	40
	480	25	460	SXL204★		SXL214★		SXL244★		SXL224★	
	600	25	575	SXL205★		SXL215★		SXL245★		SXL225★	
	120			SXL301★		SXL311★		SXL341★		SXL321★	
	208	25	200	SXL30G★		SXL31G★		SXL34G★		SXL32G★	
3	240	30	230	SXL302★	478	SXL312★	558	SXL342★	966	SXL322★	662
	480	50	460	SXL304★		SXL314★		SXL344★		SXL324★	
	600	50	575	SXL305★		SXL315★		SXL345★		SXL325★	
	120			SXL401★		SXL411★		SXL441★		SXL421★	
	208	40	200	SXL40G★		SXL41G★		SXL44G★		SXL42G★	
4	240	50	230	SXL402★	1070	SXL412★	1238	SXL442★	1934	SXL422★	1582
	480	100	460	SXL404★		SXL414★		SXL444★		SXL424★	
	600	100	575	SXL405★		SXL415★		SXL445★		SXL425★	
	120			SXLF01★		SXLF11★		SXLF41★		SXLF21★	
	208	50	200	SXLF0G★		SXLF1G★		SXLF4G★		SXLF2G★	
4½	240	75	230	SXLF02★	2306	SXLF12★	2616	SXLF42★	3498	SXLF22★	3066
	480	150	460	SXLF04★		SXLF14★		SXLF44★		SXLF24★	
	600	200	575	SXLF05★		SXLF15★		SXLF45★		SXLF25★	
	120			SXL501★		SXL511★		SXL541★		SXL521★	
	208	75	200	SXL50G★		SXL51G★		SXL54G★		SXL52G★	
5	240	100	230	SXL502★	2588	SXL512★	2886	SXL542★	3778	SXL522★	3336
	480	200	460	SXL504★		SXL514★		SXL544★		SXL524★	
	600	200	575	SXL505★		SXL515★		SXL545★		SXL525★	
	120			SXLG01★		SXLG11★		SXLG41★		SXLG21★	
	208	100	200	SXLG0G★		SXLG1G★		SXLG4G★		SXLG2G★	
5½	240	125	230	SXLG02★	3816	SXLG12★	5816	SXLG42★	6698	SXLG22	96
	480	250	460	SXLG04★		SXLG14★		SXLG44★		SXLG2	
	600	300	575	SXLG05★		SXLG15★		SXLG45★		SXLG2	

COIL VOLTAGE SUFFIX TABLE⑦

FREQUENCY	VOLTS									
Hz.	24	110	120	208	220	240	277	380	480	600
60	C		1	G		2	L		4	5
50		1			2			4		

COIL VOLTAGE TOLERANCE 85 TO 110% OF RATED VOLTAGE

ORDERING INFORMATION

★ **To complete catalog number, replace ★** With suffix se lected page 123. For starters with close coupled overloads add C, size 00 or CS2 for size 0 & 1
Ex: Separate Mounted OLR - SLR001A
Close Coupled OLR - SLR001ACS2

VERTICAL MOUNTING, SIZE 3 & 4

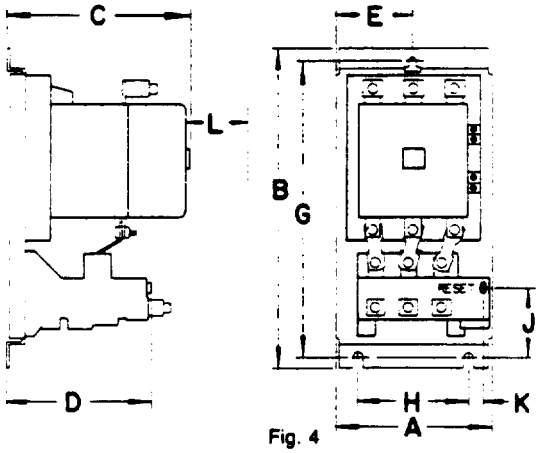


Fig. 4

NON-REVERSING STARTERS ①

Size	Fig. No.	A	B	C	D	E	F	G	H	J	K	② L
		Dimensions in Inches										
00	1	3.31	8.03	4.83	4.87	1.65	—	7.56	2.75	1.54	0.90	—
00	2	4.72	4.88	4.83	4.87	2.36	—	4.41	2.75	2.12	0.69	—
0&1	1	3.31	8.03	4.83	4.61	1.65	—	7.56	2.75	1.54	0.90	—
0&1	2	4.72	4.88	4.83	4.61	2.36	—	4.41	2.25	2.12	0.69	—
2	3	3.70	9.61	5.32	4.83	1.85	—	9.13	2.75	1.65	0.78	1.18
3	4	4.69	10.00	5.98	5.00	2.34	—	9.45	3.66	2.15	0.29	1.60
~~4~~	~~4~~	~~5.31~~	~~11.30~~	~~6.57~~	~~5.00~~	~~2.66~~	~~—~~	~~10.43~~	~~3.94~~	~~2.09~~	~~0.51~~	~~1.60~~
4½	5	5.98	13.94	7.60	6.65	2.99	4.72	13.07	4.05	2.91	2.01	2.00
5&5½	5	6.53	17.05	8.50	8.16	3.27	5.12	16.10	4.30	3.94	2.16	2.00

DECKMASTER

OHMITE® Resistors

VITREOUS ENAMELED RESISTORS

Dividohm® Adjustable Type: Vitreous enameled on ceramic cores with narrow strip of the wire-turns forming a contact surface for the embossed contact of a screwdriver—adjustable lug. A patented percentage of the resistance scale is stamped on the units to make it easy to set the lug at the desired value. **Fixed Resistors:** Lug type, wire-wound on ceramic cores. Wattage ratings are for use in free air.

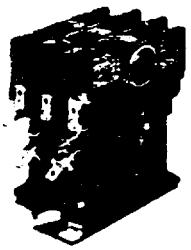
STOCK VALUE ORDERING NUMBERS

	Dividohm Adjustable Resistor Type 210							Fixed Resistor Type 276				
Ohms	12-Watt	25-Watt	50-Watt	75-Watt	100-Watt	175-Watt	225-Watt	25-Watt	50-Watt	100-Watt	175-Watt	225-Watt
1	1001	0361	0560 A	0769 A	0956 A	1156 A	1356 A	0200J	0400J	0600C	0700C	0800C
2	1002	0360 B	0560 B	0769 B	0956 B	1156 B	1356 B	0200K	0400K	0600D	0700D	0800D
3	1003	0361	0560 C	0769 C	0956 C	1156 C	1356 C	0200L	0400L	0600E	0700E	0800E
4			0560 D	0769 D	0956 D	1156 D	1356 D	0200N	0400N	0600F	0700F	0800F
5	1004	0362	0560	0769	0956	1156	1356	0200A	0400A	0600A	0700A	0800A
7.5	1005	0362 B										
10	1006	0363	0561	0770	0957	1157	1357	0200B	0400B	0600B	0700B	0800B
15	1007	0364		0771				0200R				
20	1008	0364 B										
25	1009	0365	0562	0772	0958	1158	1358	0200C	0400C	0601	0701	0801
50	1010	0366	0563	0773	0959	1159	1359	0200D	0400D	0602	0702	0802
75	1011	0367	0564					0200E	0400E	0603	0703	0803
100	1012	0368	0565	0774	0960	1160	1360	0200F	0400F	0604	0704	0804
125										0604B	0704B	
150	1013	0369	0566					0200G	0400G	0605	0705	0805
200	1014	0370	0567	0774 B				0200H	0400H			
250	1015	0371	0568	0775	0960 B	1160 B	1360 B	0201	0401	0606	0706	0806
300	1016	0371 B	0568 B	0775 B								
350	1017											
400	1018	0371 C	0568 C	0775 C								
500	1019	0372	0569	0776	0961	1161	1361		0402	0607	0707	0907
600	1020											
750	1021	0373	0570	0777				0203	0403	0608	0708	0908
800	1022	0374	0571	0777 B				0204	0404			
1000	1023	0375	0572	0778	0962	1162	1362	0205	0405	0609	0709	0909

Rowan Contactors

GOULD

CONTROL
CONTACTORS



HP and AMPERE RATED MOTOR CONTACTORS 25–40 AMPERE TYPE 2200EB

RESISTANCE HEATING—FLUORESCENT, INCANDESCENT LIGHTING, MERCURY VAPOR LAMP CONTACTORS

Resistance Lighting Ampere Rating①	Maximum Motor Ampere Rating: Full Load Amperes	Hermetic Compressor Lock Rotor Amperes 3 Phase 3 Pole Break– 1 Phase 2 Pole Break: 277V	480V	600V	Maximum Horsepower: Volts	Single Phase	3 Phase	No. of N/O Power Poles ⑤	Coil② VAC	Open Type: Cat. No.	List Price	General Purpose—NEMA Type 1: Cat. No.	List Price
								2	24	2200EB220EA		2200EB220EB	
									110–120	2200EB220AA		2200EB220AB	
									208–240	2200EB220BA	$34.00	2200EB220BB	$44.00
									440–480	2200EB220KA		2200EB220KB	
									(60 Hz)				
								3	24	2200EB230EA		2200EB230EB	
					120	2	3		110–120	2200EB230AA		2200EB230AB	
30	25	150	125	100	200–230	3	5		208–240	2200EB230BA	36.00	2200EB230BB	46.00
					460–575	—	7½		440–480	2200EB230KA		2200EB230KB	
									(60 Hz)				
								4	24	2200EB240EA		2200EB240EB	
									110–120	2200EB240AA		2200EB240AB	
									208–240	2200EB240BA	43.00	2200EB240BB	53.00
									440–480	2200EB240KA		2200EB240KB	
									(60 Hz)				
								2	24	2200EB320EA		2200EB320EB	
									110–120	2200EB320AA		2200EB320AB	
									208–240	2200EB320BA	36.00	2200EB320BB	46.00
									440–480	2200EB320KA		2200EB320KB	
									(60 Hz)				
								3	24	2200EB330EA		2200EB330EB	
					120	2	5		110–120	2200EB330AA		2200EB330AB	
40	30	180	150	120	200–230	5	7½		208–240	2200EB330BA	41.00	2200EB330BB	51.00
					460–575	—	10		440–480	2200EB330KA		2200EB330KB	
									(60 Hz)				
								4	24	2200EB340EA		2200EB340EB	
									110–120	2200EB340AA		2200EB340AB	
									208–240	2200EB340BA	46.00	2200EB340BB	58.00
									440–480	2200EB340KA		2200EB340KB	
									(60 Hz)				
								2	24	2200EB420EA		2200EB420EB	
									110–120	2200EB420AA		2200EB420AB	
									208–240	2200EB420BA	44.00	2200EB420BB	54.00
									440–480	2200EB420KA		2200EB420KB	
									(60 Hz)				
								3	24	2200EB430EA		2200EB430EB	
					120	2	5		110–120	2200EB430AA		2200EB430AB	
50	40	240	200	160	200–230	5	10		208–240	2200EB430BA	49.00	2200EB430BB	59.00
					460–575	—	15		440–480	2200EB430KA		2200EB430KB	
									(60 Hz)				
								4	24	2200EB440EA		2200EB440EB	
									110–120	2200EB440AA		2200EB440AB	
									208–240	2200EB440BA	56.00	2200EB440BB	66.00
									440–480	2200EB440KA		2200EB440KB	
									(60 Hz)				

① Per Pole Rating:
Resistive—600V Max.
Lighting—Incandescent—250V Max.
Fluorescent and Mercury Vapor—277V max.—For use on 480V/277V system

② Other standard coils available. Select voltage suffix code letter from coil chart and substitute for next to last letter in catalog number

③ For normally closed power poles see page 27

AC COILS

All AC Coils, Except Where Specifically Designated, Are 50/60 Hz

Volts	24	110–120	208–240	277	440–480 (60 Hz.) 380–460 (50 Hz.)	550–600	120/240③
Code Letter	E	A	B	G	K	D	AB

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	15
Quantity Required:	40 GALS
Description:	HYDRAULIC FLUID
Manufacturer:	Gulf Oil Corporation
Part Number:	46 AW Hydraulic Oil (or equivalent)
Source:	Gulf Oil Corporation (use local distributor)

DECKMASTER

HYDRAULIC OIL SPECIFICATIONS

Type:	Gulf Harmony 46 AW		
Gravity API:	30.3		
Viscosity cSt:	42.70	@	40° C
	6.57	@	100° C
Viscosity SUS:	220	@	100° F
	48.2	@	210° F
Viscosity Index:	105		
Pour Point:	-32° C/-25° F		
Flash Point O.C.:	221° C/430° F		
Color ASTM:	L 0.5		

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET

Harmony 46 AW, Gulf 091277RP

SECTION I

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
Gulf Oil Company - U.S.	713-226-1011
ADDRESS (NUMBER, STREET, CITY, STATE & ZIP CODE) P. O. Box 1519, Houston, TX 77001	TRADE NAME AND SYNONYMS: Gulf Harmony 46 AW (formerly Gulf Harmony 48 AW)
CHEMICAL NAME & SYNONYMS NA	
CHEMICAL FAMILY Petroleum Hydrocarbon	FORMULA Lubricant Mixture

SECTION II — HAZARDOUS INGREDIENTS

MATERIALS	%	TLV (Units)	MATERIALS	%	TLV (Unit

According to U.S. Department of Labor (DOL) Criteria, this is a non-hazardous material.

SECTION III — PHYSICAL DATA

BOILING POINT °C (°F) Overpoint (Oil Base)	365°C (689°F)	SPECIFIC GRAVITY (H_2O=1) 15.6° / 15.6°C	0.8745
VAPOR PRESSURE (mm Hg.)	Negligible	PERCENT, VOLATILE BY VOLUME (%)	0
VAPOR DENSITY (Air=1)	NA	EVAPORATION RATE (Ether=1)	0
SOLUBILITY IN WATER	Negligible		
APPEARANCE AND ODOR	Clear pale lubricating oil		

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	FLAMMABLE LIMITS	LEL	UEL
207°C (405°F) P-M	ND		

EXTINGUISHING MEDIA

☐ ALCOHOL FOAM ☒ CARBON DIOXIDE ☒ DRY CHEMICAL ☒ FOAM ☒ WATER SPRAY (F

☐ OTHER

SPECIAL FIRE FIGHTING PROCEDURES Use foam and water spray carefully to prevent excessi frothing. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from exposures.

FIRE AND EXPLOSION HAZARDS

Slight when exposed to heat or flame; can react with oxidizing materials. Combusti.

NA = Not Applicable
ND = No Data Available

Gulf Modified Form OSHA

SECTION V – HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
Observe current ACGIH TLV of 5 mg/m^3 for oil mist.

EFFECTS OF OVEREXPOSURE
May irritate the skin of some individuals after prolonged and repeated exposure.

EMERGENCY AND FIRST AID PROCEDURES Skin Contact- Remove by wiping and wash with soap and water. Eye Contact- Wash with copious amounts water. Inhalation- Remove from exposure to fumes, mists. Ingestion- Admin. 2-4 oz. vegetable or olive oil and 1 to 2 oz. activated charcoal. Seek medical aid.

SECTION VI – REACTIVITY DATA

STABILITY:	UNSTABLE		STABLE	X	CONDITIONS TO AVOID	NA

INCOMPATABILITY (Materials to avoid) NA

HAZARDOUS DECOMPOSITION PRODUCTS NA

HAZARDOUS POLYMERIZATION:	MAY OCCUR		WILL NOT OCCUR	X	CONDITIONS TO AVOID	NA

SECTION VII – SPILL OR LEAK PROCEDURES

☒ STOP FLOW	☒ SKIN PROTECTION (AS PER SECTION VIII)	☒ INCINERATE UNDER CONTROLLED CONDITIONS	☐ NEUTRALIZE
☐ ELIMINATE ALL SOURCES OF IGNITION, FLAMMABLES	☒ ABSORB OR SCRAPE UP	☐ INCINERATE USING AFTER BURNER & SCRUBBER	☐ WASH AWAY WITH WATER
☐ AVOID INHALATION	☐ VACUUM UP	☐ BURY IN REMOTE AREA	☒ OBSERVE FEDERAL SPILL & WATER QUALITY REGULATIONS
☒ AVOID DERMAL CONTACT	☐ EVAPORATE SMALL AMOUNTS IN HOOD	☐ USE AS LANDFILL	☒ REMOVE SOILED CLOTHING
☐ RESPIRATORY PROTECTION (AS PER SECTION VIII)	☐ OTHER		

SECTION VIII – SPECIAL PROTECTION INFORMATION

	DURING NORMAL USE	FOR GASES, VAPORS, DUSTS, FUMES, MISTS EXCEEDING TLV	SPECIAL (E.G. THERMAL PROCESSING, SPRAY APPLICATIONS)
GENERAL VENTILATION	Usually not required	Yes	Yes
LOCAL EXHAUST	Usually not required	Yes	Yes
RESPIRATORY PROTECTION (1-4)	NA	2 or 4	2 or 4

1. USUALLY NONE
2. PARTICLE-REMOVING AIR PURIFYING RESPIRATOR (MECHANICAL FILTER)
3. GAS AND VAPOR-REMOVING AIR PURIFYING RESPIRATOR (CANISTER)
4. FULL FACE MASK POSITIVE PRESSURE-DEMAND TYPE SUPPLIED AIR

EYE PROTECTION	Usually not required SAFETY GLASSES		CHEMICAL GOGGLES		FACE SHIELD	
PROTECTIVE GLOVES (frequent contact)	NEOPRENE	G	POLYVINYL ALCOHOL	E	POLYETHYLENE	E
	NATURAL RUBBER	P	BUTYL RUBBER	E	POLYVINYL CHLORIDE	F

RATING: (E) EXCELLENT (G) GOOD (F) FAIR (P) POOR (NR) NOT RECOMMENDED)

OTHER PROTECTIVE EQUIPMENT Protective garment when applicable.

SECTION IX – SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Avoid frequent or prolonged skin contact or inhalation of fumes, mists, vapors. Combustible. Handle and store using methods generally advocated for combustible hydrocarbons.

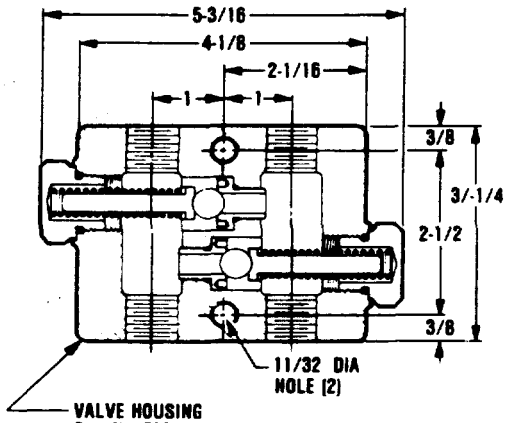
OTHER PRECAUTIONS
Do not wear oil-soaked clothing.

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	16
Quantity Required:	One
Description:	Dual Relief Valve
Manufacturer:	Gresen
Part Number:	DXV-75-30U
Source:	Gresen Manufacturing Dana Corp. P. O. Box 1313 Minneapolis, MN 55440

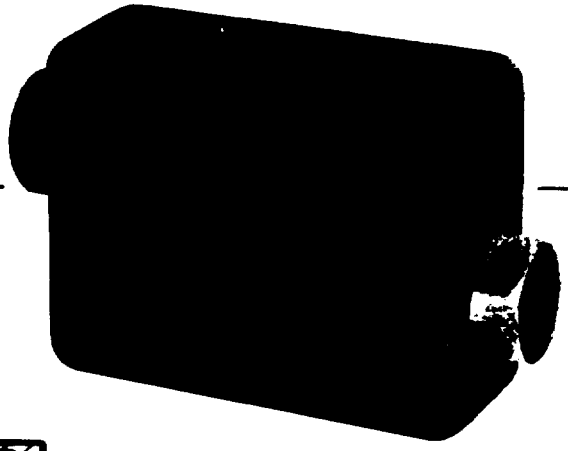
Tele #: (612) 623-1960

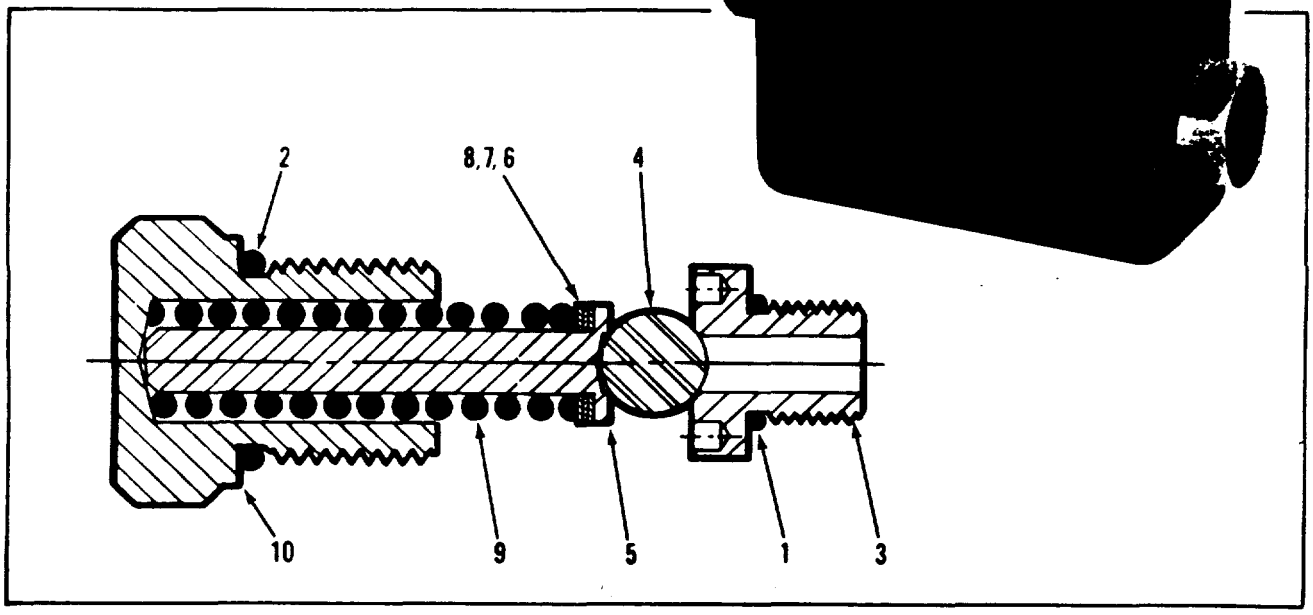


NO.	PORT SIZES (ALL 4 PORTS)
DXV-8	SAE 8(3/4"—16UNF)
DXV-10	SAE 10(7/8"—14UNF)
DXV-12	SAE 12(1-1/16"—12UNF)
DXV-38	3/8"—18NPT
DXV-50	1/2"—14NPT
DXV-75	3/4"—14 NPT

GRESEN

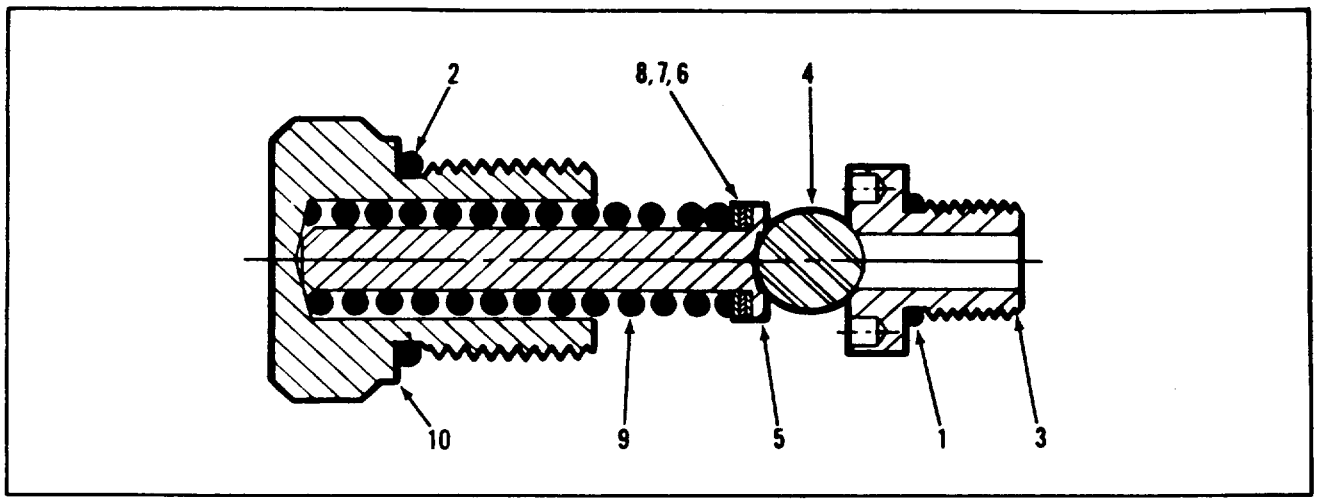
MODEL DXV CUSHION VALVE (DOUBLE RELIEF) PARTS LISTING





MODEL DXV CUSHION VALVE

Item No.	Part No.	Description	Quantity Per Cushion Valve
	K-20008	SEAL KIT (Contains items 1 and 2)	
1	0449-001	SEAL, O-Ring } Not Sold Separately Order K-20008	2
2	0455-001	SEAL, O-Ring }	2
3	0452-001	SEAT, Ball (50-1450 PSI Crack)	2
	0461-001	SEAT, Ball (1451-2000 PSI Crack)	2
	0463-001	SEAT, Ball (2001-3500 PSI Crack)	2
4	0071-001	BALL, Steel (50-2000 PSI Crack)	2
	0155-001	BALL, Steel (2001-3500 PSI Crack)	2
5	0453-001	GUIDE, Spring (50-2000 PSI Crack)	2
	0464-001	GUIDE, Spring (2001-3500 PSI Crack)	2
6	0458-001	SHIM (.040 nominal)	A/R
7	0459-001	SHIM (.020 nominal)	A/R
8	0462-001	SHIM (.010 nominal)	A/R



MODEL DXV CUSHION VALVE (Cont.)

Item No.	Part No.	Description	Quantity Per Cushion Valve
9	0454-001	SPRING (50-400 PSI, with 0452-001 Seat)	2
	3443-001	SPRING (401-750 PSI, with 0452-001 Seat)	2
	3458-001	SPRING (751-900 PSI, with 0452-001 Seat)	2
	3459-001	SPRING (901-1300 PSI, with 0452-001 Seat)	2
	3460-001	SPRING (1301-1450 PSI, with 0452-001 Seat)	2
	3459-001	SPRING (1451-1800 PSI Crack, with 0461-001 Seat)	2
	3460-001	SPRING (1801-2000 PSI Crack, with 0461-001 Seat)	2
	3459-001	SPRING (2001-3000 PSI Crack, with 0463-001 Seat)	2
	3460-001	SPRING (3001-3500 PSI Crack, with 0463-001 Seat)	2
10	0451-001	CAP, Relief	2

Gresen Manufacturing Company reserves the right to discontinue or modify parts listed herein. All specifications herein are approximate and may vary depending upon installation

GRESEN Manufacturing Company
A Subsidiary of **DANA CORPORATION**
P.O. BOX 1313 • MINNEAPOLIS, MINNESOTA 55440 • U.S.A.
Phone (612) 623-1960 • Telex 290492
EUROPEAN AFFILIATE: **S.A. GRESEN HYDRAULICS N.V.**
Parc Industriel des Hauts-Sarts
B-4400 Herstal, Belgium
Tel: 41/64.85.93 • Telex: 42318 Gresen B
World Wide Sales/Service

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	17
Quantity Required:	One
Description:	Dual Relief Valve
Manufacturer:	Gresen
Part Number:	DWV-10-A-3000

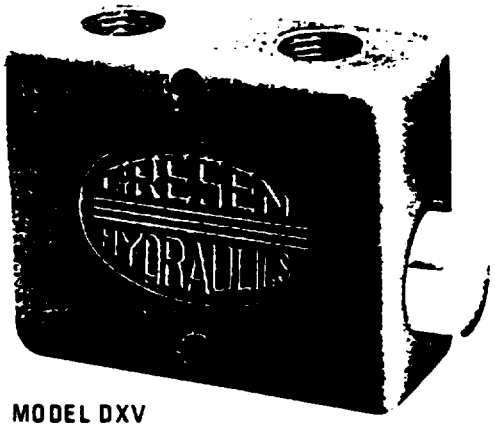
Source: Gresen Manufacturing
Dana Corporation
P. O. Box 1313
Minneapolis, MN 55440

Tele #: 1-612-623-1960
TELEX #: 290492

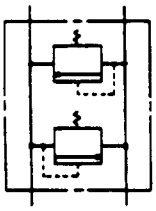
MODELS
DXV
DWV

DOUBLE RELIEF CUSHION VALVES

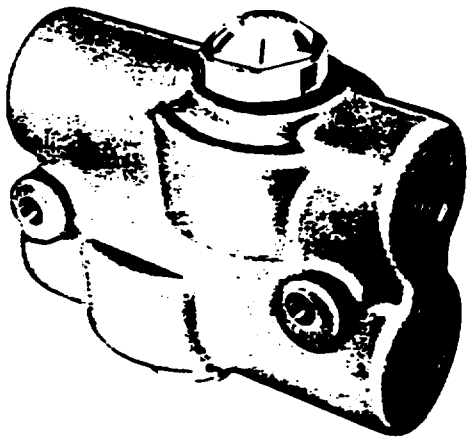
FOR USE WITH CYLINDERS OR MOTORS OF EQUAL DISPLACEMENT



MODEL DXV
Ball/Spring Relief Valve



MODEL DWV
Uses Model WC
Relief Cartridge
Differential Poppet Type



The Models DXV and DWV Cushion Valves are designed to eliminate or minimize shock, surge and overload conditions on hydraulic equipment. They may be used with one or more cylinders (of equal displacement) in a multiple hydraulic circuit—regulating surge pressure without disturbing pressure demands of any other cylinder in the system.

Under standard conditions, when a control valve is in neutral or hold position, the excess pressure created by overload, shock or stress has no possibility of relief through the primary relief valve. Cushion Valves located between control valve and cylinders minimize or eliminate this condition. Sudden shock experienced in starting and stopping hydraulic motors may also be controlled by the same installation.

The need for an anti-cavitation check is eliminated. Relieved oil is directed into the opposite side of the Cushion Valve preventing cylinder or motor cavitation.

Model DXV with ball spring relief valve has hardened seats for long, trouble-free service. It is available with a 5 PSI [0,3 bar] check spring which will allow the cushion valve to act as a relief in one direction and permits free-flow at 5 PSI [0,3 bar] in the opposite direction.

Model DWV has cartridge-type, hydraulically dampened reliefs (Model WC). Designed to meet requirements for a "quieter" operating relief and to provide a smaller differential between "cracking" and "full-flow" pressures. An optional adjustable relief is available.

FEATURES

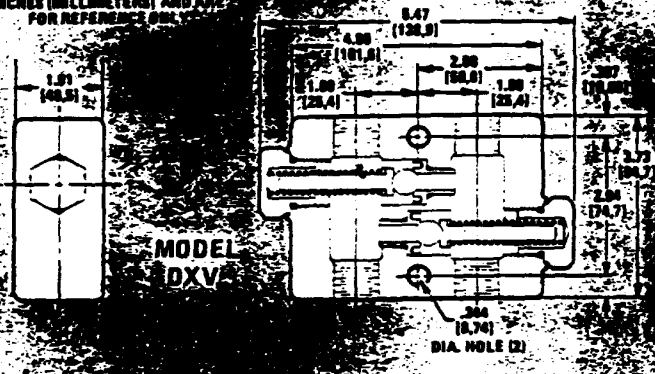
- **Non-Adjustable Type Reliefs—can be adjusted by adding or subtracting shims.**
- **[illegible] available for Model DWV**
- **Factory Pre-Set to Customer's Specific Pressure Requirements**
- **High-Tensile Cast Iron Body**

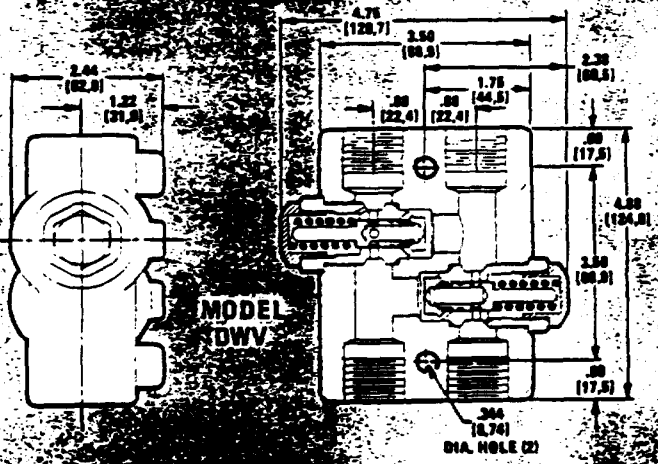
SPECIFICATIONS

	MODEL DXV	[illegible]
Capacity (nominal)	10 GPM [37 litres/min]	30 GPM [113 litres/min]
Minimum Operating Pressure	5 PSI [0,3 bar]	300 PSI [20 bar]
Maximum Operating Pressure	2500 PSI [172 bar]	3000 PSI [207 bar]
Shipping Weight	4 Pounds [1,8 kg]	5 Pounds [2,3 kg]

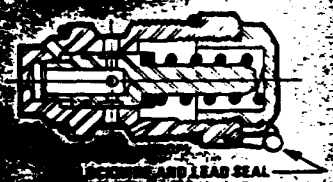
DIMENSIONS

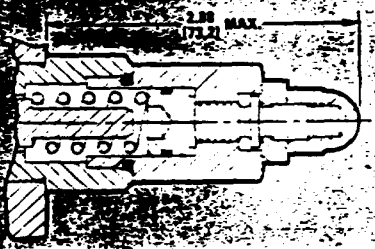
ALL DIMENSIONS ARE IN INCHES [MILLIMETERS] AND ARE FOR REFERENCE ONLY





DXV DWV





OPTIONAL TAMPER PROOF RELIEF

FOR DWV ONLY

OPTIONAL ADJUSTABLE RELIEF

An Adjustable Relief Cartridge is available for the Model DWV only and is adjustable within range of the spring installed.

OPTIONAL STAINLESS STEEL SPRINGS

Green Standard relief valve springs are of a spring steel material. Where hydraulic systems tend to run at temperatures above 160°F [71,17°C] stainless steel relief springs are recommended. These optional stainless steel springs are available but must be specified when ordered.

For best system performance and longest oil life, the ideal oil temperature range in a hydraulic system should be approximately 100°F to 130°F [37,81°C to 54,49°C] when measured at the oil reservoir.

Standard relief valve springs (spring steel) will begin to "decay" as temperatures increase. System decay will vary depending on the relief valve setting and spring load.

ORDERING INSTRUCTIONS

MODEL NO. DWV - 8 - A - 2500 PSI

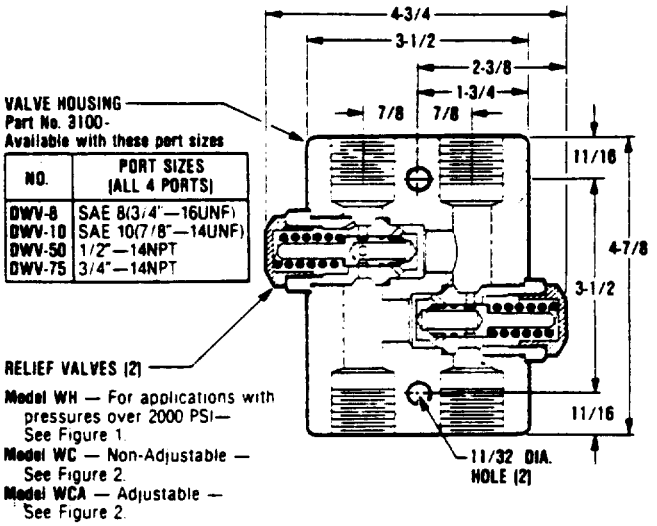
MODEL	
DXV	Ball/Spring Relief Valves
DWV	Differential Poppet Relief Valves

PORT SIZES (ALL 4 PORTS)	
8	SAE 8(3/4" – 16 UNF)
10	SAE 10(7/8" – 14 UNF)
12	SAE 12(1-1/16" – 12 UNF) DXV only
38	3/8" – 18 NPT DXV only
60	1/2" – 14 NPT
75	3/4" – 14 NPT
51	1/2" – 14 BSP (DWV only)
71	3/4" – 14 BSP

NOTE: NPT pipe ports are not recommended for pressures above 2000 PSI [138 bar].

Specify cracking pressure for relief valve setting

ADJUSTMENT OPTIONS		
–	Standard, Shim Adjustable	
	Adjustable Relief Option Model DWV Only Reliefs are adjustable within range of spring installed	
	Adjustment Range (Cracking pressure)	Spring Color
	500-1350 PSI [34-93 bar]	Natural
	1351-1750 PSI [93-120 bar]	Silver
	1751-2200 PSI [120-151 bar]	Yellow
	1751-2200 PSI [120-151 bar]	Yellow S.S. (optional)
	2201-3000 PSI [151-207 bar]	Red
	2201-3000 PSI [151-207 bar]	Red S.S. (optional)
NJ	Tamperproof, with lockwire and lead seal (DWV only)	



U.S.A.

MODEL DWV CUSHION VALVE (DOUBLE RELIEF) PARTS LISTING

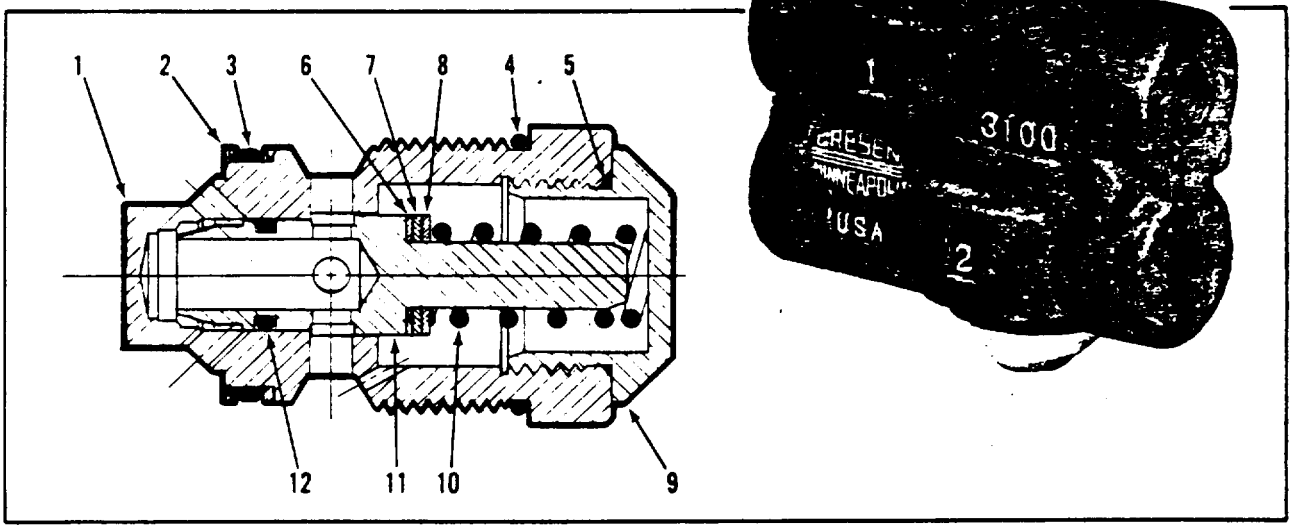


Figure 1. Model WH Relief Valve

MODEL WH RELIEF VALVE

WH Relief should be used on applications over 2000 PSI

Item No.	Part No.	Description	Quantity
	K-19003	SEAL KIT (Contains items 2, 3, 4 and 5)	
	K-19002	SERVICE KIT (Contains items 11 and 12)	
1	6533-001	BODY, Relief	1
2	6530-001	WASHER, Back-Up } Not Sold Separately Order K-19003	2
3	1718-001	SEAL, O-Ring } Not Sold Separately Order K-19003	1
4	1615-001	SEAL, O-Ring } Not Sold Separately Order K-19003	1
5	2707-001	SEAL, O-Ring } Not Sold Separately Order K-19003	1
6	0458-001	SHIM (.040 nominal)	A/R
7	0459-001	SHIM (.020 nominal)	A/R
8	0462-001	SHIM (.010 nominal)	A/R
9	1880-001	CAP, Relief	1
10	1450-001	SPRING (500-1350 PSI)	1
	1864-001	SPRING, Silver (1351-1750 PSI)	1
	1451-001	SPRING, Yellow (Standard 1751-2200 PSI Crack)	1
	7497-001	SPRING, (Optional S.S., 2601-3500 PSI Crack)	1
	1865-001	SPRING, Red (Standard, 2201-3000 PSI Crack)	1
	1870-001	SPRING, Red (Optional S.S., 2201-3000 PSI Crack)	1
11	1881-001	POPPET, Relief } Not Sold Separately Order K-19002	1
12	1883-001	RING, Piston } Not Sold Separately Order K-19002	1

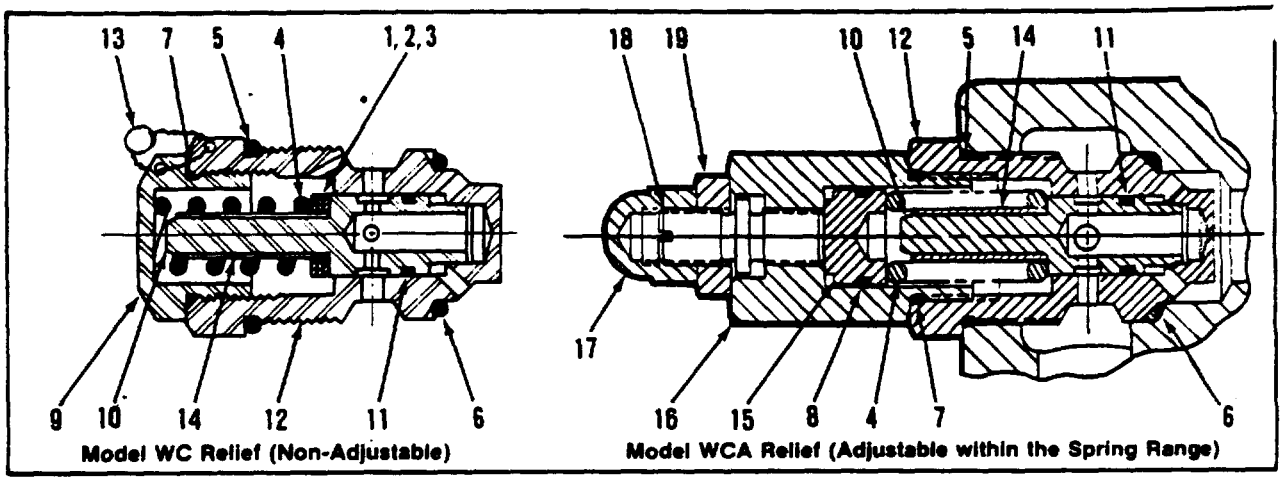


Figure 2. Models WC and WCA Relief Valves

MODELS WC AND WCA RELIEF VALVES.
Specify pressure setting.

Item No.	Part No.	Description	Quantity Each Relief WC	WCA
	K-6006	SEAL KIT (Contains items 5, 6, 7, 8 and 9)		
	K-19002	SERVICE KIT (Contains items 10 and 11)		
1	0458-001	SHIM (.040 nominal)	A/R	—
2	0459-001	SHIM (.020 nominal)	A/R	—
3	0462-001	SHIM (.010 nominal)	A/R	—
4	1450-001	SPRING (500-1350 PSI)	1	—
	1864-001	SPRING, Silver (1351-1750 PSI)	1	1
	1451-001	SPRING, Yellow (Standard 1751-2200 PSI Crack)	1	1
	7078-001	SPRING, Yellow (Optional S.S., 1751-2200 PSI Crack)	1	1
	1865-001	SPRING, Red (Standard, 2201-3000 PSI Crack)	1	1
	1870-001	SPRING, Red (Optional S.S., 2201-3000 PSI Crack)	1	1
5	1615-001	SEAL, O-Ring } Not Sold Separately Order K-6006	1	1
6	1863-001	SEAL, O-Ring } Not Sold Separately Order K-6006	1	1
7	2707-001	SEAL O-Ring } Not Sold Separately Order K-6006	1	1
8	1818-001	SEAL, O-Ring } Not Sold Separately Order K-6006	—	1
9	1880-001	CAP, Relief without hole for lockwire (Standard)	1	—
	1880-003	CAP, Relief with hole for lockwire (Optional)	1	—
10	1881-001	POPPET, Relief } Not Sold Separately Order K-19002	1	1
11	1883-001	RING, Piston } Not Sold Separately Order K-19002	1	1
12	1890-001	BODY, Relief without hole for lockwire (Standard)	1	1
	1890-002	BODY, Relief with hole for lockwire (Optional)	1	—
13	1234-001	LOCKWIRE AND LEAD SEAL (Optional, Non-Adjustable Type)	1	—
14	7874-001	SLEEVE, Dampening (not to be used with 1450-001 or 1451-001 Springs)	1	1
15	3495-001	PISTON	—	1
16	3498-001	CAP, Adjustable Relief	—	1
17	3497-001	NUT, Acorn	—	1
18	3496-001	STEM, Adjustable	—	1
19	3500-001	NUT, Jam	—	1

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.: 18

Quantity Required: ONE

Description: 3/4 inch Ball Valve

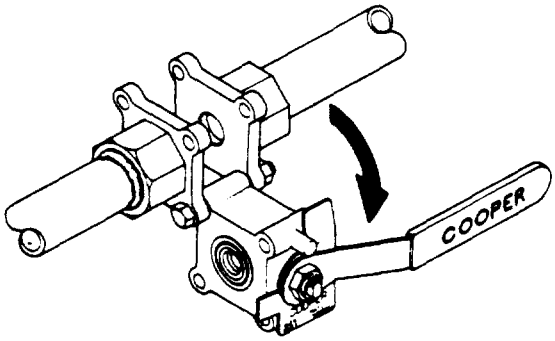
Manufacturer: COOPER

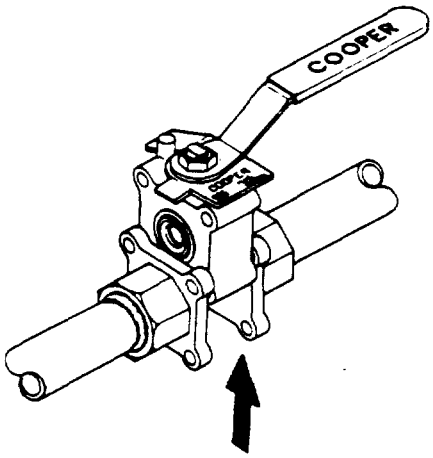
Part Number: HP34150SE - 316SS

Source: COOPER VALVE CORIPANY
5524 Harvey Wilson Drive
Houston, Texas 77020

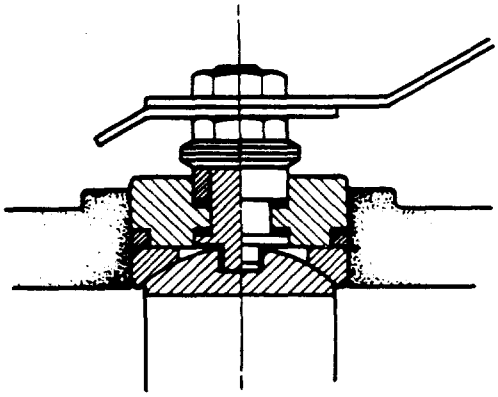
Tele #: 1-713-675-4201

TELEX #: 76-2953





BLOW-OUT PROOF STEM — SELF ADJUSTING PACKING



For a maximum safety, the stem is designed with a COOPERFILL 133 thrust-bearing and inserted through the body cavity until it rests against a shoulder in the valve body. A reinforced TFE seal, above the body shoulder, is held in place by a follower, two Belleville washers and adjusting nut. Simple, in-line stem adjustments keep washers flexed, automatically compensating for normal wear as well as for seal expansion and contraction from temperature fluctuations.

CHOICE OF END-CONNECTIONS FOR ANY PIPING SYSTEM

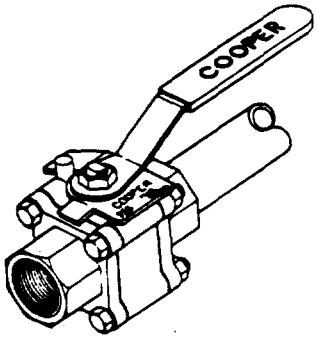


FIGURE NO. 4150
THREE PIECE CONSTRUCTION
STANDARD PORT

Figure # 4151SE Threaded

SIZE	A	B	C	D	E	F
¼	2 9/16	1 13/16	4 ¾	¼	1 ½	7/16
⅜	2 9/16	1 13/16	4 ¾	⅜	1 ½	7/16
½	2 9/16	1 13/16	4 ¾	½	1 ½	7/16
¾	2 13/16	2	4 ¾	¾	1⅞	9/16
1	3 11/16	2 ¼	5⅞	1	2 3/16	13/16
1 ¼	4 3/16	2 ½	5⅞	1 ¼	2 7/16	1
1 ½	4 9/16	3	7⅝	1 ½	2⅞	1 ¼
2	5	3 ¼	7⅝	2	3⅛	1 ½
2 ½	5 31/32	4	9 ½	2 ½	3 ¾	2
3	7 ¼	6	9 ½	3	5 ¼	2 ½

ITEM	DESCRIPTION	MATERIAL
1	BODY	316SS
2	BALL	316SS
3	END PC	316SS - Low Carbon
4	SEAT	Reinforced TFE
5	STEM	316SS
6	STEM NUT	304SS
7	STEM BUSHING	316SS
8	STEM SEAL	Reinforced TFE
9	THRUST BEARING	COOPERFILL 133
10	STOP PLATE	304SS
11	BODY SEAL	Reinforced TFE
12	HANDLE	316SS
13	HANDLE NUT	316SS
14	BELLEVILLE WASHER	17-7 Ph SS
15	BODY NUT	316SS
16	BODY BOLT	316SS
17	HANDLE SLEEVE	VINYL
18	THREAD PROTECTOR	CPVC

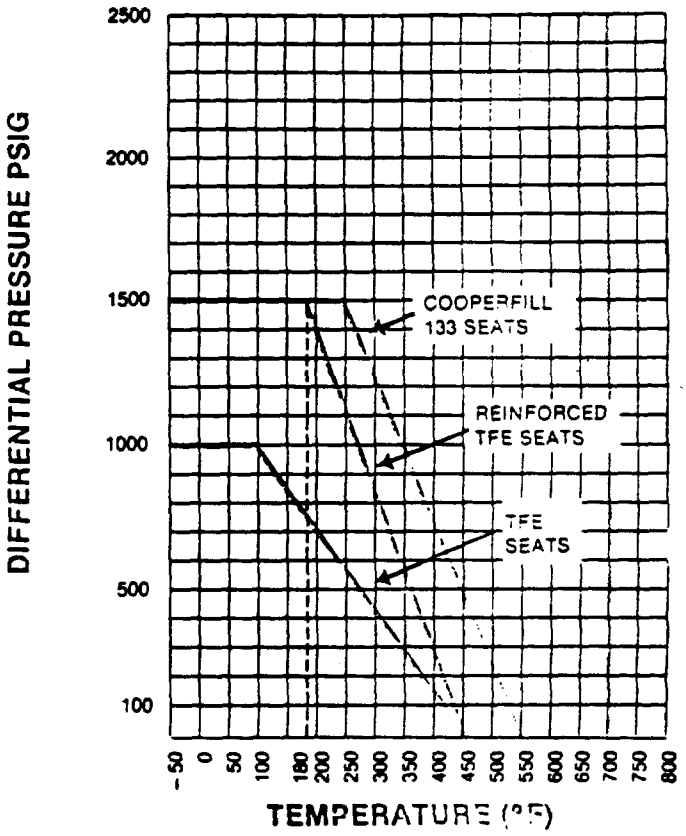
ENGINEERING DATA

FLOW DATA

STANDARD PORT	
Valve Size	Approximate C_v
¼", ⅜"	9
½"	9
¾"	17
1"	35
1¼"	55
1½"	95
2"	140
2½"	220
3"	360

FULL PORT	
Valve Size	Approximate C_v
¼", ⅜"	10
½"	19
¾"	35
1"	60
1¼"	95
1½"	140
2"	230
2½"	360
3"	590

PRESSURE VS. TEMPERATURE



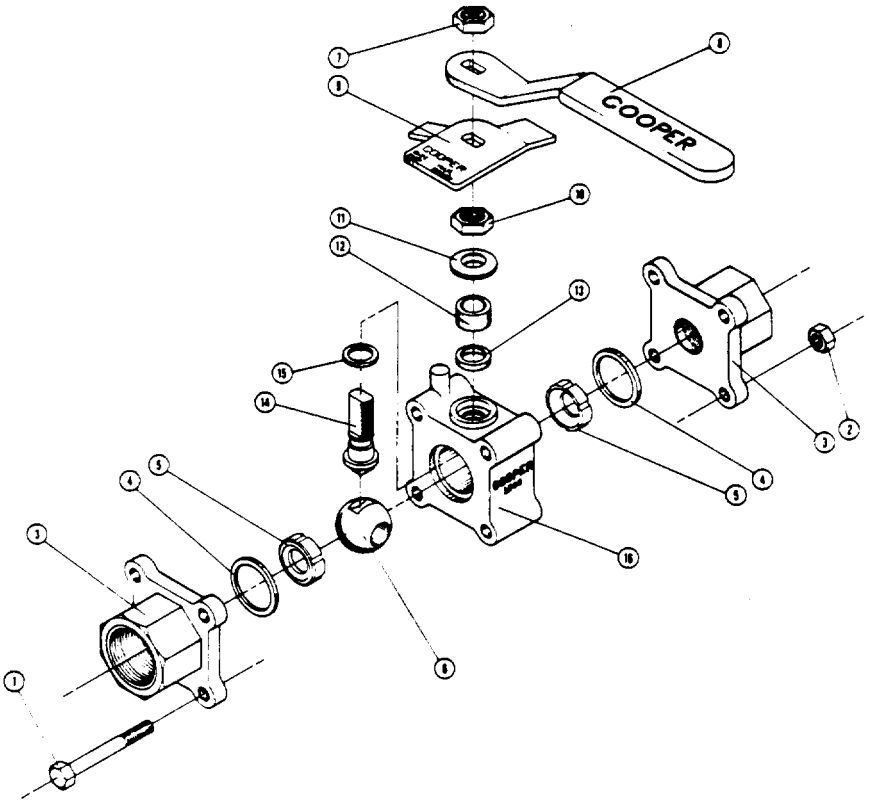
MAXIMUM EXPECTED BREAKAWAY TORQUE
(Running Torques approximately 1/3 value shown)

STANDARD PORT	
Valve Size	Torque
¼"	30 in.-lbs.
⅜"	30 in.-lbs.
½"	30 in.-lbs.
¾"	40 in.-lbs.
1"	90 in.-lbs.
1¼"	190 in-lbs.
1½"	280 in.-lbs.
2"	390 in.-lbs.
2½"	600 in.-lbs.
3"	800 in.-lbs.

FULL PORT	
Valve Size	Torque
¼"	30 in.-lbs.
⅜"	30 in.-lbs.
½"	40 in.-lbs.
¾"	90 in.-lbs.
1"	190 in.-lbs.
1¼"	280 in.-lbs.
1½"	390 in.-lbs.
2"	600 in.-lbs.
2½"	800 in.-lbs.
3"	1100 in.-lbs.

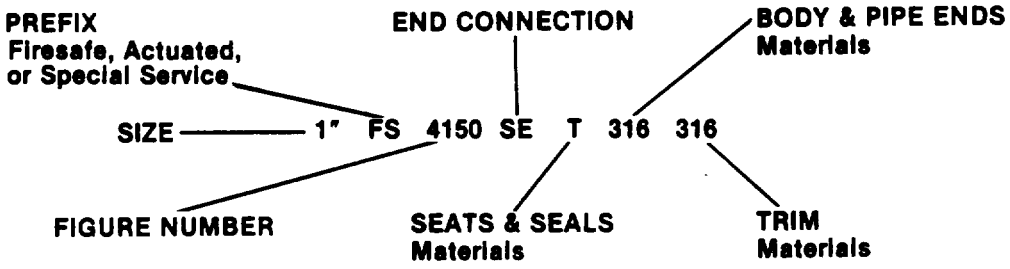
NOTE:

1. Pressure and temperature curves shown are for standard stock valves. For other seat-seal combinations through 5000 PSI and -450° to 1100°F consult special application brochures.
2. Reinforced TFE may be used to 150 PSIG steam maximum. COOPERFILL 133 may be used to 300 PSIG steam. (See Brochure BV-1102)
3. Maximum temperature for TFE and reinforced TFE seals is 450°F. Maximum temperature for Flex Gaskets is 550°F. Consult special application brochures for higher temperatures.
4. Pressure and temperature curves shown apply to ¼"-3" valves except 3" full port maximum pressure 1000 PSI.



1	Body Bolt (4)	9	Stop Plate
2	Body Nut (4)	10	Stem Nut
3	End Piece (2)	11	Belleville Washers (2)
4	Body Seals (2)	12	Stem Bushing
5	Seats (2)	13	Stem Seat
6	Ball	14	Stem
7	Handle Nut	15	Thrustbearing
8	Handle	16	Body

ORDERING EXAMPLE



DECKSMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH. HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	19
Quantity Required:	One
Description:	Shuttle Valve
Manufacturer:	Racine
Part Number:	MH-04-P

Source: Racine
Rexnord Hydraulic Components Division
4675 Clark Road
Sarasota, Florida 33583

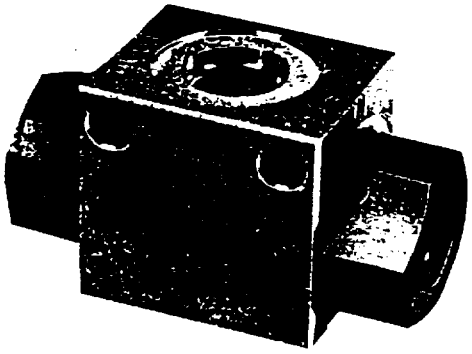
Tele #: 1-813-924-1284

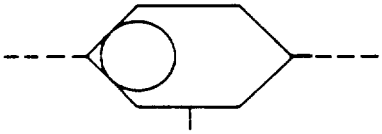
Racine
fluid power products

ENGINEERING DATA

SPECIAL CONTROLS SHUTTLE VALVE 1/4"

4 GPM
3000 PSI



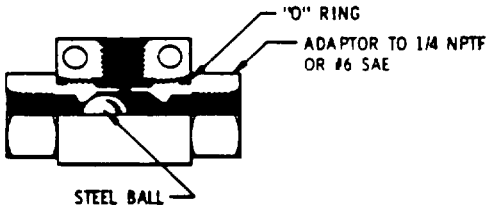


SYMBOL

SPECIFICATIONS

PRESSURE RATING	3000 psi (207 bar; 20,700 kPa)
FLOW RATING	4 GPM (15.2 L/min)
PORT SIZE	1/4" NPTF or 6 SAE
MOUNTING	Unrestricted
MATERIAL	All steel
WEIGHT (Approx.)	0.75 lbs. (0.34 kg)

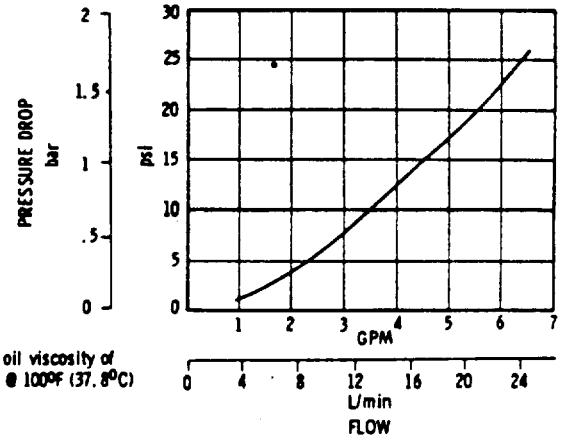
PICTORIAL



THE SHUTTLE VALVE IS NORMALLY USED IN A SYSTEM TO SELECT THE HIGHER OF TWO PRESSURES FOR PILOT USE.

PERFORMANCE CHARACTERISTICS

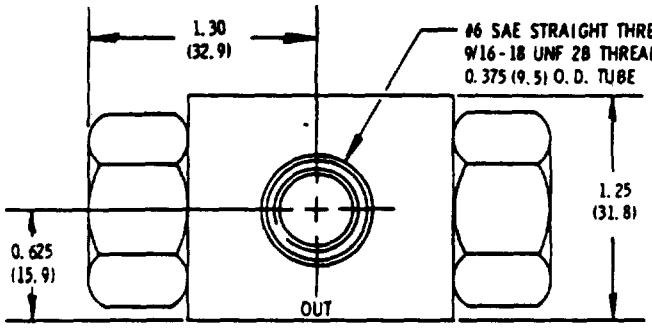
MAXIMUM LEAKAGE .15 in^3/min (2.5 cm^3/min)



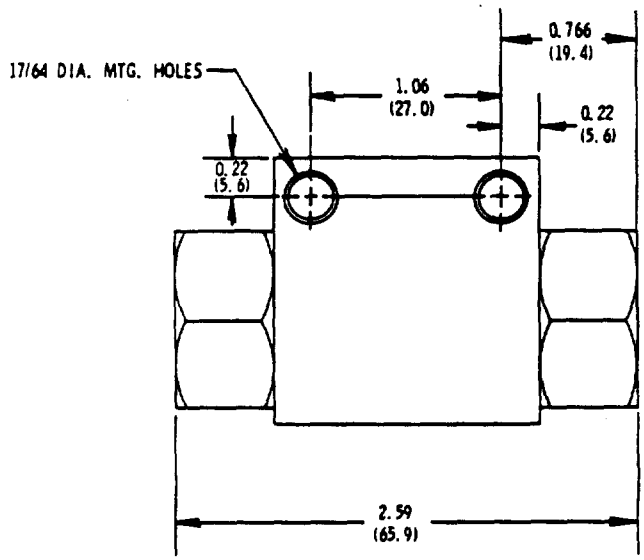
Note: Data taken with oil viscosity of 200 SUS (43cSt) @ 100°F (37.8°C)

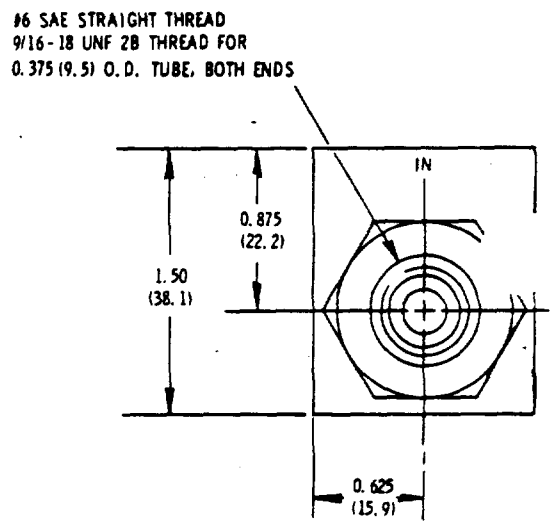
For repair parts see Bulletin SD 12.15

DIMENSIONAL DATA

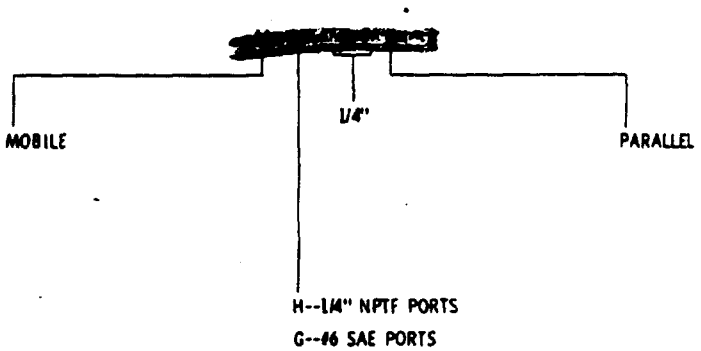


INCHES
(MILLIMETRES)





HOW TO ORDER



Troubleshooting Guide

NOTE: Before troubleshooting any system problem, check service literature published by the equipment and/or component manufacturers. Follow their instructions, if given, for checking any component other than the MAB or MAE Torqmotor ô unit.

Preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted-place;
- have proper tools and materials nearby;
- have an adequate supply of clean petroleum-based solvent.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REOUIREMENTS.

Preliminary Checks

Hydraulic systems are often trouble-free. The problem an operator complains of could be caused by something other than the hydraulic components.

Thus, once you have determined that a problem exists, start with the easy-to-check items, such as:

- parts damaged from impact that were not properly repaired, or that should have been replaced; and
- improper replacement parts used in previous servicing
- mechanical linkage problems such as binding, broken, or loose parts or slipping belts.

Hydraulic Components

If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any useable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings and fittings. Replace any hoses or lines that don't meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Check the filter(s). A filter with a maximum 50 micron filtration is recommended for the MAB and MAE system.

Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

Excessive heat in a hydraulic system can create problems that can easily be overlooked. Every system has its limitation for the maximum amount of temperature. After the temperature is attained and passed, the following can occur:

- oil seal leaks
- loss of efficiency such as speed and torque
- pump loss of efficiency
- pump failure
- hoses become hard and brittle
- hose failure

A normal temperature range means an efficient hydraulic system. Consult the manuals published by equipment and/or component manufacturers for maximum allowable temperatures and hydraulic tests that may be necessary to run on the performance of the hydraulic components. The MAB and MAE are not recommended for hydraulic systems with maximum temperatures above 200 °F (93.3°C).

Troubleshooting Checklist

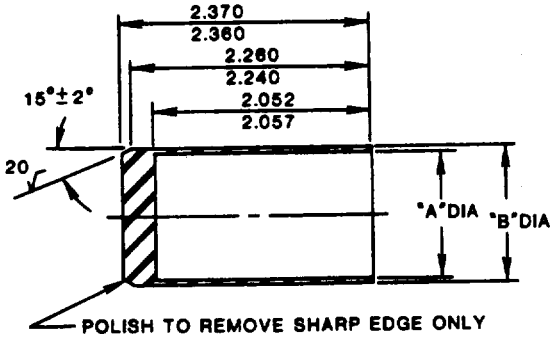
Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged	Check & replace damaged-fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (7) deteriorated by excess heat	Replace oil seal rings by disassembling Torqmotor™ unit.
	3. Special bolt (24) loose or its sealing area deteriorated by corrosion	(a). Loosen then tighten single bolt to 45-55 ft.lbs. (60-76 N m) (b) Replace bolt.
	4. Internal shaft seal (5) worn or damaged	Replace seal. Disassembly of Torqmotor™ unit not necessary.
	5. Worn coupling shaft (11) and internal seal (5)	Replace coupling shaft and seal by disassembling Torqmotor™ unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.
	2. High internal motor leakage	(a) Replace worn rotor set by disassembling Torqmotor TM unit.
	3. Severely worn or damaged internal splines	Replace rotor set, drive link and coupling shaft by disassembling Torqmotor TM unit.
	4. Excessive heat	Locate excessive heat source (usually a restriction) in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate Torqmotorô unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble Torqmotor TM unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to MAB/MAE unit.	Locate source and eliminate cause.

CAUTION: If the hydraulic system fluid becomes overheated [in excess of 200°F (93.3 °C)], seals in the system can shrink, harden or crack, thus losing their sealing ability.

Patents

Ross Gear Division products and systems described in this manual are protected by one or more of the following United States patents: 3,289,602; 3,288,034; 3,452,680 and 3,606,601. In addition, patent applications have been filed in Brazil, Canada, Denmark, France, Italy, Japan, Sweden, the United Kingdom, and West Germany.

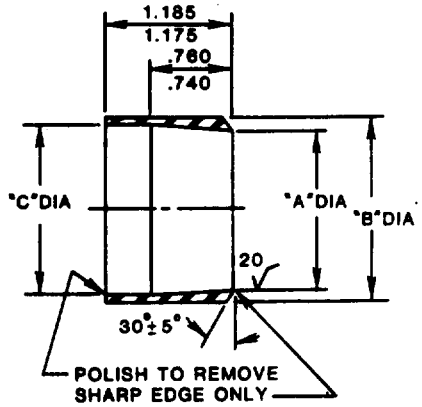
Seal Installation Tools



Dimensions Shown in Inches

Tool No.	Shaft Seal Dia.	Dim. "A"	Dim. "B"
J26751	1¼	1.252/1.258	1.290/1.280
J33074-1	1½	1.502/1.508	1.540/1.530

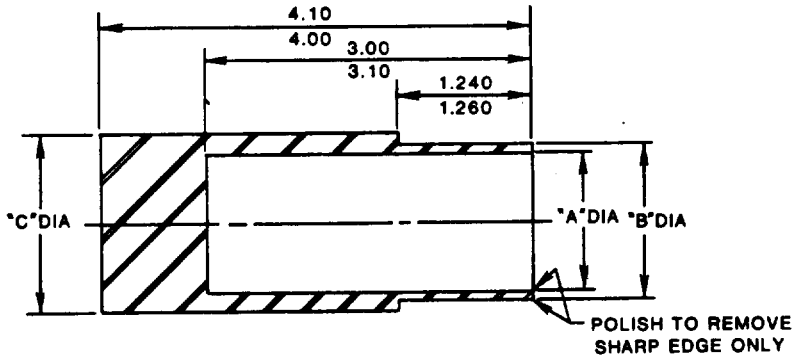
Seal Thimble
Figure 1.



Dimensions Shown in Inches

Tool No.	Shaft Seal Dia.	Dim. "A"	Dim. "B"	Dim. "C"
J26753	1¼	1.502/1.504	1.735/1.715	1.590/1.610
J33074-3	1½	1.751/1.753	1.985/1.965	1.640/1.860

Seal Compression Ring
Figure 3.



Dimensions Shown in Inches

Tool No.	Shaft Seal Dia.	Dim. "A"	Dim. "B"	Dim. "C"
J26752	1¼	1.300/1.350	1.500/1.498	1.800/1.600
J33074-2	1½	1.550/1.600	1.747/1.745	2.400/2.200

Seal Driver
Figure 2.

CONVERSIONS

Inches	mm	Inches	mm
.740	18.80	1.610	40.89
.760	19.30	1.715	43.55
1.175	29.85	1.735	44.07
1.185	30.10	1.745	44.32
1.240	31.50	1.747	44.37
1.252	31.80	1.751	44.48
1.258	31.95	1.753	44.53
1.260	32.00	1.800	45.72
1.280	32.51	1.840	46.74
1.290	32.77	1.860	47.24
1.300	33.02	2.052	52.12
1.350	34.29	2.057	52.25
1.498	38.05	2.200	55.88
1.500	38.10	2.240	56.90
1.502	38.15	2.260	57.40
1.504	38.20	2.360	59.94
1.508	38.30	2.370	60.20
1.530	38.87	2.400	60.96
1.540	39.12	3.00	76.2
1.550	39.37	3.10	78.7
1.590	40.39	4.00	101.6
1.600	40.46	4.10	104.1

NOTE: Tool Kit J26905 for 1¼ inch (32 mm) seal diameter coupling shaft includes tools J26751, J26752 and J26753.

Tool Kit J33074 for 1½ inch (38 mm) seal diameter coupling shaft includes tools J33074-1, J33074-2 and J33074-3.

Tool Kits available from: Kent-Moore, 29784 Little Mack, Roseville, Michigan 46066, Phone (313) 774-9500.

MAB Service Parts List Chart (1¼ Inch, 31.8 mm, Seal Dia. Coupling Shaft)

CHART USE EXAMPLE: MAB06002 TORQMOTOR™ INCLUDES PART NUMBERS LISTED TO THE RIGHT OF MAB, 06- AND -002 SHOWN IN LEFT HAND COLUMN OF CHART.

CAUTION: THE CHARTED COMPONENT SERVICE INFORMATION IS FOR THE TORQMOTORS LISTED ONLY. REFER TO THE ORIGINAL EQUIPMENT MANUFACTURER OF THE EQUIPMENT USING THE TORQMOTOR FOR ASSEMBLY NUMBERS NOT LISTED BELOW.

	EXPLODED VIEW ITEM #	1*	2*	3*	4*	5*	7*	
	DESCRIPTION	Seal	Retaining Ring	Back-Up Washer	Washer	Seal	Seal Ring(2)	
MAB	SERVICE PART #	032436	401346	028398	029106	032633	032519	
	EXPLODED VIEW ITEM #	8 & 8A**	9**	10**	12**	13**	15	
	DESCRIPTION	Thrust Washer(2)	Thrust Bearing	Bearing	Bearing	Thrust Bearing	Wear Plate	
MAB	SERVICE PART #	400103	067029	070502	070501	067031	477237	
	EXPLODED VIEW ITEM #	17+18	19+21	20*	23			
	DESCRIPTION	Manifold Plate + Manifold	Commutator Assy.	Seal Ring	End Cover Assy.			
MAB	SERVICE PART #	MAB015003X1	MAB018000S1	032435	MAB016000A1			
	EXPLODED VIEW ITEM #	14	16	22	24			
	DESCRIPTION	Drive Link	Rotor Set	Sleeve	Special Bolt(7)			
06-	SERVICE PART #	MAB083001	MAB067001A1	099025	021270			
08-	SERVICE PART #	MAB083001	MAB087000A2	099025	021270			
10-	SERVICE PART #	MAB103000	MAB107000A1	099091	021270			
16-	SERVICE PART #	MAB163001	MAB167000A2	099026	021271			
24-	SERVICE PART #	MAB243001	MAB247000A3	099024	021272			
32-	SERVICE PART #	MAB323001	MAB327005A1	099085	021273			
	EXPLODED VIEW ITEM ✓	6	11	11A	11B***	11C	11D	11E
	DESCRIPTION	Housing	Coupling Shaft	Key	Nut	Washer	Bolt	Lock Washer
-002	SERVICE PART #	MAB012000A1	091399					
-003	SERVICE PART #	MAB012002A1	091404	039027	025126			
-004	SERVICE PART #	MAB012000A1	091404	039027	025126			
-005	SERVICE PART #	MAB012002A1	091399					
-008	SERVICE PART #	MAB012000A1	091405					
-009	SERVICE PART #	MAB012002A1	091405					
-010	SERVICE PART #	MAB012000A1	091416	039028		028413	G223734	G103325
-011	SERVICE PART #	MAB012002A1	091416	039028		028413	G223734	G103325
-014	SERVICE PART #	MAB012002A1	091462			028413	G223734	G103325
-015	SERVICE PART #	MAB012000A1	091937					
-016	SERVICE PART #	MAB012000A1	091462			028413	G223734	G103325
-017	SERVICE PART #	MAB012002A1	091437					
-041	SERVICE PART #	MAB012000A1	091435					

NOTES:

*Included in MAB500003—standard seal kit. Other kits: MAB500004—viton, synthetic fluid applications, MAB500005—cold temperature applications.

**Included with Item #8, Service Housing Assembly.

***Item #11B nut service part number listed is for Torqmotor assembly part numbers with an A1 suffix only.
Item #11B nut service part number for Torqmotor assembly part numbers with an A4 suffix is 025113.
1B nut service part number for Torqmotor assembly part numbers with an A7 suff[illegible]5132.

MAE (Standard) Service Parts List Chart (1¼ Inch, 31.8 mm. Seal Dia. Coupling Shaft)

CHART USE EXAMPLE: MAE 10002 TOROMOTOR INCLUDES PART NUMBERS LISTED TO THE RIGHT OF MAE 10 AND 002 SHOWN IN LEFT HAND COLUMN OF CHART.

CAUTION: THE CHARTED COMPOMENT SERVICE INFORMATION IS FOR THE TOROMOTORS LISTED ONLY. REFER TO THE ORIGINAL EQUIPMEMT MANUFACTURER OF THE EQUIPMENT USING TOROMOTOR FOR ASSEMBLY NUMBERS NOT LISTED BELOW

	EXPLODED VIEW ITEM #	1*	2*	3*	4*	5*	7*		
	DESCRIPTION	Seal	Retaining Ring	Back-Up Washer	Washer	Seal	Seal Ring(2)		
MAE	SERVICE PART #	032436	401393	028398	029106	032633	032519		
	EXPLODED VIEW ITEM #	8 & 8A**	9**	10**	12**	13**	19-21	20*	
	DESCRIPTION	Thrust Washer(2)	Thrust Bearing	Bearing	Bearing	Thrust Bearing	Commutator Assy.	Seal Ring	
MAE	SERVICE PART #	400103	067029	070502	070501	067031	MABD18000S1	032435	
	EXPLODED VIEW ITEM #	14	15	16	17	18	22	23	24
	DESCRIPTION	Drive Link	Wear Plate	Rotor Set	Manifold Plate	Manifold	Sleeve	End Cover Assy.	Special Bolt(7)
10-	SERVICE PART #	MAE103000	477259	MAE107000	477260	MAED15000	099082	MAED16000A1	021271
14-	SERVICE PART #	MAE143000	477259	MAE147000	477260	MAED15080	099086	MAED16000A1	021352
20-	SERVICE PART #	MAE203000	477259	MAE207000	477260	MAED15090	099092	MAED16000A1	021348
24-	SERVICE PART #	MAE243000	477259	MAE247000	477260	MAED15000	099086	MAED16000A1	021273
34-	SERVICE PART #	MAE343000	477257	MAE347000	477256	MABD15003	099084	MABD16000A1	021273
68-	SERVICE PART #	MAE683000	477257	MAE687000	477256	MABD15003	099079	MABD16000A1	021329
	EXPLODED VIEW ITEM #	6	11	11A	11B***	11C	11D	11E	
	DESCRIPTION	Housing	Coupling Shaft	Key	Nut	Washer	Bolt	Lock Washer	
-002	SERVICE PART #	MABD12000A1	091443						
-003	SERVICE PART #	MABD12002A1	091442	039027	025126				
-004	SERVICE PART #	MABD12000A1	091442	039027	025126				
-005	SERVICE PART #	MABD12002A1	091443						
-008	SERVICE PART #	MABD12000A1	091445						
-009	SERVICE PART #	MABD12002A1	091446						
-010	SERVICE PART #	MABD12000A1	091441	039028		028413	G223734	G103325	
-011	SERVICE PART #	MABD12002A1	091441	039028		028413	G223734	G103325	
-014	SERVICE PART #	MABD12002A1	091453			028413	G223734	G103325	
-015	SERVICE PART #	MABD12000A1	091452						
-016	SERVICE PART #	MABD12000A1	091453			028413	G223734	G103325	
-017	SERVICE PART #	MABD12002A1	091452						
-029	SERVICE PART #	MABD12007A2****	091460	039027	025126				

NOTES:

*Included in MAB500003 – standard seal kit. Other kits: MAB500004 – vion, synthetic fluid application: MAB500005 – cold temperature applications

**Included with item #6, Service Housing Assembly

***Item #11B nut service part number listed is for Toromotor assembly part numbers with an A1 suffix only.
Item #11B nut service part number for Toromotor assembly part number with an A4 suffix is 025113.
Item #11B nut service part number for Toromotor assembly part number with an A7 suffix is 025132.

****Housing MAB012007A2 uses chambered washer #400135 for item 8A in the exploded assembly view.

MAE Service Parts List Chart (1½ Inch, 38.1 mm, Seal Dia. Coupling Shaft)

CHART USE EXAMPLE: MAE10037 TOROMOTOR™ INCLUDES PART NUMBERS LISTED TO THE RIGHT OF MAE, 10- and -037 SHOWN IN LEFT HAND COLUMN OF CHART.

CAUTION: THE CHARTED COMPONENT SERVICE INFORMATION IS FOR THE TOROMOTORS LISTED ONLY. REFER TO THE ORIGINAL EQUIPMENT MANUFACTURER OF THE EQUIPMENT USING THE TOROMOTOR FOR ASSEMBLY NUMBERS NOT LISTED BELOW.

	EXPLODED VIEW ITEM #	1*	2*	3*	4*	5*	7*		
	DESCRIPTION	Seal	Retaining Ring	Back-Up Washer	Washer	Shaft Seal	Seal Ring (2)		
MAE	SERVICE PART #	032752	401431	028475	029107	032726	032519		
	EXPLODED VIEW ITEM #	8**	8A**	9**	10&12**	13**	19+21	20*	
	DESCRIPTION	Thrust Washer	Thrust Washer	Thrust Bearing	Bearing(2)	Thrust Bearing	Commutator Assy.	Seal Ring	
MAE	SERVICE PART #	400136	400138	069017	071017	068024	MAB018000S1	032435	
	EXPLODED VIEW ITEM #	14	15	16	17	18	22	23	24
	DESCRIPTION	Drive Link	Wear Plate	Rotor Set	Manifold Plate	Manifold	Sleeve	End Cover Assy.	Special Bolt(7)
10-	SERVICE PART #	MAE103000	477259	MAE107000	477260	MAE015000	098082	MAE016000A1	021271
14-	SERVICE PART #	MAE143000	477259	MAE147000	477260	MAE015000	098096	MAE016000A1	021352
20-	SERVICE PART #	MAE203000	477259	MAE207000	477260	MAE015000	098092	MAE016000A1	021340
24-	SERVICE PART #	MAE243000	477259	MAE247000	477260	MAE015000	098086	MAE016000A1	021273
34-	SERVICE PART #	MAE343000	477257	MAE347000	477256	MAB015003	098084	MAB016000A1	021273
68-	SERVICE PART #	MAE683000	477256	MAE687000	477256	MAB015003	098079	MAB016000A1	021329
	EXPLODED VIEW ITEM #	6	11	11A	11B*** For A1 Assys.	11B*** For A4 Assys.	11B*** For A7 Assys.		
	DESCRIPTION	Housing	Coupling Shaft	Key	Nut	Nut	Nut		
-037	SERVICE PART #	MAB012015A1	091466	039039	025131				
-038	SERVICE PART #	MAB012013A1	091466	039027	025126	025113	025132		
-039	SERVICE PART #	MAB012014A1	091466	039027	025126	025113			
-040	SERVICE PART #	MAB012014A1	091466	039039	025131	025133			
-048	SERVICE PART #	MAB012015A1	091466	039027	025126	025113			

NOTES:

*Included in MAE500003—Standard seal kit.

**Included with item #6, Service Housing Assembly.

***Item #11B nut service part number varies as shown for Torqmotor assembly part numbers listed that have an A1, A4 or A7 suffix.

Disassembly and Inspection Procedures

PREPARATION BEFORE DISASSEMBLY

Before disconnecting hoses, thoroughly clean off all outside dirt around fittings. (After disconnecting hoses and before removing from vehicle, IMMEDIATELY plug portholes.) Drain fluid and finish cleaning and drying assembly before placing on a clean work surface. (A piece of clean paper makes an excellent disposable top.) All disassembled parts should be cleaned separately in clean petroleum-based solvent and blown dry with air to avoid nicks and burrs. Discard all seal and seal rings as they are removed from Torqmotor. Use Ross Gear Division or OEM approved service parts.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.

REPLACEMENT OF HIGH PRESSURE SEAL (5) WITHOUT COMPLETE TORQMOTOR Ô DISAS-SEMBLY

(Reference Exploded Assembly View)

1. Remove and discard dirt seal (1) and retaining ring (2) from Torqmotor. [Some applications may not require dirt seal (1).]
2. Completely fill Torqmotor with oil. Plug "A" and "B" ports and set Torqmotor in a clean pan. Place a clean rag around the coupling shaft seal area of the housing to prevent oil spray. Carefully grip coupling shaft with appropriate wrench and rotate coupling shaft rapidly in a counter-clockwise direction. Oil pressure generated by Torqmotor will eject backup washer (3), washer (4) and seal (5).
3. Select the proper seal assembly tools for the 1 1/4 inch (31.8 mm) or 1 1/2 inch (38.1 mm) seal diameter coupling shaft involved. See Figures 1, 2 and 3, page 2.

   Insert the selected seal compression ring tool (Figure 3), with chamfered end inward, into housing (6) until it bottoms out. Assemble the selected seal thimble tool (Figure 1) over coupling shaft (11). Coat new seal (5) with clean grease and assemble over seal thimble with lip side inward. Push new seal (5) into housing (6) with the appropriate seal driver tool (Figure 2). Remove seal driver, thimble and compression tools.
4. Hold washer (4) between thumb and index finger and slightly collapse washer and assemble into housing (6). Assemble back-up washer (3) tab side out, and retaining ring (2). Be sure rounded edge of retaining ring is faced inward, and that back-up washer tab is between ends of retaining ring. Be sure the new retaining ring (2) is the same thickness as the one removed. (Seal kit contains two retaining rings to select from.) Apply a small amount of clean grease to the back side of new seal (1) and assemble into housing (6) if required.

TORQMOTOR DISASSEMBLY

(Reference Exploded Assembly View

1. Place Torqmotor in a vise, clamping down on the housing (6) port bosses with the coupling shaft (11) pointed down.

   WARNING: IF THE TORQMOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.
2. If the end cover assembly (23) has a valve (28), scribe a line on housing (6) in some manner in line with the port in the end cover for reassembly orientation. Loosen the two plugs (25) with a 3/16 inch Allen wrench, for later disassembly. Remove the seven special bolts (24) using a 9/16 inch thin wall socket. Inspect bolts for damaged threads, or the sealing ring under the bolt head. Replace damaged bolts.
3. Remove end cover assembly (23) and sea! ring (7) by inserting screwdriver between end cover assembly and sleeve (22). Pry up end cover assembly and lift from unit with seal ring attached. Discard seal ring (7). It may be necessary to use a chisel and hammer to break the end cover loose.
4. If the end cover (23) has valve (28) and the previously loosened plugs (25), remove the two plugs and O-rings (26).

   CAUTION: Be ready to catch two springs (27) and valve (28) that will fall out of the end cover valve cavity when the plug assemblies are removed.

   Thoroughly wash cover in proper solvent and blow dry. Be sure the cover valve apertures, including the internal orifice plug, are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace cover as necessary.

   NOTE: O-ring (26) is not included in seal kits but is serviced separately if required.
5. Remove commutator ring (21), commutator (19), seal ring (20), and manifold (18) by using two of the special bolts (24) as a lifting tool-insert the two special bolts Into two holes and lift out the previously mentioned parts.
6. Remove seal ring (20) from commutator (19), using an air hose to blow air into ring groove until seal ring is lifted out and discard seal ring. Inspect commutator and commutator ring (21) for cracks or burrs. Inspect commutator for wear, scoring, spalling or brinelling. If any of these conditions exist, replace commutator and commutator ring as a matched set.
7. Remove manifold plate (17) by again using two special bolts (24) as a lifting tool. Inspect

manifold (18) and manifold plate (17) for cracks, surface scoring, brinelling or spalling. Replace manifold or manifold plate that exhibits any of these conditions. A polished pattern on the ground surfaces from commutator or rotor rotation is normal.

8. Remove rotor set (16) and wear plate (15), by again using the two bolts as a lifting tool. Retain rotor set in its assembled form, if possible, to maintain the same rotor vane to stator contact surfaces. Inspect the rotor set in its assembled form for nicks, scoring, or spalling, on any surface and broken or worn rotor splines. If any rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the wear plate for cracks, brinelling, or scoring.
9. Place rotor set on a flat surface and center rotor (16A) in stator (16C) such that two rotor lobes (180° apart) and a roller vane (16B) centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is more than .005 inches (0.13 mm) of clearance, replace rotor set.
10. Remove drive link (14) from coupling shaft (11) if it was not removed with rotor set and wear plate. Inspect drivelink for cracks and for worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts.
11. Remove thrust bearing (13) and inspect for wear, brinelling, corrosion, and a full complement of retained rollers.
12. Remove coupling shaft (11) by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. Replace coupling shaft if any of these conditions exist.

NOTE: Minor shaft wear in seal area is permissible. If wear exceeds .020 inches (0.51 mm) diametrically, replace coupling shaft.

A slight "polish" is permissible in the shaft bearing area. Anything more would require coupling shaft replacement.

13. Remove sleeve (22) by inserting screwdriver between sleeve and housing (6) and pry up. Inspect sleeve for deformation from the original cylindrical shape to a "barrel" or "hour glass" shape. Inspect sleeve ends for severe nicks, burrs or corrosion. Replace sleeve if any of these conditions exist.

NOTE: Minor burrs and corrosion that would damage new seal rings during assembly can be removed from sleeve ends.

14. Remove seal ring (7) from housing (6) and discard seal ring.
15. Remove housing (6) from vise, turn over and reclamp in vise with dirt seal (1) end pointed up.
16. Remove dirt seal (1), retaining .ring (2), back-up washer (3), washer (4), and seal (5) from housing (6). Discard seals and washers but keep retaining ring(2) for comparison when selecting new retaining ring from seal kit. If burr exists on retaining ring groove, remove with a scraping tool.
17. Inspect housing (6) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly and the disassembly of the Torqmotor is complete.
18. If the housing assembly (6) has passed inspection to this point, inspect the bearings (9), (10), (12) and thrust washers (8) and (8A). The bearing rollers must be firmly retained in the bearing cages, but must rotate and orbit freely. All rollers and the thrust washers must be free of brinelling and corrosion. If the housing has passed this inspection the disassembly of the Torqmotor is completed.
19. If only the outer bearing (12) requires replacement, carefully use a suitable bearing puller to remove bearing so the housing is not damaged.
20. If bearing (10) requires replacement, use a 1.488 inch (37.80 mm) maximum diameter shaft or a 1.745 inch (44.32 mm) maximum diameter shaft based on the internal seal (5) bore diameter and press out thrust washers (8), (8A), thrust bearing (9), and bearings (10) and (12). The housing wearplate face should be placed on a block of wood during the pressing operation to protect it. Discard thrust washers (8) and (8A), thrust bearings (9), and bearings (10) and (12) and replace with new parts, as parts will have been damaged when being pressed out.

NOTE: The depth or location of bearings (10) and (12) in relation to the housing wearplate face should be measured and noted before pressing the bearings out. This will facilitate the correct reassembly of new bearings.

The disassembly of Torqmotor is completed.

TORQMOTOR ASSEMBLY PROCEDURES

(Reference Exploded Assembly View)

Replace all seals and seal rings with new ones each time you reassemble the Torqmotor unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

NOTE

Individual seals and seal rings as well as a complete seal kit are available. The parts should be available through most OEM parts distributors or Ross approved Torqmotor distributors. (Contact your local dealer for availability.)

NOTE

Unless otherwise indicated, do not oil or grease parts before assembly.

Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, sleeve, and housing and from port and sealing areas.

HOUSING BEARING REPLACEMENT PROCEDURES

1. If bearing components were removed for replacement, assemble new thrust washer (8), new thrust bearing (9) and new thrust washer (8A) in that order into housing 161 bearing cavity. If thrust washer (8A) has a chamfer on the inside diameter, the chamfered side must face away from thrust bearing (9).

   NOTE

   Thrust washer (8A) will be identical to thrust washer (8) unless a chamfered inside diameter is required because of coupling shaft design.

   NOTE:

   An appropriate size piloted bearing mandrel is required to press in housing bearings.

2. If bearings (10) and (12) required are for a 2.25 inch (57.2 mm)l diameter (nominal) housing bearing bore, press in new bearing (10) which is 1.0 inch (25.4 mm) long, into housing 161 bearing bore to a depth of 2.410 ± .010 inch (61.2 ± 0.254 mm), measured from the housing wear plate contact surface. Then, press in new bearing (12) which is .5 inch (12.7 mm) long into housing bearing bore to a depth of .115 ± .010 inch (2.92 ± 0.254 mm) measured from the housing wear plate contact surface.

   NOTE

   Press against the lettered end of bearing cage when pressing in a roller bearing assembly.

3. If the bearings (10) and (12) required are for a 2.50 inch (63.5 mm) diameter nominal) bearing bore, press in new bearing (10) which is 1.0 inch (25.4 mm) long into housing 161 bearing bore to a depth of 2.379 ± .010 inch (60.43 ± 0.254 mm) measured from housing wear plate contact surface. Press new bearing (12) which is identical to bearing (10) into housing bearing bore to a depth of .115 ± .010 inch (2.92 ± 0.254 mm) measured from the housing wear plate surface.

   NOTE

   The bearings (10) and (12) must be assembled to the correct depths to assure the necessary clearance for thrust washer (8A) and thrust bearing (13) and to assure required bearing support.

TORQMOTOR ASSEMBLY.

If the sealing diameter of the coupling shaft (11) is larger than any other diameter on the output end of the coupling shaft, begin the Torqmotor assembly procedures with Step 1 below. If there is a diameter on the output end of the coupling shaft equal to the sealing diameter of the coupling shaft begin the procedures with Step 6 below.

1. Place housing (6) in a vise and clamp down on housing port bosses with small bore end pointed up. Apply clean grease to new seal (5) and assemble into housing with seal lip pointed inward.
2. Hold washer (4) between thumb and index finger and slightly collapse to facilitate assembly into housing (6).
3. Assemble back-up washer (3) into housing (6) with the anti-rotation tab facing out.
4. Select a new retaining ring (2) from the seal kit, that is the same thickness as the retaining ring removed.

   Assemble the new retaining ring into housing 16). Be sure rounded edge of retaining ring is faced inward and that back-up washer tab is between ends of retaining ring.
5. Apply a small amount of clean grease to back side of new seal (1) and assemble into housing (6), if a seal Ill is required.
6. Invert housing (6) in vise so that the large bore end is up.
7. Apply cellophane tape around splines or keyway on coupling shaft (11) to prevent damaging seals.
8. Assemble coupling shaft (11), firmly seating it against thrust washer (8A).
9. Assemble thrust bearing (13) onto end of coupling shaft (11).
10. Assemble drive link (14) into coupling shaft (11) with their splines in mesh. (Align hole in drive link with hole in coupling shaft (11), if applicable.)

    NOTE

    Two alignment studs screwed finger tight into housing (6) boltholes, approximately 180° apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of 318-24 UNF 2A bolts that are over .5 inch (12.7 mm) longer than the bolts (24) used in the Torqmotor.
11. Assemble wear plate 1151 over drive link (14) and studs onto housing (6).
12. Install assembled rotor set (16) with counterbore in rotor (16A) down, if applicable, and splines in mesh with drive link splines.

    NOTE

    If necessary, go to "Rotor, Stator, Vane Assembly" procedures on page 9.
13. Assemble manifold plate (17), manifold (18) and then the commutator ring (21) over the drive link (14) onto rotor set (16) per the exploded assembly view. Be sure swirls in manifold and manifold plate are faced together.

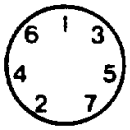
14. Assemble a new seal ring (20), flat side up, into commutator (19) and assemble commutator over end of drive link (14) onto manifold (18) with seal side up.
15. Assemble new seal (7) on housing (6), apply a generous amount of SAE 10W40 to both ends of sleeve (22)1 and assemble onto housing. Make sure sleeve is sitting in a non-cocked position.
16. Turn a plug (25) with a new O-ring (26) if required loosely onto one end of cover (23) valve cavity if required.
17. Then insert a spring (27), the valve (28) and another spring (27) into the other end of the valve cavity. Turn another plug (25) with new O-ring (26) loosely into cover valve cavity.
18 Assemble a new seal ring (7) onto end cover and assemble end cover onto sleeve (22) in a non-cocked position.

NOTE

If the end cover has a valve (28) use the line you previously scribed on the housing (6) to radically align the end cover port into its original position.

19. Assemble seven special bolts (24) and screw in finger tight. Removal of the two alignment studs should be made after at least two bolts have been assembled. Alternately and progressively tighten the bolts to pull end cover assembly (23) and sleeve (22) into place with a final torque of 50 ± 5 ft. lbs. (68 ± 8 N m).

Tightening sequence:



NOTE

The special bolt (24) required for use with the shuttle valve (28) end cover assembly (23) is longer than the bolt required with the standard end cover assembly. Refer to the individual service parts list for correct service part number.

20. Torque the two plug assemblies (25) in end cover assembly to 12-19 ft. lbs. (16-26 N m).
21. If seal (5), washer (4), back-up washer (3), snap ring (2) and seal (1) have not yet been assembled, invert housing in vise so the coupling shaft (11) is pointing up and follow procedures #3 and #4 under "Replacement of High Pressure Seal" on page 6 to assemble these components.

The assembly of Torqmotor is now. complete except for woodruff key (1A), nut (11B), washer (11C), bolt (11D) or lock washer (11E) if applicable at Torqmotor installation. See final checks.

ROTOR, STATOR, VANE ASSEMBLY PROCEDURE

A disassembled rotor (16A), stator (16C) and vanes (16B) the cannot be readily assembled by hand can be assembly by the following procedures.

1. Place stator (16C) onto wear plate (15) after following Torqmotor assembly procedures 1 through 11.
2. If assembly alignment studs are not being utilized, alights stator bolt holes with wear plate bolt holes and turn two bolts (24) finger tight into bolt holes 180° apart to retain stator and wear plate stationary.
3. Assemble six vanes (1681 into the stator vane packets.
4. Assemble rotor (16A), counterbore down, if applicable, into stator (16CI and onto wear plate (15) with rotor splines in mesh with drive link splines.
5. Grasp the output end of coupling shaft Ill with locking pliers or other appropriate turning devices and Ttate coupling shaft, drive link and rotor to seat the rotor and assembled vanes into stator, creating necessary clearance to assemble seventh vane. Assemble the seven vanes using minimum force.
6. Remove the two assembled bolts if used to retain stator and wear plate.

Final Checks

Final Checks

- Pressurize the Torqmotor™ with 100 p.s.i. (6.9 BAR) dry nitrogen and submerge in solvent to check for external leaks.
- Check Torqmotor™ for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)
- Pressure port with "A" cast under it on housing 1181 is for counter-clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for clockwise coupling shaft rotation.
- Use test stand if available, to check operation of the Torqmotor™.

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

- 10W40 SE or SF manufacturers suggested oil.
- Hydraulic fluid as recommended by equipment manufacturer, but the viscosity should not drop below 50 SSU or contain less than .125% zinc anti-wear additives.

CAUTION

Do not mix oil types. Any mixture, or an unproved oil, could deteriorate the seals. Maintain the proper fluid level in the reservoir. When changing fluid, completely drain old oil from the system. It is suggested also that you flush the system with clean oil.

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

Maximum operating temperature 200°F (93.3°C).

Tips for Maintaining the Torqmotor™
Hydraulic System

- Adjust fluid level in reservoir as necessary.
- Encourage all operators to report any malfunction or accident that may have damaged the hydraulic system or component.
- Do not attempt to weld any broken Torqmotor"' component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any Torqmotor™ part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around and the filler caps before checking oil level.
- Investigate and correct any external leak in the hydraulic system, no matter how minor the leak.
- Comply with manufacturer's specifications for cleaning or replacing the filter.

CAUTION

Do not weld, braze, solder or any way alter any TorqmotorTM component.

CAUTION

Maximum operating pressure must not exceed recommended Torqmotor™ pressure capacity.

CAUTION

Always carefully inspect any system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

CAUTION

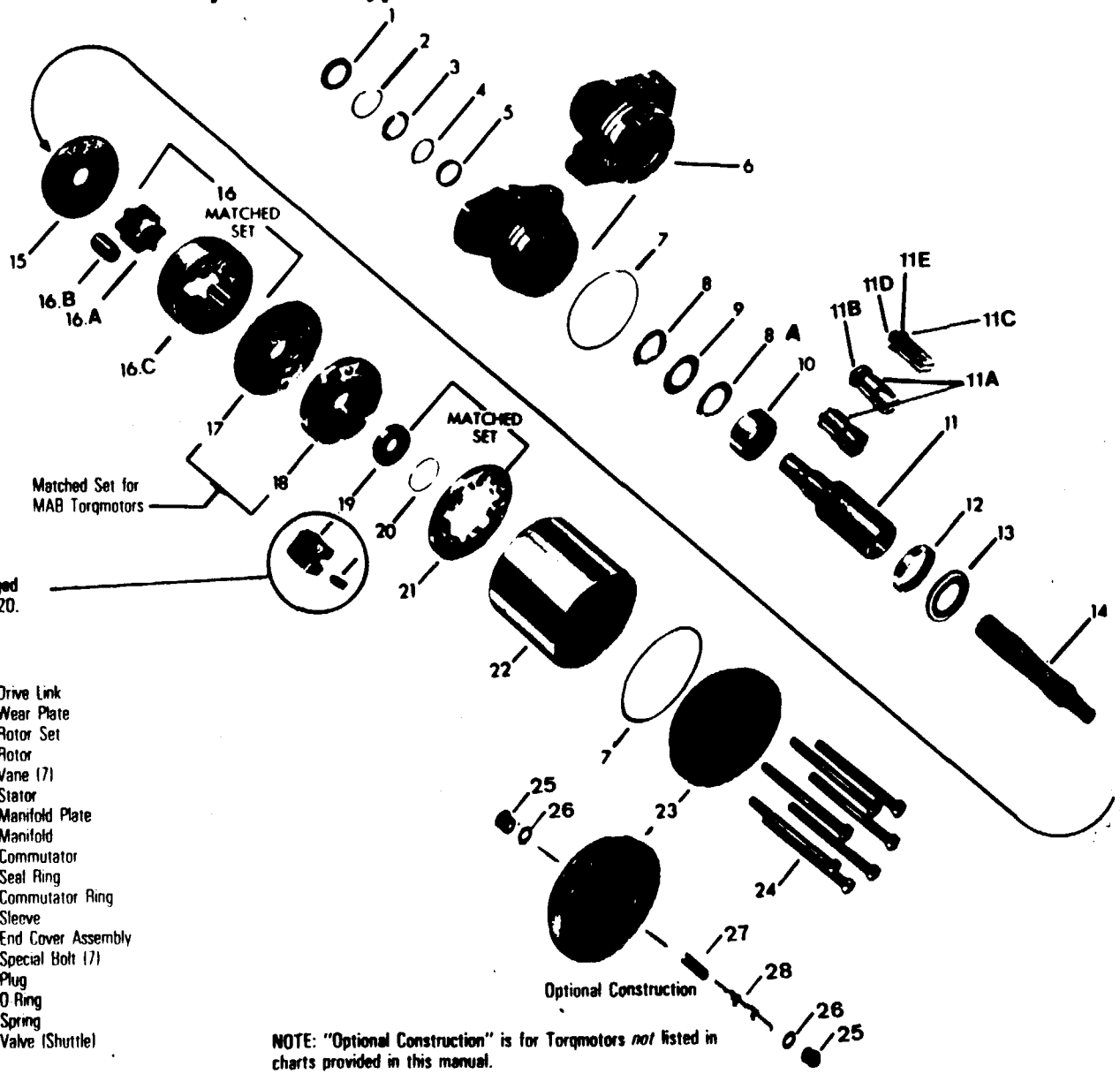
Do not force any coupling onto the Torqmotor™ coupling shaft as this could damage the unit internally.

Ross Gear extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact our Ross Service Department or local Ross approved Distributor. Our phone number and telex number and address are on the back cover of this manual.

Write or call for information and added details concerning your installation and applications:

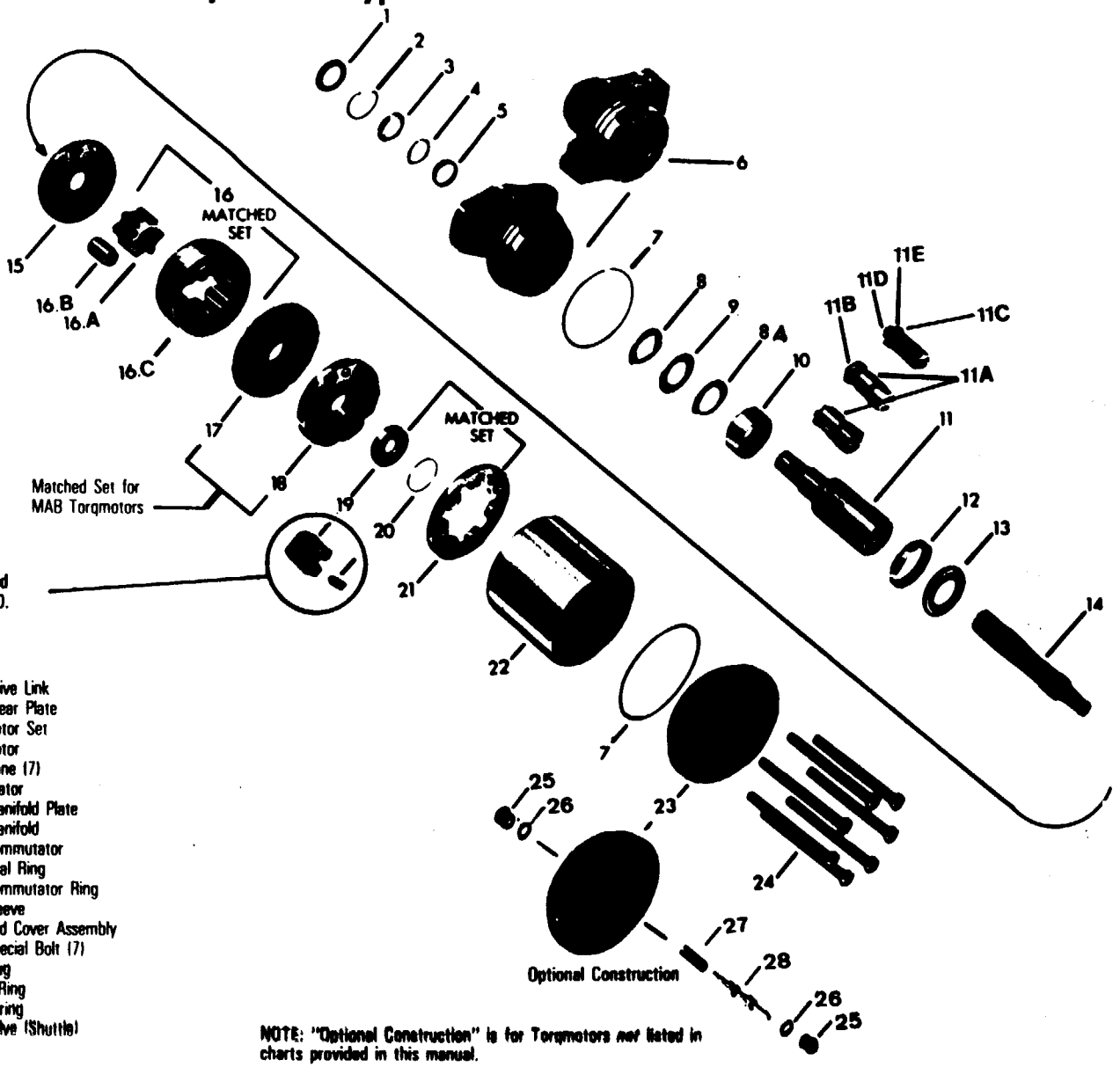
Phone: 317.423.5377
Telex: 279413
Write: Ross Gear Division
800 Heath Street
Lafayette, Indiana 47902

MAB/MAE Torqmotor™ Exploded Assembly View—Typical



Item No.	Description	Item No.	Description
1.	Seal	14.	Drive Link
2.	Retaining Ring	15.	Wear Plate
3.	Back-Up Washer	16.	Rotor Set
4.	Washer	16A.	Rotor
5.	Seal	16B.	Vane (7)
6.	Housing	16C.	Stator
7.	Seal Ring (2)	17.	Manifold Plate
8.	Thrust Washer	18.	Manifold
8A.	Thrust Washer	19.	Commutator
9.	Thrust Bearing	20.	Seal Ring
10.	Bearing	21.	Commutator Ring
11.	Coupling Shaft	22.	Sleeve
11A.	Key	23.	End Cover Assembly
11B.	Nut	24.	Special Bolt (7)
11C.	Washer	25.	Plug
11D.	Bolt	26.	O-Ring
11E.	Lock Washer	27.	Spring
12.	Bearing	28.	Valve (Shuttle)
13.	Thrust Bearing		

MAB/MAE Torqmotor™ Exploded Assembly View—Typical



NOTE: Assemble Seal Flat Side Out as Shown in Enlarged View of Sectioned Segments of Items Number 19 and 20.

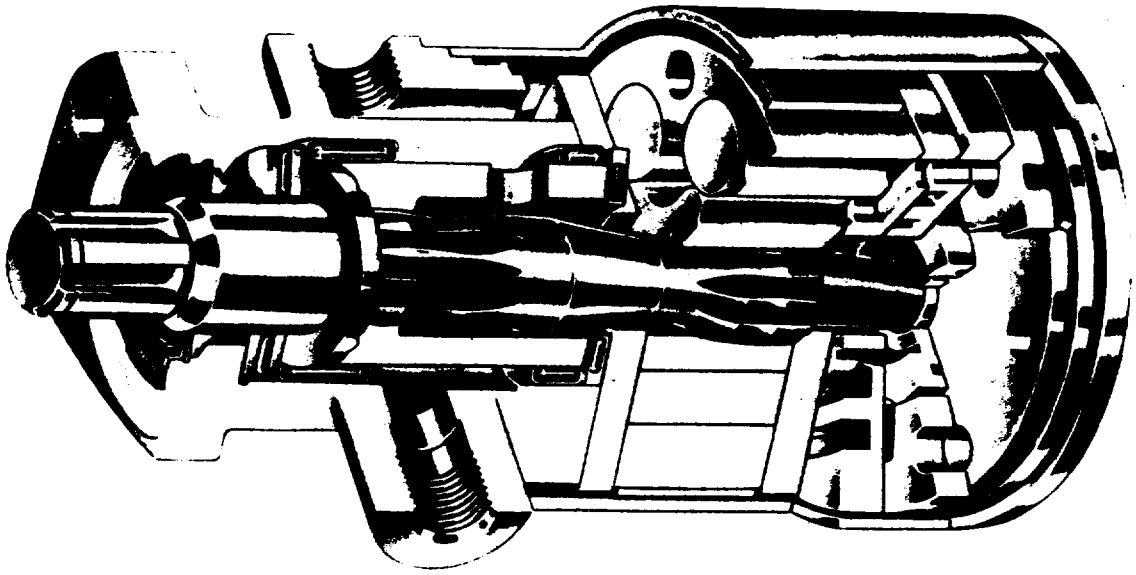
Item No.	Description
1.	Seal
2.	Retaining Ring
3.	Back-Up Washer
4.	Washer
5.	Seal
6.	Housing
7.	Seal Ring (2)
8.	Thrust Washer
8A.	Thrust Washer
9.	Thrust Bearing
10.	Bearing
11.	Coupling Shaft
11A.	Key
11B.	Nut
11C.	Washer
11D.	Bolt
11E.	Lock Washer
12.	Bearing
13.	Thrust Bearing
14.	Drive Link
15.	Wear Plate
16.	Rotor Set
16A.	Rotor
16B.	Vane (7)
16C.	Stator
17.	Manifold Plate
18.	Manifold
19.	Commutator
20.	Seal Ring
21.	Commutator Ring
22.	Sleeve
23.	End Cover Assembly
24.	Special Bolt (7)
25.	Plug
26.	O-Ring
27.	Spring
28.	Valve (Shuttle)

NOTE: "Optional Construction" is for Torqmotors *not* listed in charts provided in this manual.

TRW

Torqmotor™

MAB and MAE Series Service Procedure



Ross Gear Division

Price $3.00

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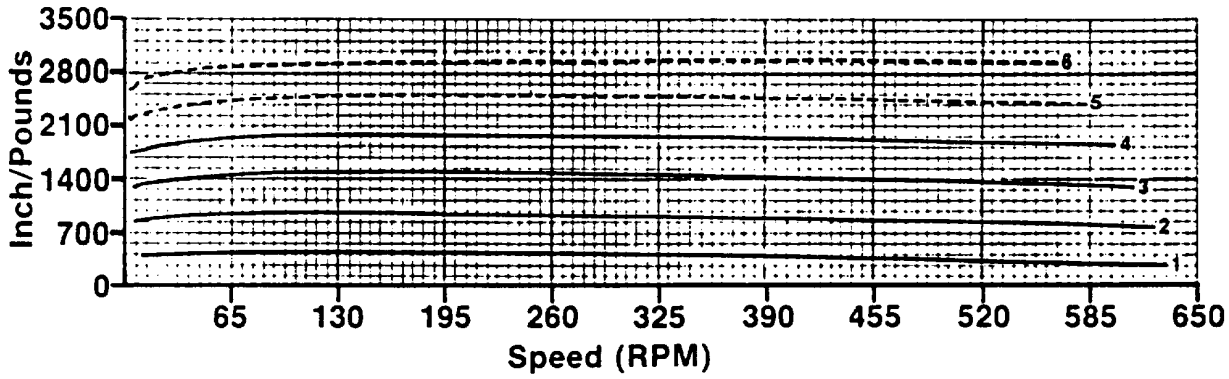
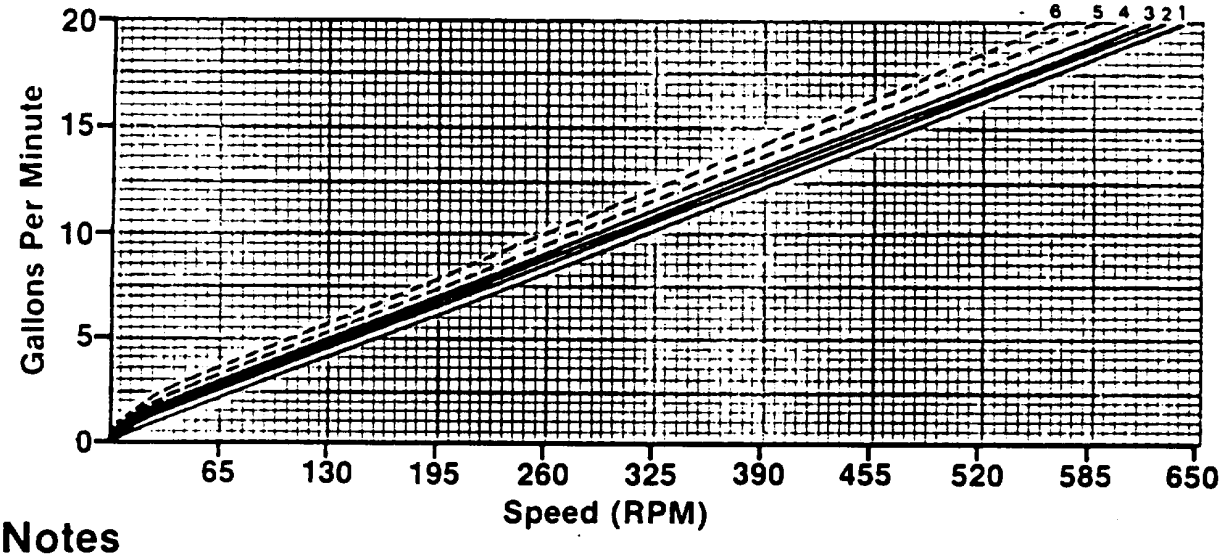
MAB 10 *Torqmotor* ™ hydraulic motors

displacement
7.4 cu. in./rev.

Torque



Flow



Notes

1. Performance curves are based on computer-assisted tests of motors taken at random off of production lines.
2. Each motor was tested using 10W40 oil at 130 degrees Fahrenheit.
3. Curves numbered "5" (2500 PSI) and "6" (3000 PSI) are for *intermittent-use* pressure ratings only.

Legend

English	
1= 500 PSI	4=2000 PSI
2=1000 PSI	5=2500 PSI
3=1500 PSI	6=3000 PSI

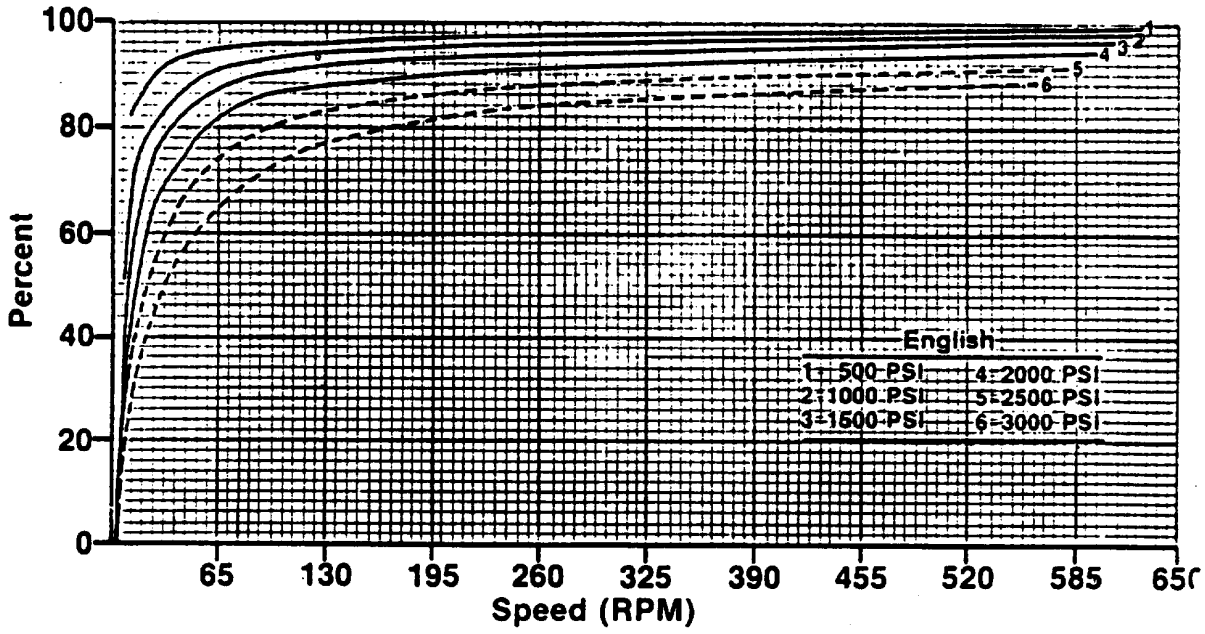
TRW ROSS GEAR DIVISION

——— Continuous ------ Intermittent
(10 percent of every minute)

Torqmotor™ hydraulic motors

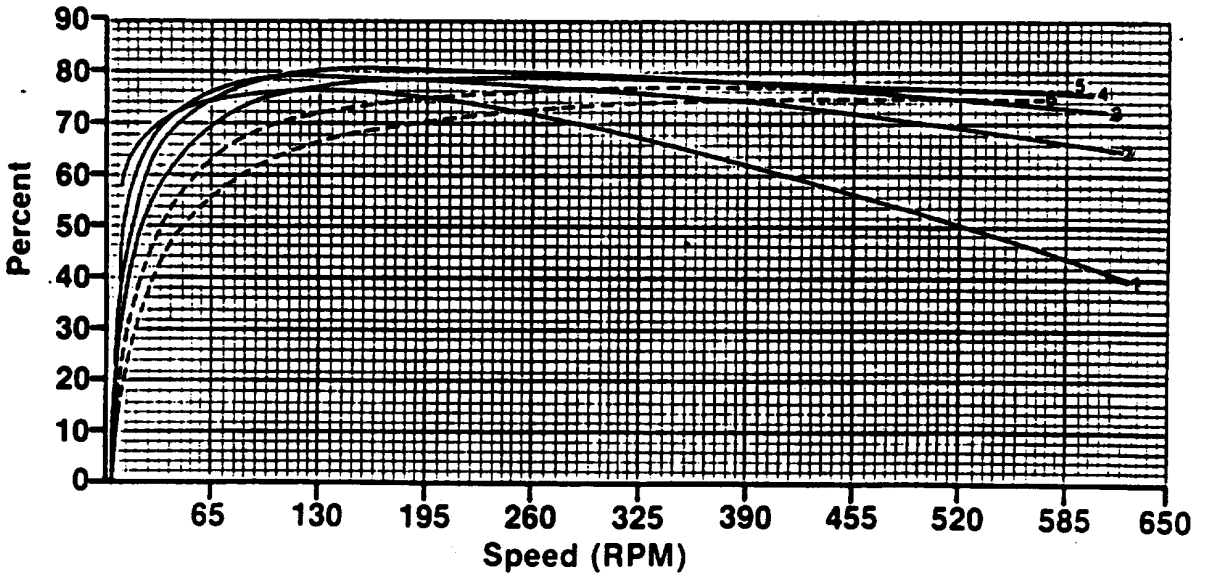
MAB 10
displacement
7.4 cu. in/re

Volumetric Efficiency



Overall Efficiency

——— Continuous ------ Intermittent
(10 percent of every minute)



TRW ROSS GEAR DIVISION

DECKMASTER

MAB
low-speed, high-torque

Torqmotor™
hydraulic motor

Performance graphs

Performance graphs are available as individual catalog sheets for each displacement in the MAB Series. Graphs include overall efficiency, volumetric efficiency, torque vs RPM, and flow vs. RPM. Please ask your TRW/Ross Sales representative to provide these graphs for displacements of specific interest to your application.

Fluid/Filtration

SAE 10W40 API is recommended fluid.

Minimum recommended oil viscosity is 50 SSU with a minimum of .125 percent of zinc anti-wear additives.

Maximum operating temperature recommended is 200°F. (93.3°C)

Recommended nominal filtration is 20-50 micron.

Specification Guide

MAB - xx - 0 - xx

Torqmotor Series

Rotor Width (Displacement)

Mount, Port, Shaft, Combination

Rotor Width (Number of 1/16" Increments) xx	Displacement (in³/Rev.)	(cm³/Rev.)
*06	4.9	80
08	5.9	97
[illegible]	[illegible]	121
16	11.8	193
24	17.8	292
32	23.6	387

[illegible] seals
1 Cold temperature seals
2 Synthetic fluid seals

Mount	Port	Shaft					
		Straight Key 10 46**	1.00-6B Spline Ret. Ring Groove [illegible]	1.25 14 Tooth Spline (12/24) 16	1.25 Tapered Square Key 04	1.00— Woodruff Key Ret. Ring Groove 08 47**	10B Spline Int. Thd. Ret. Ring Groove 19
[illegible]	[illegible]						
Wheel	7/8 "O" Ring	11	05	14	03	09	
							13 Tooth Spline (16/32) 20
2 Hole	1/2" Pipe						

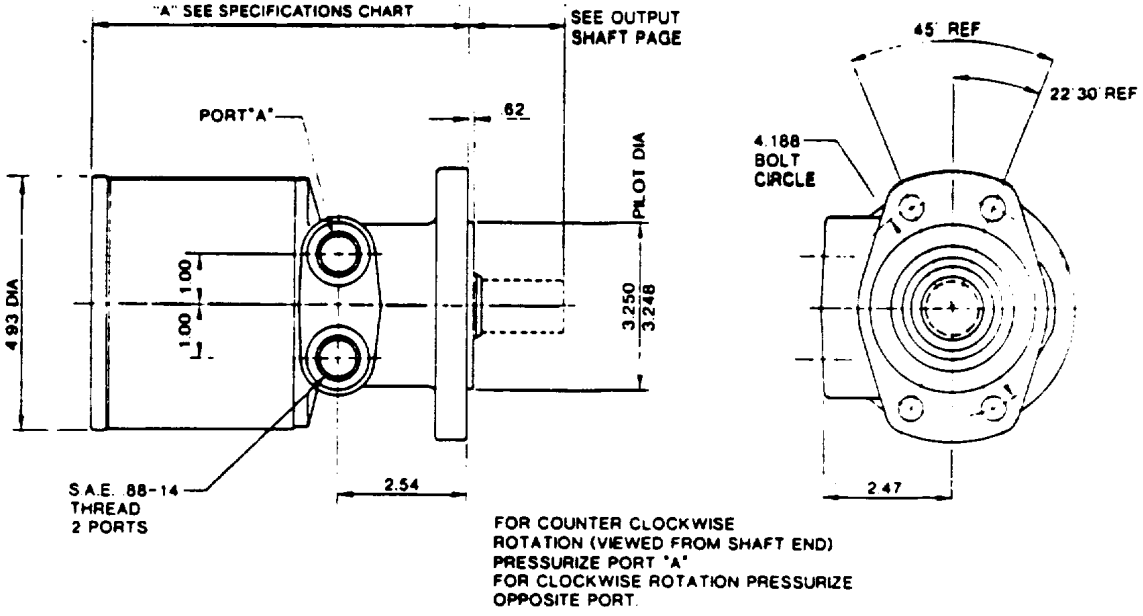
*Not rotor width of 06
**Free running
The 6B spline shaft and the woodruff key shaft are machined for use with a Waldes Truarc snap ring No. 5100-100 or equivalent.

DECKMASTER

[redacted] unit and mount

MAB

Ser

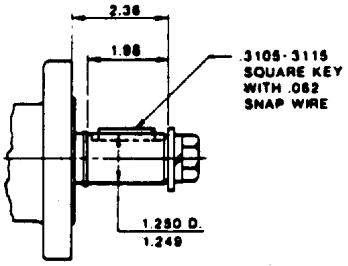


FOR COUNTER CLOCKWISE ROTATION (VIEWED FROM SHAFT END) PRESSURIZE PORT "A"
FOR CLOCKWISE ROTATION PRESSURIZE OPPOSITE PORT.

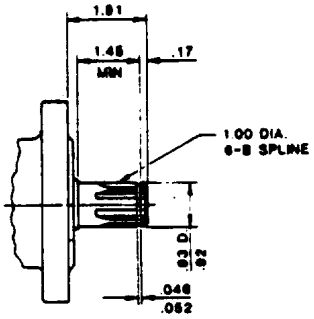
Shafts

[redacted]

Straight key



[redacted]



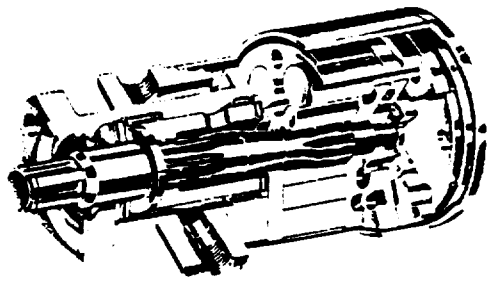
DECKMASTER

Torqmotor™
hydraulic motors

MAB
low-speed, high-torque

Features

- Roller vanes to reduce friction and internal leakage and to maintain efficiency;
- A patented orbiting commutation system for less wear and longer life;
- A patented 60:40 arrangement of internal and external spline members, to transmit more torque with less weight;
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing with motors run in series;
- A manifold and manifold plate combination designed to improve operating efficiency;
- Heavy-duty thrust and needle-roller bearings for high side-load capacity;
- Up to 1,000 lbs (953.6 kg) end-thrust capacity toward or away from motor;
- Up to 36 output horsepower.



Options

- Choose among six displacements, from 4.9 to 23.6 cubic inches/revolution (80 to 387 cm³/rev);
- Choose among five shafts, to suit your application;
- Choose standard or wheel mount.

Notes

Differential pressure (ΔP) is the difference between inlet and outlet port pressures.

Peak (intermittent) operation rating applies to 10 percent of every minute.

Maximum pressure at the motor inlet port (without regard to differential pressure or back pressure ratings or both) is 4000 PSI (281.2 kg/cm²).

Specifications

English								Metric					
MAB TORQMOTOR SERIES		06	08	10	16	24	32	06	08	10	16	24	32
DISPLACEMENT	in³/Rev (cm³/rev)	4.9	5.9	7.4	11.8	17.8	23.6	80	97	121	193	292	387
PRESSURE (P.S.I.) (Kg/cm²)	Continuous (differential)	3000	2250	2000	2000	2000	1150	210.9	158.2	140.6	140.6	140.6	80.9
	Peak (differential)	4000	3500	3000	3000	3000	1500	281.2	246	210.9	210.9	210.9	105.4
	Back (Max.)	1500	1500	1500	1500	1500	1500	105.4	105.4	105.4	105.4	105.4	105.4
THEO./100 psi	(7 kg/cm²)	78	94	118	188	283	376	9	11	14	22	33	43
TORQUE (in. Lbs.) (Kg-m)	@Rated pressure and flow	1955	1708	1850	3103	4564	3117	22.6	19.8	21.9	35.9	52.7	36.0
	@Peak pressure and rated flow	2561	2661	2941	4698	6989	4374	29.6	30.8	34.0	54.3	80.8	50.6
FLOW (GPM) (liters/min.)	Con't. Rated	12	15	15	15	20	20	45	57	57	57	76	76
	Peak	15	20	20	20	25	25	57	76	76	76	95	95
SPEED (RPM)	@Con't. rated flow & pressure	491	536	544	268	224	187	491	536	446	268	224	187
	Maximum	707	783	624	392	324	245	707	783	624	392	324	245
WEIGHT (Lbs.) (Kg)	Standard Mount	24	24	25	27	30	33	10.9	10.9	11.3	12.2	13.6	15.0
	Wheel Mount	26	26	26	29	32	35	11.8	11.8	12.2	13.2	14.5	15.9
"A" DIM. IN. (MM)	Standard Mount	7.40	7.40	7.80	7.90	8.40	8.90	188.0	188.0	191.3	200.7	213.4	226.1
	Wheel Mount	5.62	5.62	5.62	6.12	6.62	7.12	142.7	142.7	145.8	155.4	168.1	180.8

WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	20
Quantity Required:	One
Description:	Winch Motor
Manufacturer:	TRW ROSS
Part Number:	MAB-10-0-02-A1
Source:	TRW ROSS GEAR DIVISION 800 Heath Street Lafayette, Indiana 47902

Tele #: 1-317-423-5377
TELEX #: 279413

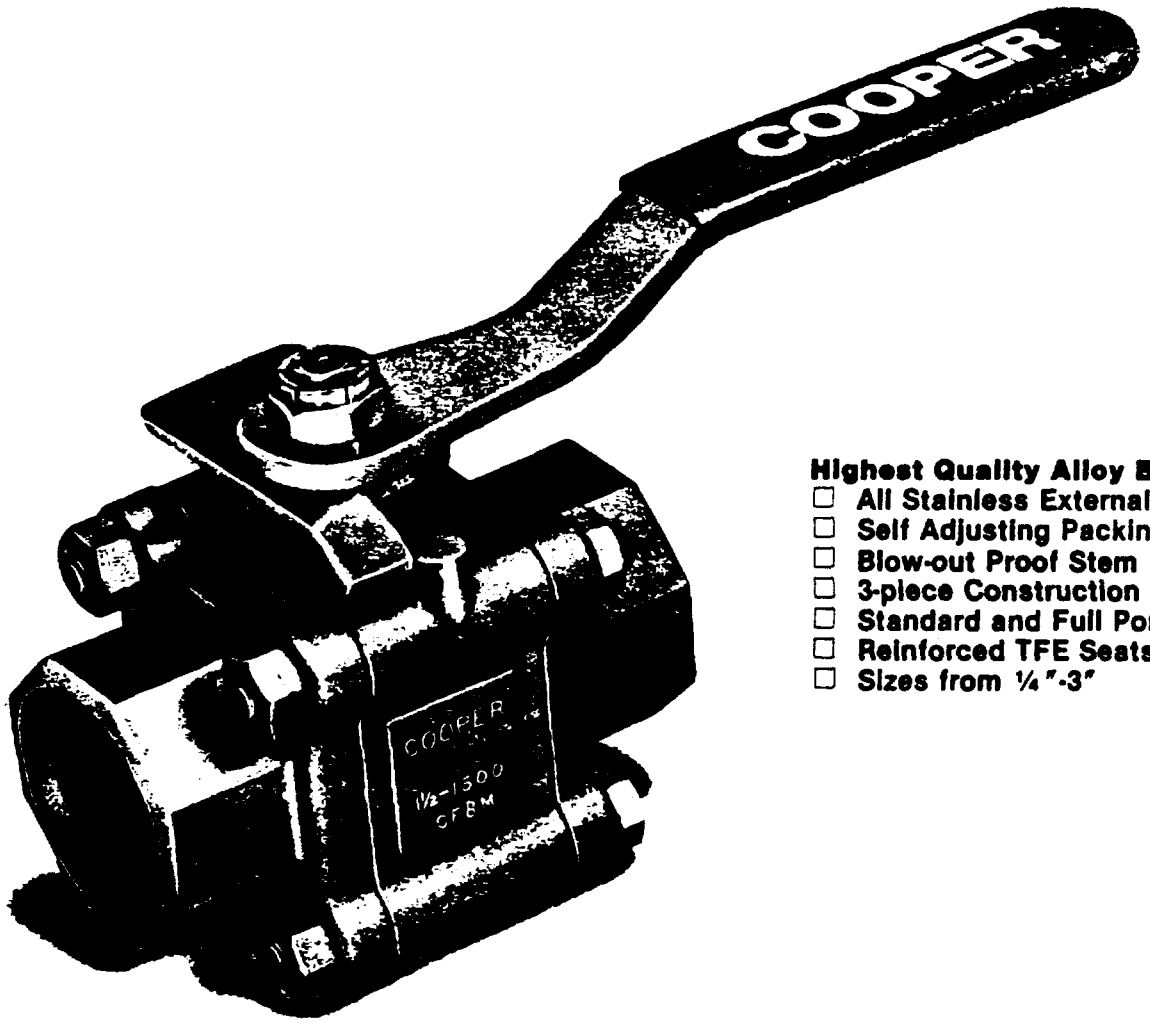
DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	21
Quantity Required:	One
Description:	Ball Valve
Manufacturer:	Cooper
Part Number:	3/4-4150-SE
Source:	Cooper Valve Co. 5524 Harvey Wilson Drive Houston, Texas 77020

Tele #: (713) 675-4201
TELEX #: 76-2953

THE COOPER 3-PIECE BALL VALVE



Highest Quality Alloy Ball Valves

- ☐ All Stainless Externals
- ☐ Self Adjusting Packing
- ☐ Blow-out Proof Stem
- ☐ 3-piece Construction
- ☐ Standard and Full Port
- ☐ Reinforced TFE Seats (1500 psi)
- ☐ Sizes from ¼"-3"

COOPER
VALVE COMPANY

First Choice in stainless steel and alloy valves.

EXACTLY WHAT YOU'D EXPECT
FROM THE SPECIALIST!

COMPLETE ALLOY COVERAGE*

304	Monel
304L	Nickel
316	Inconel
316L	Incoloy
317	Hastelloy B
321	Hastelloy C
347	Titanium
Alloy 20	Zirconium

*Common alloys shown - others available on special order

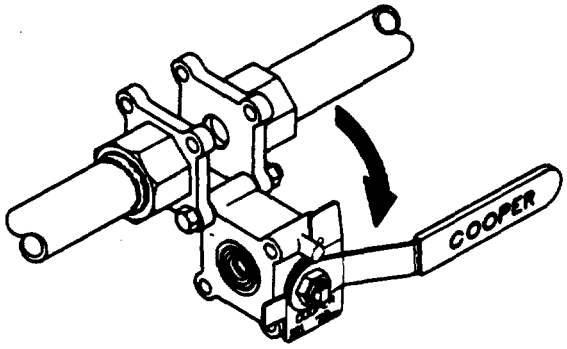
SPECIAL ADVANTAGES

STANDARD FEATURES:

- ALL STAINLESS EXTERNALS.
- REINFORCED TFE SEATS AND SEALS - 1500 PSI - (AVAILABLE TO 5000 PSI WITH SPECIAL SEATS AND SEALS)
- SECONDARY METAL TO METAL SEAT.
- SELF-ADJUSTING PACKING.
- BLOW-OUT PROOF STEM.
- 1/4 "-3" STANDARD AND FULL PORT - ALL ALLOYS.
- COOPERFILL 133 THRUST BEARING - EXCEPTIONALLY LONG LIFE.
- ALL PASSIVATED STAINLESS.
- ALL VALVES HYDROSTATICALLY TESTED TO APPLICABLE ANSI, MSS OR API SPECIFICATIONS.
- ALL VALVES SERIALIZED - FULL TRACEABILITY OF MATERIALS.
- FLEXIBLE MANUFACTURING FACILITY - WIDEST CHOICE OF SPECIAL APPLICATIONS IN THE INDUSTRY.

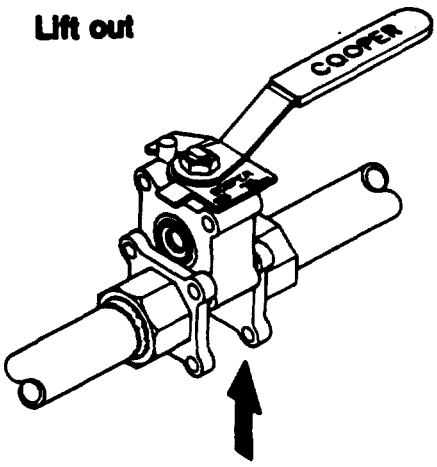
COOPER
VALVE COMPANY

3-PIECE CONSTRUCTION MAKES SWING AWAY POSSIBLE, COMPLETE REMOVAL SIMPLE

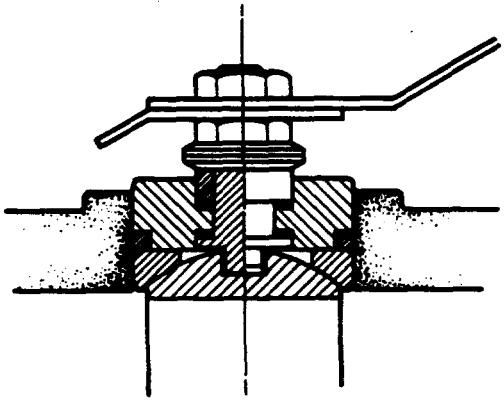


Swing away

Lift out

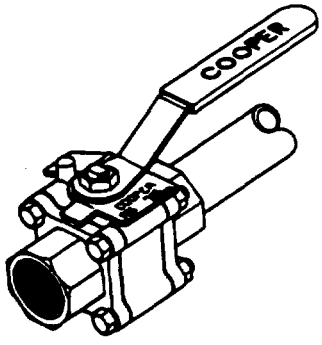


BLOW-OUT PROOF STEM — SELF ADJUSTING PACKING

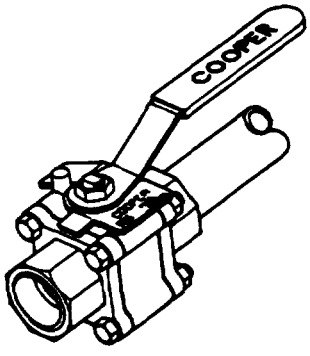


For a maximum safety, the stem is designed with a COOPERFILL 133 thrust-bearing and inserted through the body cavity until it rests against a shoulder in the valve body. A reinforced TFE seal, above the body shoulder, is held in place by a follower, two Belleville washers and adjusting nut. Simple, in-line stem adjustments keep washers flexed, automatically compensating for normal wear as well as for seal expansion and contraction from temperature fluctuations.

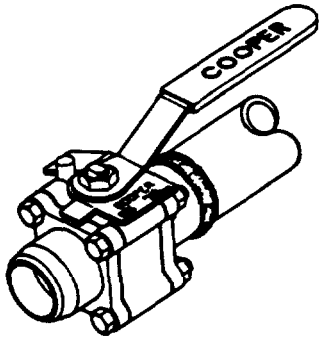
CHOICE OF END-CONNECTIONS FOR ANY PIPING SYSTEM



Screwed-end



Socket-weld



Butt-weld

COOPER
VALVE COMPANY

BALL VALVES

FIGURE NO. 4150
THREE PIECE CONSTRUCTION
STANDARD PORT
1500 PSI

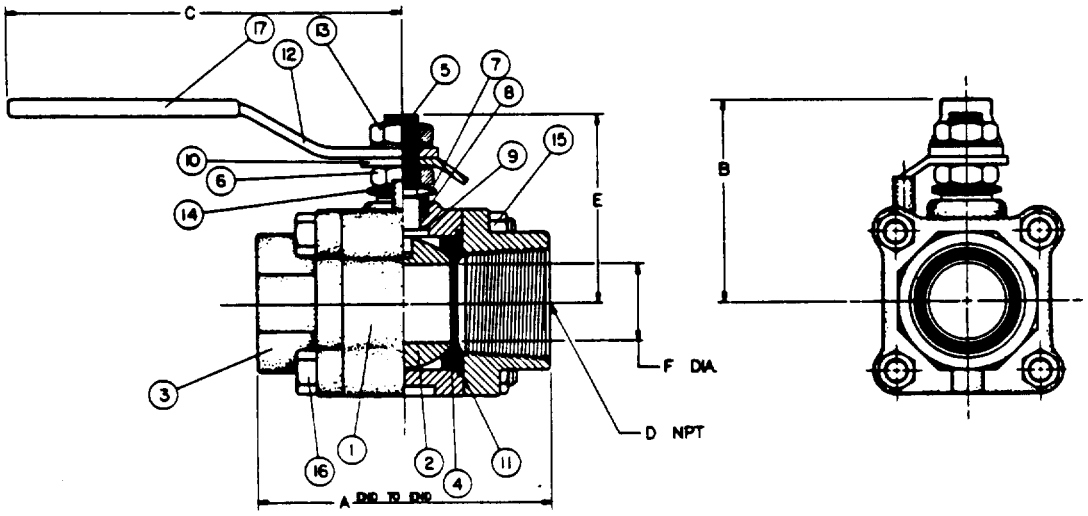


Figure	**#**	**4150SE**	**Threaded**
Figure	**#**	**4150X**	**Socketweld**
Figure	**#**	**4150X-SE**	**Socketweld by Screwed**
Figure	**#**	**4150BW**	**Buttweld**

SIZE	A	B	C	D	E	F
¼	2 9/16	1 15/16	4 3/4	¼	1 ½	7/16
⅜	2 9/16	1 15/16	4 3/4	⅜	1 ½	7/16
½	2 9/16	1 15/16	4 3/4	½	1 ½	7/16
¾	2 13/16	2	4 3/4	¾	1⅝	9/16
1	3 1/16	2¼	5⅞	1	2 5/16	13/16
1¼	4 5/16	2½	5⅞	1¼	2 7/16	1
1½	4 5/16	3	7⅝	1½	2⅞	1¼
2	5	3¼	7⅝	2	3⅛	1½
2½	5 31/32	4	9½	2½	3¾	2
3	7¼	6	9½	3	5¼	2½

BILL OF MATERIAL

ITEM	DESCRIPTION	MATERIAL
1	BODY	316SS
2	BALL	316SS
3	END PC	316SS - Low Carbon
4	SEAT	Reinforced TFE
5	STEM	316SS
6	STEM NUT	304SS
7	STEM BUSHING	316SS
8	STEM SEAL	Reinforced TFE
9	THRUST BEARING	COOPERFILL 133
10	STOP PLATE	304SS
11	BODY SEAL	Reinforced TFE
12	HANDLE	316SS
13	HANDLE NUT	316SS
14	BELLEVILLE WASHER	17-7 Ph SS
15	BODY NUT	316SS
16	BODY BOLT	316SS
17	HANDLE SLEEVE	VINYL
18	THREAD PROTECTOR	CPVC

COOPER
VALVE COMPANY

BALL VALVES

FIGURE NO. 4151
THREE PIECE CONSTRUCTION
FULL PORT
1500 PSI
(3"-1000 PSI)

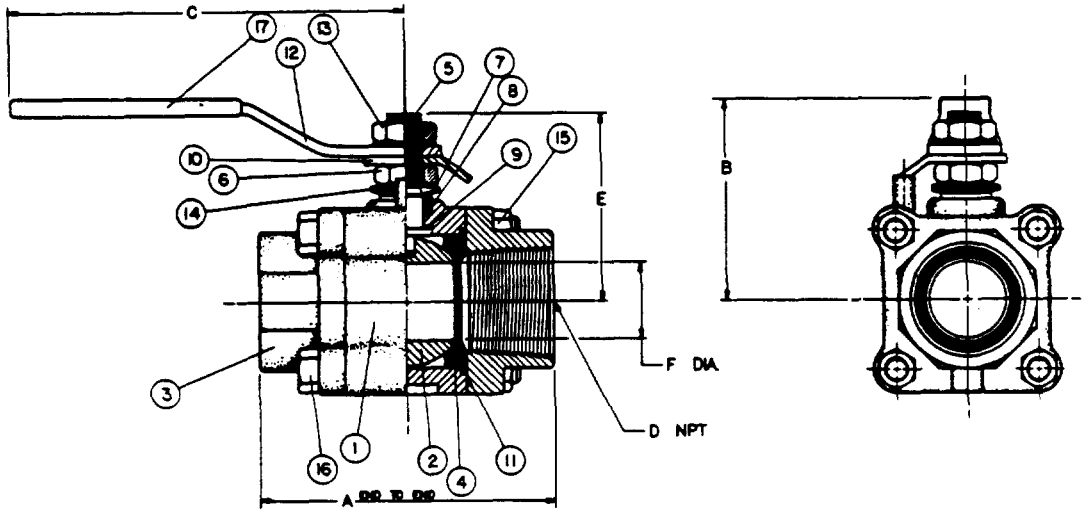


Figure	**#**	**4151SE**	**Threaded**
Figure	**#**	**4151X**	**Socketweld**
Figure	**#**	**4151X-SE**	**Socketweld by Screwed**
Figure	**#**	**4151BW**	**Buttweld**

SIZE	A	B	C	D	E	F
¼	2 9/16	1 13/16	4 ¾	¼	1 ½	7/16
⅜	2 9/16	1 13/16	4 ¾	⅜	1 ½	7/16
½	2 13/16	2	4 ¾	½	1⅝	9/16
¾	3 1/16	2 ¼	5⅞	¾	2 5/16	13/16
1	4 5/16	2 ½	5⅞	1	2 7/16	1
1¼	4 5/16	3	7⅝	1¼	2⅞	1¼
1½	5	3¼	7⅝	1½	3⅛	1½
2	5 31/32	4	9½	2	3¾	2
2½	7¼	6	9½	2½	5¼	2½
3	8	7	10	3	5½	3

BILL OF MATERIAL

ITEM	DESCRIPTION	MATERIAL
1	BODY	316SS
2	BALL	316SS
3	END PC	316SS - Low Carbon
4	SEAT	Reinforced TFE
5	STEM	316SS
6	STEM NUT	304SS
7	STEM BUSHING	316SS
8	STEM SEAL	Reinforced TFE
9	THRUST BEARING	COOPERFILL 133
10	STOP PLATE	304SS
11	BODY SEAL	Reinforced TFE
12	HANDLE	316SS
13	HANDLE NUT	316SS
14	BELLEVILLE WASHER	17-7 Ph SS
15	BODY NUT	316SS
16	BODY BOLT	316SS
17	HANDLE SLEEVE	VINYL
18	THREAD PROTECTOR	CPVC

COOPER
VALVE COMPANY

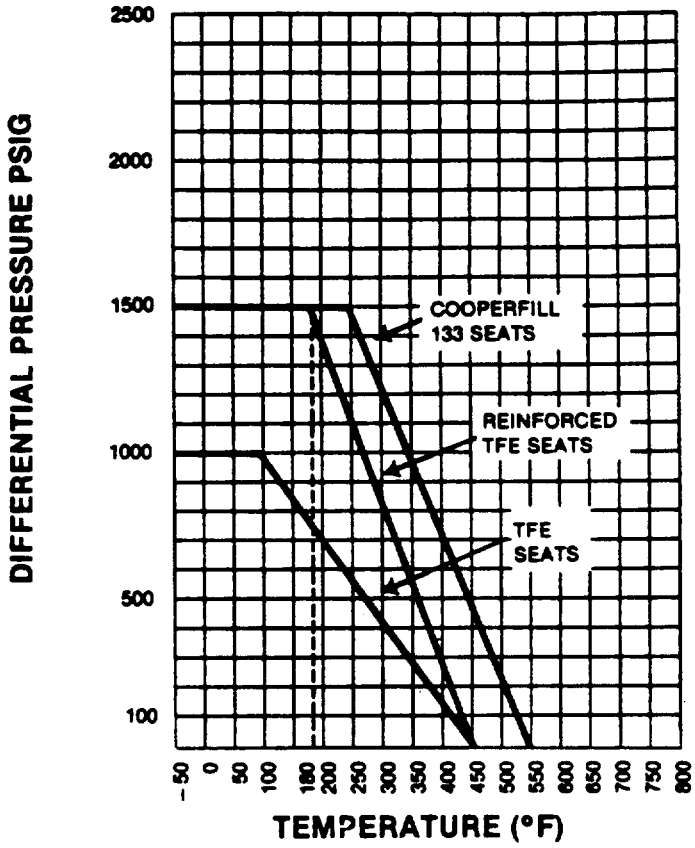
ENGINEERING DATA

FLOW DATA

STANDARD PORT	
Valve Size	Approximate C_v
¼", ⅜"	9
½"	9
¾"	17
1"	35
1¼"	55
1½"	95
2"	140
2½"	220
3"	360

FULL PORT	
Valve Size	Approximate C_v
¼", ⅜"	10
½"	19
¾"	35
1"	60
1¼"	95
1½"	140
2"	230
2½"	360
3"	590

PRESSURE VS. TEMPERATURE



MAXIMUM EXPECTED BREAKAWAY TORQUE
(Running Torques approximately 1/3 value shown)

STANDARD PORT	
Valve Size	Torque
¼"	30 in.-lbs.
⅜"	30 in.-lbs.
½"	30 in.-lbs.
¾"	40 in.-lbs.
1"	90 in.-lbs.
1¼"	190 in-lbs.
1½"	280 in.-lbs.
2"	390 in.-lbs.
2½"	600 in.-lbs.
3"	800 in.-lbs.

FULL PORT	
Valve Size	Torque
¼"	30 in.-lbs.
⅜"	30 in.-lbs.
½"	40 in.-lbs.
¾"	90 in.-lbs.
1"	190 in.-lbs.
1¼"	280 in.-lbs.
1½"	390 in.-lbs.
2"	600 in.-lbs.
2½"	800 in.-lbs.
3"	1100 in.-lbs.

NOTE:

1. Pressure and temperature curves shown are for standard stock valves. For other seat-seal combinations through 5000 PSI and -450° to 1100°F consult special application brochures.
2. Reinforced TFE may be used to 150 PSIG steam maximum. COOPERFILL 133 may be used to 300 PSIG steam. (See Brochure BV-1102)
3. Maximum temperature for TFE and reinforced TFE seals is 450°F. Maximum temperature for Flex Gaskets is 550°F. Consult special application brochures for higher temperatures.
4. Pressure and temperature curves shown apply to ¼"-3" valves except 3" full port maximum pressure 1000 PSI.

COOPER
VALVE COMPANY

SPECIAL APPLICATIONS
COOPER 3-PIECE BALL VALVE

FIRESAFE DESIGN
Minimum leakage under fire conditions - Full swing out capabilities. (See Brochure BV-1103)

CRYOGENIC SERVICE
Available 1/4"-3", standard and full port for service to 450^{o}F. (See Brochure BV-1 111)

3-WAY & DIVERTER CONFIGURATION
All alloys - Standard and full port - Cryogenic to high-temperature applications**.** (See Brochure BV 1109)

HIGH PRESSURE SERVICE
To 5000 PSI with special seats and seals**.** (See Brochure BV-1123)

HIGH TEMPERATURE SERVICE
To 1100°F with special seat and seal configurations**.** (See Brochure BV-1115)

CHLORINE SERVICE
Cooper ball valves are available in special designs for the most exacting chlorine applications**.** (See Brochure BV-1107)

VACUUM SERVICE
Standard Cooper ball valves are suitable for service down to 20 microns. With special preparation, they may be used to 10Jmm mg. (See Brochure BV-1108)

STEAM SERVICE
Rated to 300 PSIG saturated steam with Cooper's exclusive COOPERFILL 133 seats and special seals**.** (See Brochure BV-1102)

OXYGEN SERVICE
All ball valves are available specially cleaned and prepared for oxygen service**.** (See Brochure BV-1114)

FLANGED ENDS
Cooper's 3-piece valve s18 available with ANSI 150, 300, 600, 900, 1500 and 2500 RF and RTJ flanges on special order**.** (See Brochure BV-1117)

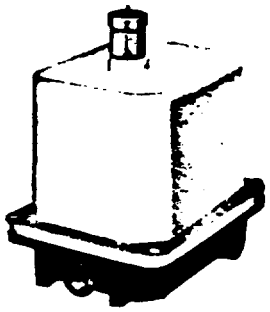
HANDLE ACCESSORIES
Available with locking handle, spring return handle, round, oval and T-handles; and stem extensions**.** (See Brochure BV-1112)

BALL CHECKS
Available in 3-piece design for high-temperature to cryogenic service - Vacuum to high pressure**.** (See Brochure BC-101)

COOPER
VALVE COMPANY

VALVE ACTUATION

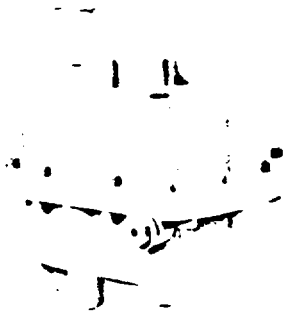
COOPER PROVIDES A COMPLETE LINE OF ELECTRIC, PNEUMATIC AND HYDRAULIC ACTUATORS.



Series 310

ELECTRIC

Fail-Safe
Unidirectional
Reversing
AC or DC Voltages
With positioners for control valve service
(See Brochure ABV 102)



Series 390

PNEUMATIC-HYDRAULIC

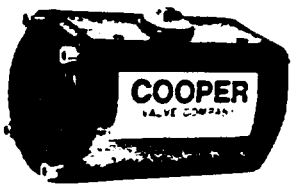
VANE

Double Acting
Spring Return
With positioners for control valve service
(See Brochure ABV-104)

Series 360

SCOTCH YOKE

Double Acting
Spring Return
Integral Solenoid
(See Brochure ABV-105)

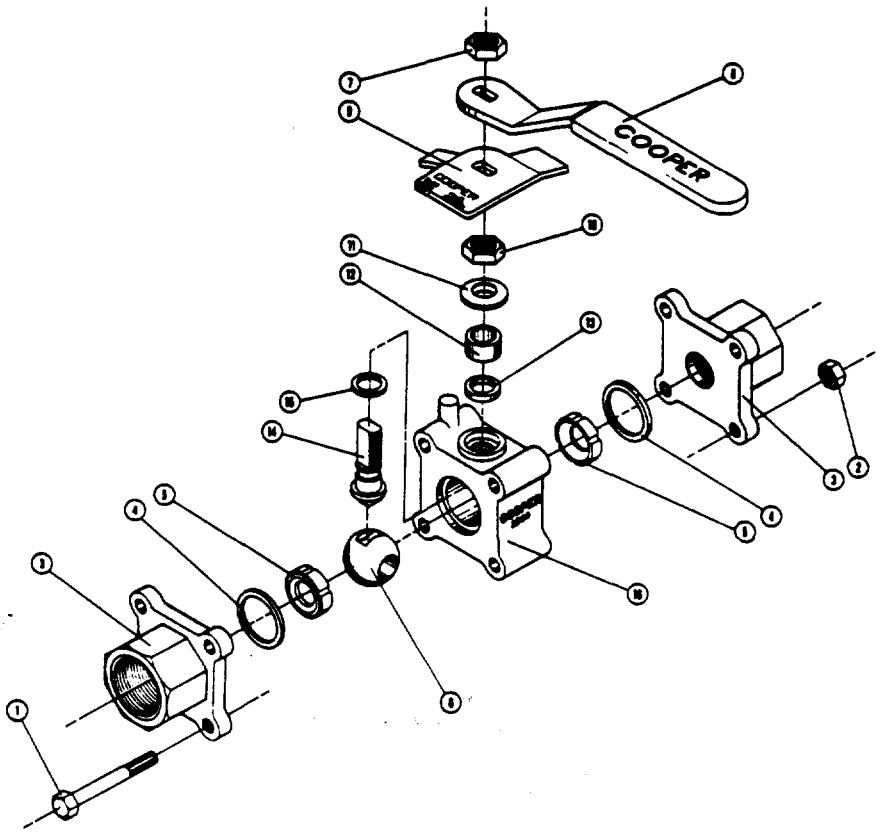


Series 380

DOUBLE RACK AND PINION

Double Acting
Spring Return
With positioners for control valve service
Integral Solenoid
(See Brochure ABV-103)

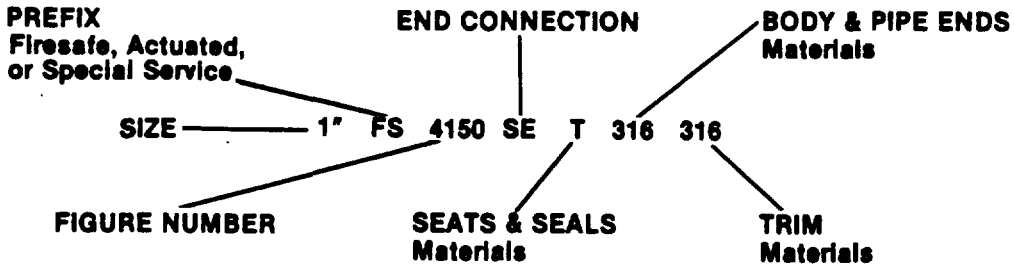
COOPER
VALVE COMPANY



PARTS ILLUSTRATED & LISTED IN DISASSEMBLY SEQUENCE

1	Body Bolt (4)	9	Stop Plate
2	Body Nut (4)	10	Stem Nut
3	End Piece (2)	11	Belleville Washers (2)
4	Body Seals (2)	12	Stem Bushing
5	Seats (2)	13	Stem Seat
6	Ball	14	Stem
7	Handle Nut	15	Thrustbearing
8	Handle	16	Body

ORDERING EXAMPLE



COOPER
VALVE COMPANY

COOPER
VALVE COMPANY

5524 HARVEY WILSON DRIVE P.O. BOX 15617
HOUSTON, TEXAS 77020

Tel: (713) 675-4201**.** Telex 76-2953

Distributed by:

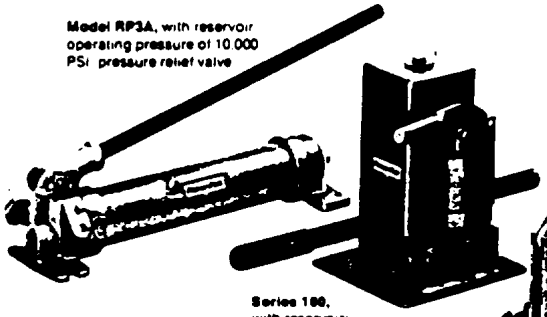
BV-1101
1-81

Remote Hand Pumps for all Force-Pak® Cylinders

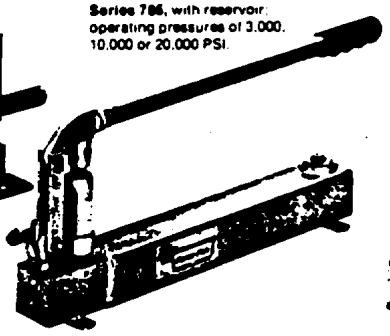
These lightweight, piston-type pumps are completely portable. Easily mounted in confined areas. Operate horizontally, or vertically (with pump head downward). Full one-year warranty.

Pumps are suppled with either pressure release screws for use with single-acting cylinders, or four-way, three-position valves, for use with double-acting cylinders. Some pumps are equipped with pressure relief valves set at 10,000 PSI. All pump pistons are ground and chrome-plated to help eliminate scoring and corrosion. Operating handles are furnished with all pumps. 3/8" NPT inlet and outlet ports.

Single-Stage Pumps for single-acting cylinders



Model RP3A, with reservoir operating pressure of 10,000 PSI pressure relief valve



Series 786, with reservoir: operating pressures of 3,000, 10,000 or 20,000 PSI.

Series 100, with reservoir: operating pressures of 3,000, 10,000 or 20,000 PSI

Series 1000, with operating pressures of 500, 1,500, 3,000, 10,000, or 20,000 PSI.

Model Number	Item Number	Usable Reservoir Capacity (Cu. In.)	Operating Pressure (PSI)	Piston Dia. (In.)	Stroke (In.)	Vol./Stroke (Cu. In.)	Handle Effort—Lbs. at 500 PSI	Handle Effort—Lbs. at Capacity	Relief Pressure (PSI)	Wt. (Lbs.)
SINGLE-STAGE PUMPS WITHOUT RESERVOIR, WITH RELEASE SCREW FOR USE WITH SINGLE-ACTING CYLINDERS										
1000-3	34100	—	20,000	3/8	1 3/8	0.16	5	198	—	11
1000-4	34101	—	10,000	1/2	1 3/8	0.28	9	176	—	11
[redacted]	34102	—	3,000	3/4	1 3/8	0.66	20	119	—	11
1000-8	34103	—	1,500	1	1 3/8	1.08	35	106	—	11
1000-12	34104	—	500	1 1/2	1 3/8	2.20	79	—	—	11

DECKMASTER

Guidelines for Safe Operation of Hydraulic Equipment

Choose the proper size cylinder or hand jack so that it is not lifting more than its rated load. If the weight of the lifted load is unknown use a pressure gauge. and do not exceed the rated working pressure. A decal listing working pressure and lifting capacity is located on every Force-Pak cylinder.

Choose the proper size pump, either hand or power, so that the pump reservoir contains enough oil to lift the plunger thru its full stroke. A decal listing usable oil capacity of the pump reservoir is located on the pump. A decal listing required oil capacity for full stroke of the plunger is located on the cylinder.

Choose the proper volume pump. either hand or power, to provide satisfactory cylinder speed. It the pump is equipped with an externally adjustable relief valve the pressure should be adjusted using a pressure gauge, and by following the manufacturers recommended procedure. **(Do not change the setting of any Internal relief valve unless authored by the manufacturer.)** Information on pump pressure is on the decal attached to the pump. Information on cylinder operating pressure is on the decal attached to the cylinder.

If an air driven pump is ing used m sure 4 is connected to the prop pressure and volume of air and that proper lubrication is provided in the air line.

Make sure that the lifting unit (cylinder or hand jack) is firmly supported at the base, the load is properly supported at the lifting point, and n tho lifting unit will not Slip Or the lohd shift and overtum the lifting unit.

Never stand in a direct line with the application of force or crawl under a load that is not blocked t0 prevent the load from falling.

After each use the equipment should be inspected and tested to a minimum of 100% of rated load. and any necessary repairs should be made by qualified or a factory authorized service center.

For further information On safe operating procedure and maintenance requirements consult the ANSI 830.1.1975 S Standards for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks and Slings.

Warranty

Templeton, Kenly & Co. warrants to the purchaser of its products that if the product or any part thereof in the judgment of Templeton, Kenly & Co. is proven to be defective in materiel or workmanship within one year from the date of original purchase, such defects will be repaired or replaced (at the company's option) free of charge for parts and labor.

This warranty does not apply to any product which has been damaged by accident or which has bon misused, abused, altered, or repaired by anyone other than recognized Templeton, Kenly authorized Service Center.

This warranty is in lieu of all other warranties expressed or implied, and no other person is authorized to assume for Templeton, Kenly & Co. any other liability in connection with the sale of this product.

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

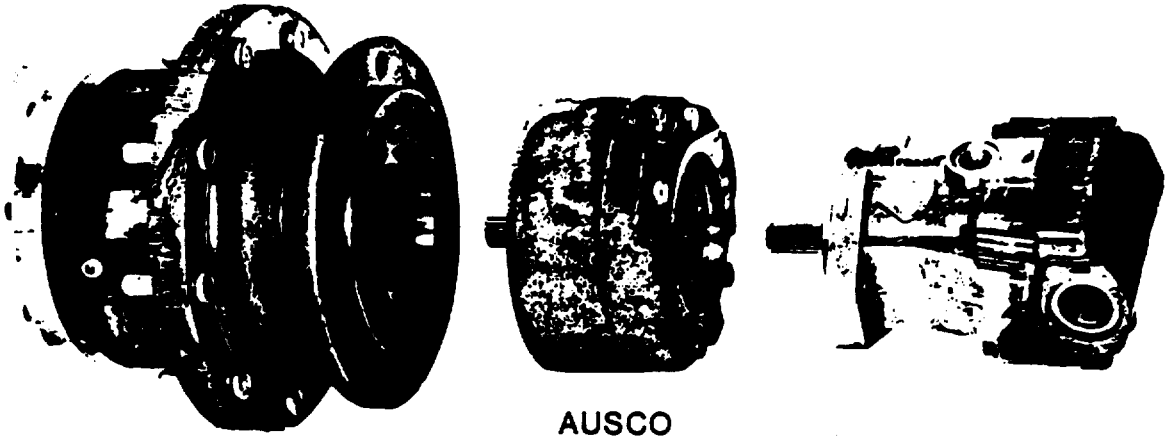
Reference Item No.:	23
Quantity Required:	One
Description:	Disc Brake
Manufacturer:	AUSCO
Part Number:	31025
Source:	AUSCO Auto Specialties Manufacturing Co. St. Joseph, Michigan 49085

Tele #: 1-616-982-2373

DECKMASTER

Ausco failsafe brake for hydrostatic drives

Bolt directly into power train



PLANETARY WHEEL | AUSCO FAILSAFE BRAKE | HYDRAULIC MOTOR

- SAE motor mounts
- Fits SAE J744 Standard
- Either charge or full line pressure
- Complete self-contained package
- Spring loaded, hydraulically released
- Rugged cast-iron construction
- Bearing supported shaft
- No extra brackets, no shimming needed

ALSO AVAILABLE:

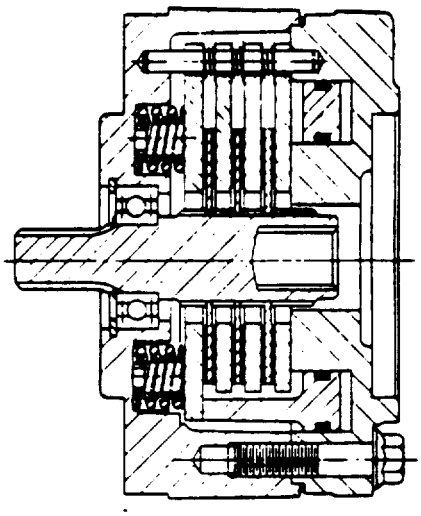
- Failsafe Brake with Back Pressure Compensation
- Failsafe Brake with Service Brake
- Failsafe Brake with One-Way Clutch
- Hydraulic Hand Pump for emergency Failsafe Brake releas

FAILSAFE BRAKE GENERAL INFORMATION

1) Mounting flange dimensions per SAE J744, unless otherwise specified.
2) Maximum recommended working pressure is 3000 psi, unless otherwise specified.
3) Brake torque:
   a) All torque values given are for DRY brakes with the exception of the Failsafe Brake with One-Way Clutch and wet operation Failsafe Brakes where noted.
   b) Torque values are static load rated at zero psi back pressure.
4) Caution notes:
   a) Hydrostatic bench testing with pressures in excess of 2000 psi may cause component warpage or bolt failure**.** Mounting bolts must be used for supplemental clamping**.** Tighten bolts to torque shown below.
   b) Surge pressure in excess of 3000 psi caused by pump surge or rapid opening or closing of control valve is detrimental to brake life and must be avoided.
5) Gaskets for the hydraulic motor and gear reducer ends are recommended and accompany each brake.
6) Use only SAE grade 5 mounting bolts adequately torqued:

.38-16 UNC 2A,	31-38 LB FT	1.00-8 UNC 2A,	540-650 LB FT
.44-14 UNC 2A,	50-60 LB FT	M12 x 1.75-6g,	65-75 LB FT
.50-13 UNC 2A,	75-85 LB FT	M16 x 2-6g,	165-200 LB FT
.62-11 UNC 2A,	135-165 LB FT	M20 x 2.5-6g9,	240-285 LB FT
.75-10 UNC 2A,	240-285 LB FT		

7) Heavy duty is designated for certain SAE 'B' and 'C' Failsafe Brake models where high torque, continuous use and rpm's in excess of 1500 are required**.** These contain heavy duty rotating discs which are designed for lower unit spline compression loading by using a combination of increased thickness, and/or larger rotating disc splines and tougher core material.
8) Side loads on brake bearings are unacceptable**.** Use overhung load adapters.
9) Hydraulic fluids other than petroleum base can be used**.** The two system brakes, Failsafe Brake with Back Pressure Compensation and Failsafe Brake with Service Brake, can use separate fluid types**.** In every instance, seal material must be compatible with the specific hydraulic fluid.
10) When emergency release of the Ausco Failsafe Brake is required, an Ausco Hydraulic Hand Pump #31090 (pg**.** 38) can be incorporated into the hydraulic system.
11) In the unlikely event of fluid leakage into the brake, all SAE 'B' and 'C' Failsafe Brakes, Failsafe Brakes with Service Brake and Failsafe Brakes with Back Pressure Compensation, are designed to prevent pressure buildup inside the brake housing.
12) Refer to Ausco Application Ideas booklet #F32840 for a general representation of-Failsafe Brake applications.



AUSCO FAILSAFE BRAKE

The Ausco Failsafe Brake is spring loaded to apply the brake and hydraulic pressure is required to release or "hold off" the brake. Normal operation is to have the brake pressurized in the released position with the vehicle hydraulic system running. Any function which reduces the hydraulic system pressure below the release pressure of the brake, will initiate a brake application.

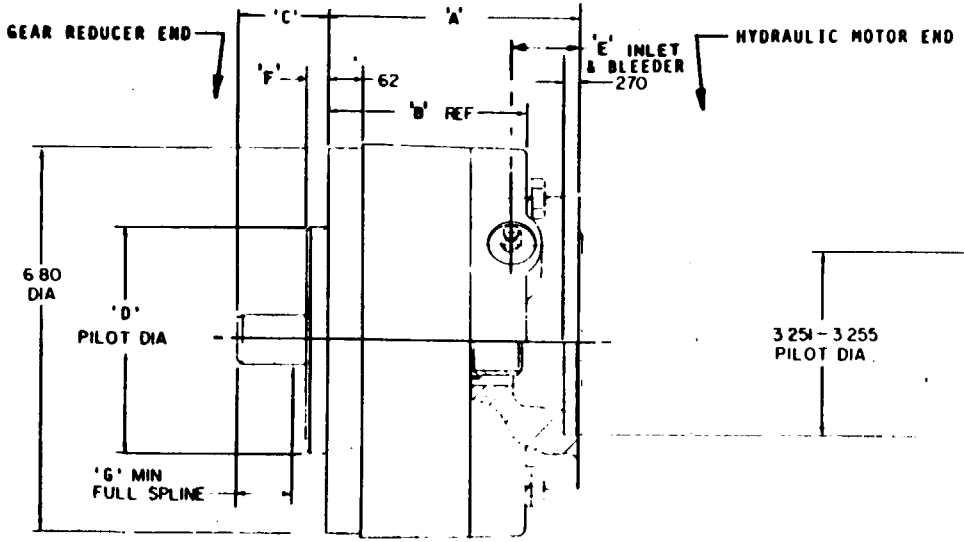
DIMENSION 'G'	1.00
DIMENSION 'F'	.375
DIMENSION 'E'	1.17
DIMENSION 'D'	3.998-4.000
DIMENSION 'C'	1.62
DIMENSION 'B'	3.59
DIMENSION 'A'	4.50
RELEASE(MIN)/WORN(MAX) DISPLACEMENT(CU IN.)	1.0/3.0
EXTERNAL:GEAR REDUCER END MAJOR DIA	13T 16/32 .853-.875
INTERNAL:HYD MOTOR END FLAT ROOT SIDE FIT,30° P.A. BRAKE SHAFT SPLINE	SAE 6B(1.00 00) PARALLEL SIDE
RELEASE HYD PRESSURE(PSI)	180
RATED TORQUE(LB IN.)	3800

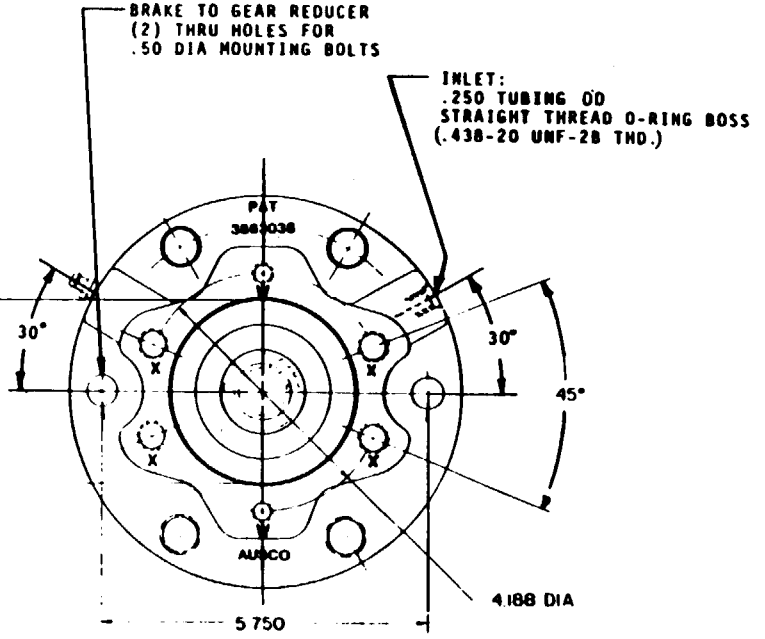
BRAKE PART NO. 21025

MOTOR TO BRAKE
'W' (2) TAPPED HOLES (.62 MIN THD) FOR .375-16 UNC-2A BOLTS
APPLICATION: SUNDSTRAND 15 SERIES
'X' (4) TAPPED HOLES (.62 MIN THD) FOR .500-13 UNC-2A BOLTS (2 BOLT MOUNT)
APPLICATION: ROSS TORQMOTOR MAB 002, CHAR-LYNN H, S & 2000 SERIES, NICHOLS 100 SERIES

REVISIONS
5-82

GEROTOR MOTORS SHOULD HAVE THEIR CASE DRAINS UTILIZED TO MINIMIZE LEAKAGE PAST THE MOTOR SHAFT SEAL AND INTO THE BRAKE.





c-FOR APPLICATIONS WHERE GEARBOX IS ABOVE BRAKE
b-1000 RPM MAX RECOMMENDED
a-THIS MODEL NOT SEALED AGAINST GEARBOX. WET OPERATION TORQUE: 600 LB IN.
* HEAVY DUTY

DECKMASTER

FAILSAFE BRAKES

28653
28886
→ 31025 ←
31087
31148

BRAKE FUNCTION

The FaiIsafe Brake is spring loaded to apply the brake and hydraulic pressure is required to release or "hold off" the brake**.** Normal operation is to have the brake pressurized in the released position with the vehicle hydraulic system running**.** Any function which reduces -e hydraulic system pressure below the release pressure of the brake**.** will cause a brake application.

The brake is designed to fit with a gear reducer and a hydraulic motor**.** The common mounting surfaces of the brake, the motor, and the gear reducer are machined to close tolerances and should be protected from damage during installation and removal.

INSTALLATION INSTRUCTIONS (Ref: Fig. 1)

1. Place the gasket (24) onto the mounting face of the brake.
2. Place the brake shaft into the gear reducer with the brake bleeder screw in the vertical position.
3. Move the brake into position with the gear reducer, assuring proper gasket location**.** Align the mounting bolt holes by rotating the engaged brake into position**.** If this is not possible, the brake may be routed after pressure has been applied to the brake inlet**.** This will release the brake and allow it to be rotated into position.
4. Insert the two half-inch bolts (Grade 5) thru the brake, the gasket, and into the threadedhole in the gear reducer mounting flange**.** Insure that the bolts are not too long so that they do not bottom out in the reducer before clamping.
5. Run bolts in alternately, to prevent binding, until snug**.** Then torque the bolts to 75-85 lb. ft.
   Note: Shafts must slide together freely - DO NOT use bolts to force the units together.
6. Similarly place the gasket (25) onto the flange of the motor.
7. Insert the shaft of the motor into the brake and push into position, assuring proper gasket location.
8. Then insert four half-inch bolts (Grade 5) or two three-eights inch bolts (Grade 5) depending upon the motor mount being used**.** Again insure that the proper length bolt is used to avoid bottoming out in the brake.
9. Run the bolts in alternately, to prevent binding, until snug**.** Then torque the bolts as follows: Four 1/2 inch bolts 75-85 lb. ft.; two 3/8 inch bolts 31-38 lf. ft.
10. With motor and brake bolted into position, remove cap plug and connect "inlet" hydraulic line to brake housing - if not done for shaft alignment Step 3**.** Brake inlet is .250 tubing O.D., straight thread O-ring boss (438-20 UNF 2B thread).
11. Bleed air from brake via bleeder screw.
    Note: Maximum pressure to brake...3000 psi.

BRAKE DISASSEMBLY PROCEDURE: (Ref: Fig. 2)

1. With shaft protrusion downward, disassemble in the following order:
2. Bolts (23) alternately, Power Plate (21), O-ring (5)**,** Stationary Discs (12), Springs (13), Rotating Discs (11)**.** Primary Disc 10), Pins (8), Springs (6 & 7).
3. Further disassembly is not recommended and should not be attempted unless necessary for the replacement of specific parts, i.e., Snap Rings (1 & 2), Bearing (3) and Shaft (9) from Housing (4)**.** If necessary: proceed as follows:

A) Remove Snap Rings (1 & 2)**.** then Shaft (9) with Bearing (3) by lightly tapping the shaft with a plastic millet.
B) Remove shaft from bearing by supporting the inner race of the bearing and applying pressure to the shaft.

4. Remove the Piston (14) from the Power Plate (21) by introducing low pressure air - 15 psi - into the hydraulic inlet**.** Make sure piston is directed away from the operator**.** Remove O-rings (16 & 18)**,** and backup Rings (15 & 17) from the piston O.D**.** and I.D**.** grooves**.** Backup Rings will be damaged and should not be removed if replacement is not planned.

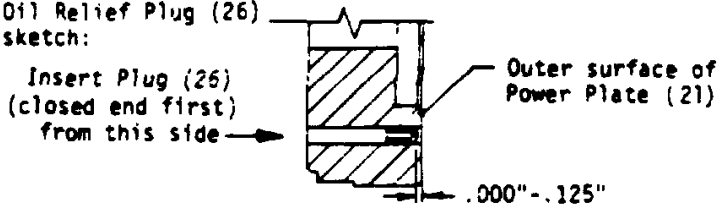
ASSEMBLY PROCEDURE

IMPORTANT: There may be more parts in a service kit than your brake requires. Check the parts list carefully for the exact quantity. In the case of springs, space the required quantity equally.

All parts must be thoroughly clean prior to reassembly.

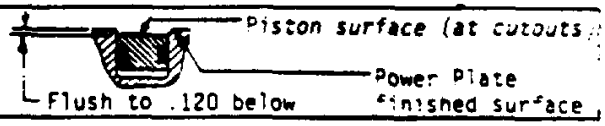
Use the reverse of the disassembly procedure with the following notes and additions:

1. Worn O-rings and damaged or worn teflon backup rings must be replaced prior to reassembly.
2. Cylinder of the power plate, piston and o-rings must be clean prior to assembly and pre-lubed with the system hydraulic fluid.
3. If replacement of Oil Relief Plug (26) is necessary, see sketch:

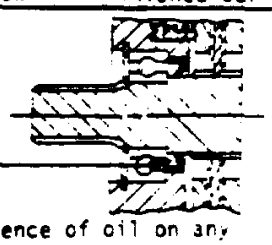


4. Assemble Piston (14) into Power Plate (21) using a shop press, being careful not to damage the O-rings or teflon back-up rings. Visually align the center of the cut-outs in the Piston with the Torque Pin (8) holes in the Power Plate (21).

Depth of piston installation into the power plate is critical. DO NOT exceed .120 depth or piston will cock, resulting in a complete loss of braking.



5. Replacement of Seal (27) for Brake 35330:
   A) Install Bearing (3) and Snap Ring (1) into Housing (4).
   B) Press Seal (27) into housing with lip facing bearing.
   C) Apply small amount of grease in cavity between bearing and seal.
   D) Press Shaft (9) into Bearing (3). Install Snap Ring (2) onto Shaft.



6. Rotating Discs must be clean and dry. There should be no presence of oil on any lining material or mating surfaces of the Stationary Discs.
7. Install Bolts (23). Tighten sequentially, one turn at a time, until Power Plate (21) is properly seated. Torque to 50-60 lb.ft.

SERVICE KITS

The following kits are available as service items. All other parts may be ordered individually.

	BRAKE ASSEMBLY		
	28653 31148	28886	31025 31087
O-ring Kit Consists of: Items 5, 15, 16, 17, 18	PK 661	PK 661	PK 661
Stack Kit Consists of: Items 6, 7, 8, 10, 11, 12, 13	PK 662	PK 662	PK 695
Bearing Kit Consists of: Items 1, 2, 3	PK 668	PK 668	PK 668
Gasket Kit Consists of: Items 24, 25	PK 664	PK 664	PK 664

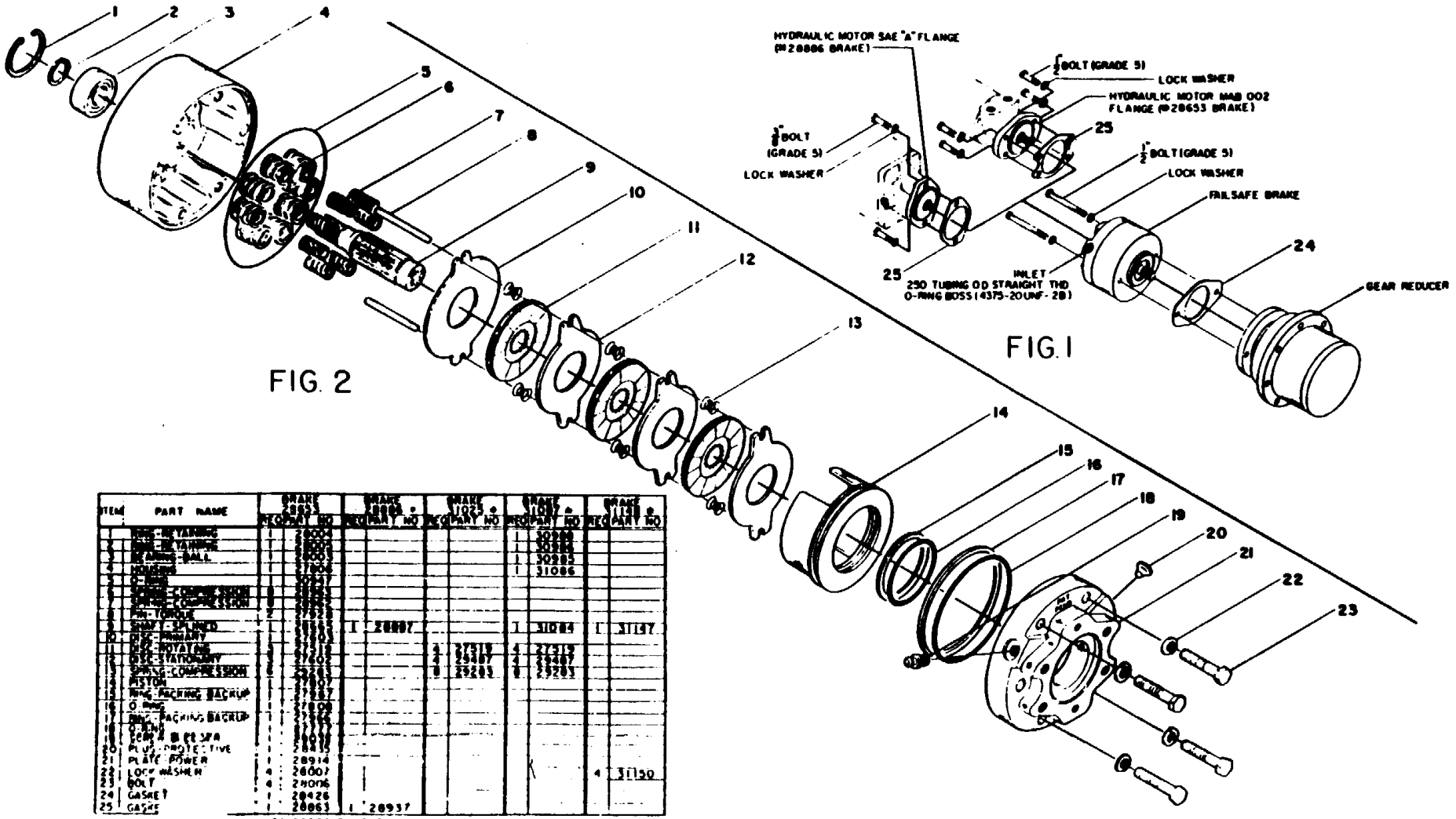


FIG. 2

FIG. 1

ITEM	PART NAME	BRAKE #28653 QTY	PART NO	BRAKE #28886 QTY	PART NO	BRAKE #1023 QTY	PART NO	BRAKE #1084 QTY	PART NO	BRAKE #1139 QTY	PART NO
1		1	28000					1	30984		
2		1	28001					1	30985		
3		1	28002					1	30986		
4		1	28004					1	31086		
5		1	28005								
6		1	28006								
7		8	28007								
8		8	28008								
9		2	28009								
10		1	28010								
11		1	28011	1	28887			1	31084	1	31147
12		1	28012			4	27213	4	27213		
13		1	28013			4	25487	4	25487		
14		8	28014			8	29283	8	29283		
15		1	28015								
16		1	28016								
17		1	28017								
18		1	28018								
19		1	28019								
20		1	28020								
21		1	28914								
22		4	28007							4	31150
23		4	28008								
24		1	28426								
25		1	28063	1	28937						

ALL ITEMS TICAL TO 28653 EXCEPT AS SHOWN

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH-HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.: 24

Quantity Required: One

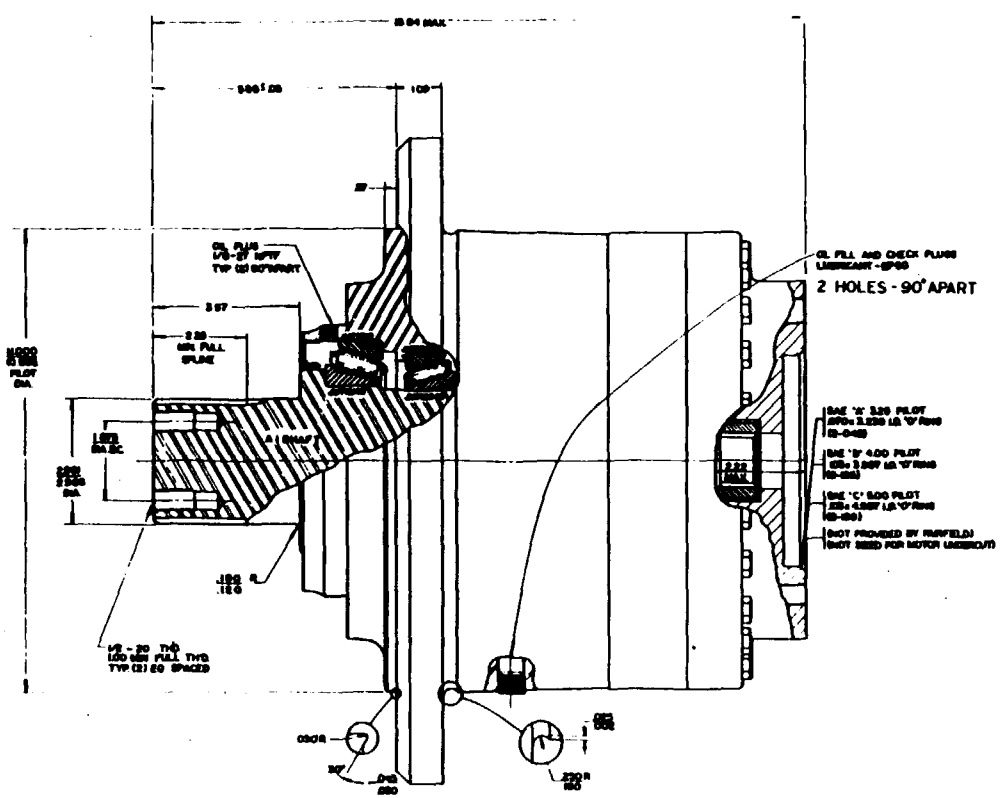
Description: Winch Gearbox

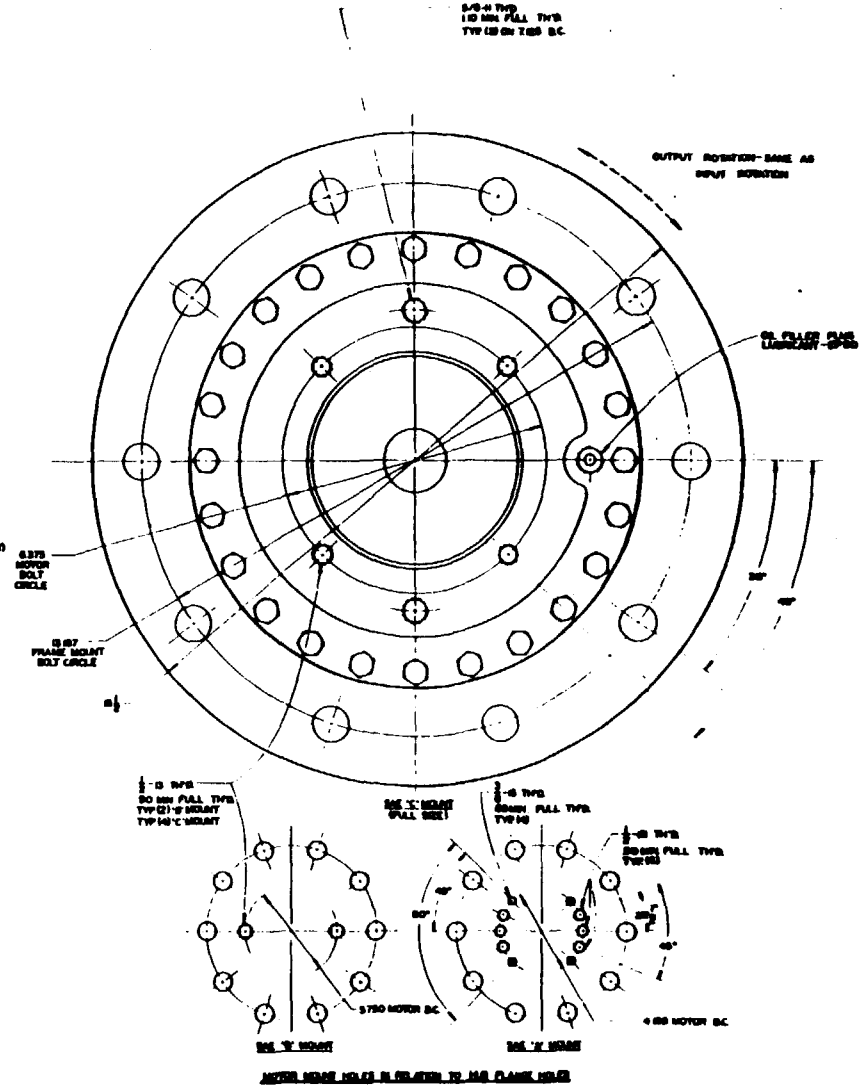
Manufacturer: Fairfield

Part Number: S6A1-33-32

Source: Fairfield Manufacturing Company, Inc.
2300 South Concord Road
Lafayette, Indiana 47902

Tele #: 1-317-474-3474





Output Torque Ratings

Max. Continuous	Max. Intermittent
60,000 lb.-in.	120,000 lb.-in.
5,000 lb.-ft.	10,000 lb.-ft.
6,774 N.-m.	13,549 N
691 Kg.-m.	1,382 K

S 6 A1 4 4 19

S — Torque Hub Shaft Output

6 — Series

Motor Mount
2 — S.A.E. "A" (3.255/3.251) Pilot
3 — S.A.E. "B" (4.005/4.001) Pilot
4 — S.A.E. "C" (5.005/5.001) Pilot

Input
3 — 13T. 16/32 Spline
4 — 14T. 12/24 Spline
6 — 6B. Parallel Side Spline Major Dia: 1:00
7 — 21T. 16/32 Spline

Reduction
13 — 13.07:1
19 — 19.04:1
26 — 25.96:1
32 — 32.31:1

	SHAFT	HUB - FLANGE			
	Output Shaft	B.C.	Thick.	Mat'l	Remarks
A1	23T. 8/16 Spline	10 Holes 13.187 B.C. (.81 Dia.)	1.09 (.81 Dia.)	Steel	
A2	5/8 Key 3.000 Shaft	"	"	"	

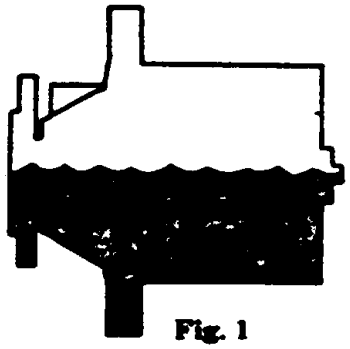


Fig. 1

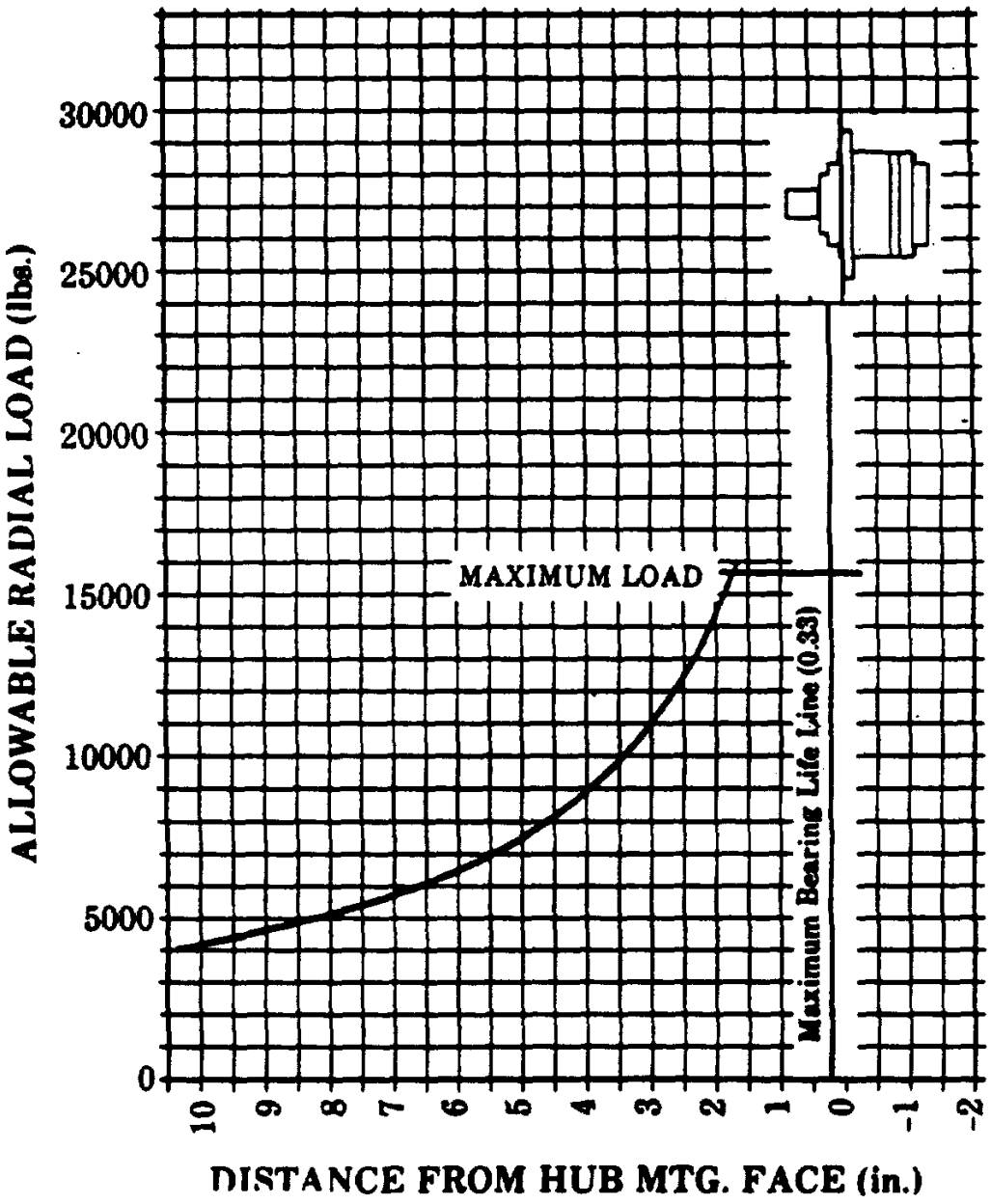
OIL
Oil fill (EP-90) to half full on most applications (Fig. 1).

Approximate Volume — 50 oz.
NOTE: Oil level and type will vary depending on specific model and application.

WEIGHT
Approximate Weight — 242 lbs.
NOTE: Specific models will change weights.

Gear Kit available for this assembly
Consult FAIRFIELD MFG. for details.

BEARING CURVE
S6A



Conditions of bearing curves: Life = 3000 hours B-10
Speed = 100 RPM output

To adjust life for loads and speeds other than shown on curve:

$$\text{Adjusted life (hours)} = 3000 \text{ hours} \times \left(\frac{100 \text{ RPM}}{\text{Speed (Adjusted)}}\right) \times \left(\frac{\text{Load (Curve)}}{\text{Load (Adjusted)}}\right)^{10/3}$$

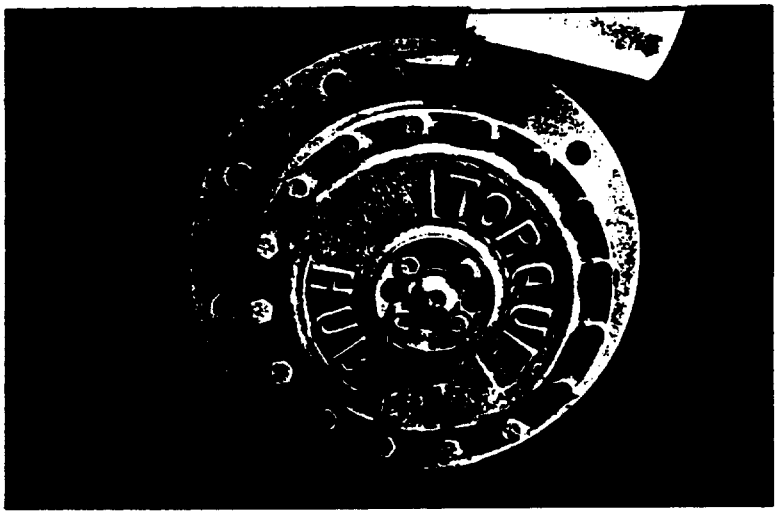
DECKMASTER

1. TYPE - EP 90
   On normal application EP 90 should be used. On applications where the lubricant must meet special requirements, the manufacturer of the lubricant should be able to recommend a suitable substitute.

2. OIL TEMPERATURE
   Continuous - 160° F.
   Intermittent - 200° F.

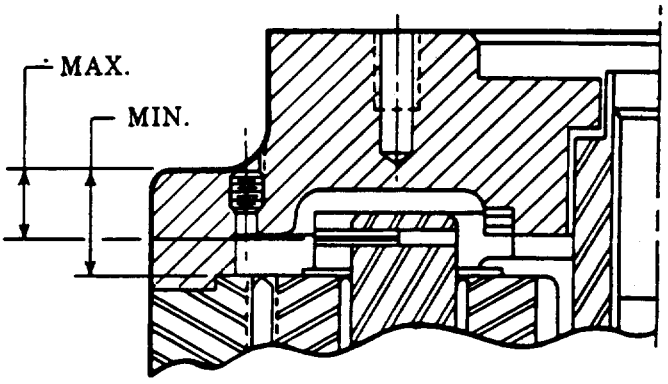
3. OIL CHANGE
   Initial - After 50 hours or 50,000 revolutions of operation. Preferably in a loaded condition.
   Subsequent - 1000 hours or (1) year whichever comes first Higher temperatures make it necessary to change oil more frequently.

4. OIL FILL LEVEL
   Unit mounted horizontal - half-full



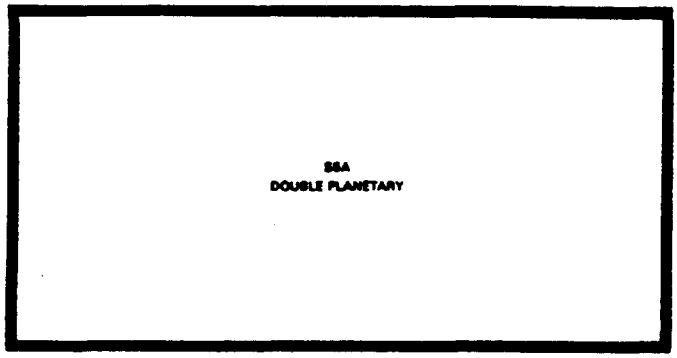
Shaft or spindle mounted down — lubrication must be as high as top of cluster bearings per chart.

Unit Size	Dimensions When Checking Shaft or Spindle Down	
	Min. Fill in.	Max. Fill in.
S1	1.02	.65
S3	1.12	.72
S6	1.34	.75
S7	1.75	1.38
S10	1.94	1.11
S12	1.75	1.38
S20	1.90	1.25
S50	1.90	1.75



Torque-Hub® Final Drives

Service Manual



Fairfield Manufacturing Company, Inc.
South Concord Road, Lafayette, Indiana 47902, U.S.A. 317/474-3474

Fairfield

THE DRIVE PEOPLE

Introduction

This Service Manual is a step-by-step guide designed for the customer or shop mechanic who is servicing or repairing a particular model of Torque-Hub Final Drive. (The model covered by this copy of the Manual is specified on the Manual cover.)

Included are -

1. assembly and exploded view drawings
2. disassembly procedure
3. main assembly procedure (assuming all sub-assemblies to be intact)
4. sub-assembly procedures.

At the time of printing, this Manual was complete for the specific Torque-Hub model designated. However, Fairfield Manufacturing Co., Inc., reserves the right to update and improve its products at any time. All specifications and procedures are therefore subject to change without notice.

Safety

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn; heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see a caution symbol (). This symbol indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

Disassembly Procedure

1. Loosen all 24 Cover Bolts (16) and drain the oil from the unit.
2. Remove the 24 Cover Bolts (16) and lift off Cover (6). Remove O Ring Seal (5) from the Cover Counterbore and discard.
3. Remove Thrust Washer (7) from the internal counterbore of the Cover (6).
4. Remove Input Gear (8) from First Stage Carrier Planet Gears (3F).
5. Remove Thrust Washer (12). Thrust Bearing (13) and Thrust Washer (14) from First Stage Carrier (3A). NOTE:

   Thrust Washer (12) may have stuck to Cover (6) as it was removed in Step 2.
6. Lift First Stage Carrier Assembly (3A-F).
7. Remove Thrust Washer (9) from end of Second Stage Sun Gear (11). This Thrust Washer would have been removed from its location on Input Gear (8) during Step 4.
8. Remove Thrust Bearing Carrier (10).
9. Remove Second Stage Sun Gear (11).
10. Remove Thrust Washer (12), Thrust Bearing (13) and Thrust Washer (14) from Second Stage Carrier (2A) counterbore. NOTE: Thrust Washer (12) may have stuck to Thrust Bearing Carrier as it was removed in Step 8.
11. Remove Ring Gear (4) from mesh with Second Stage Carrier Assembly (2A-G). Find O Ring (5), remove and discard.
12. Remove Second Stage Carrier Assembly from engagement with Output Shaft(1A)
13. Remove Retaining Ring (1J) from the Retaining Ring Groove in Output Shaft (1A).

⚠ Eye protection should be worn during this Retaining Ring removal.

14. Remove Bearing Spacer (1H) from Output Shaft (1A) and Bearing Cone face (1F).
15. The Output Shaft (1A) may now be pressed out of Hub (16).
16. Bearing Cups (1C & 1E) will remain in Hub (1G) as will Bearing Cone (1F). Bearing Cone (1D) will remain on Output Shaft (1A). Seal (1B) will be automatically removed during this procedure.

NOTE:

Should Bearing replacement be necessary, the Bearing Cups (1C & 1E, can be removed with a "slide hammer" puller or driven out with a punch.

WARNING:

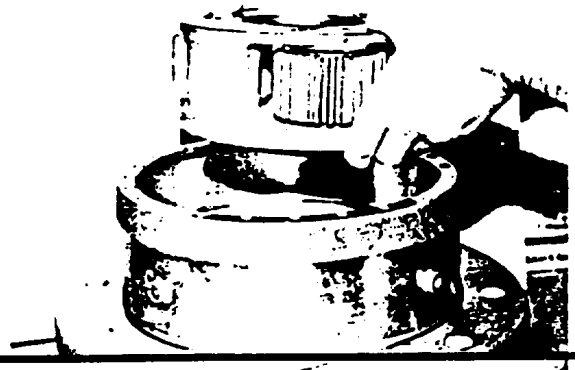
When rebuilding the unit, the O' Rings and Retaining Rings should always be replaced.

To remove Planet Gears from the Carrier Assemblies, tap Roll Pins (2G) & (3D) into Planet Pins (2E) & (3E). Tap Planet Pins (2E) & (3E) out of location in the Carrier Assembly. Roll Pins (2G) & (3D) may now be driven through Planet Pins (2E) & (3E). Slide Planet Gears (2F) & (3F), Thrust Washers (2B) & (3B) out of Carriers (2A) & (3A). Remove Roller Bearings (2C) & (3C) from Planet Gears (2F) & (3F). Remove Spacer (2D) from Second Stage Planet Gear (2F).

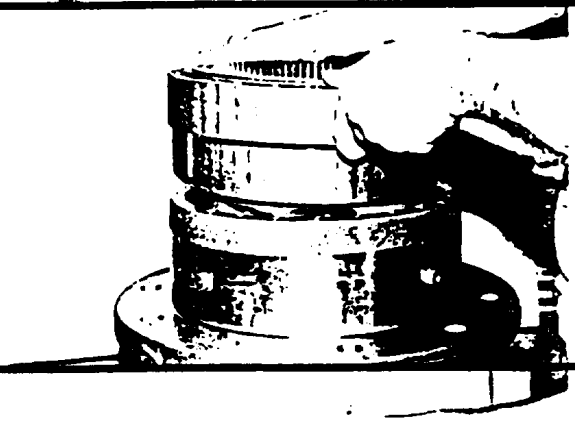
Main Assembly Procedure

1. With the Hub Shaft Sub-Assembly located on Shaft (1A), O'Ring (5) is installed into the counterbore provided. Slight stretching of the O'Ring may be necessary. Use sufficient grease or petroleum jelly to hold the O'Ring in place.

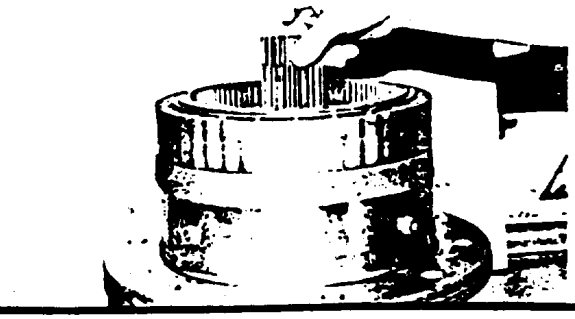
⚠ Beware of sharp edges of the counterbore while seating the O' Ring.



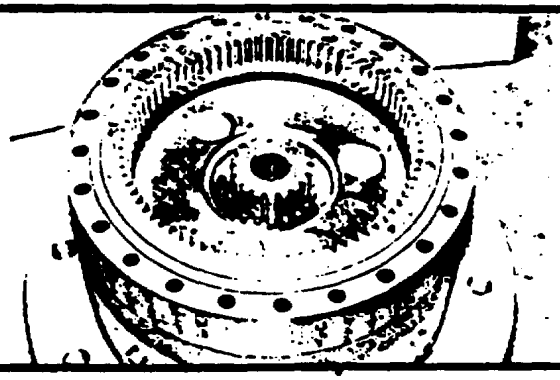
2. The Second Stage Carrier (2A-G) is now installed into the Hub (1G) and onto the Spline of Output Shaft (1A). This should be a slip fit.



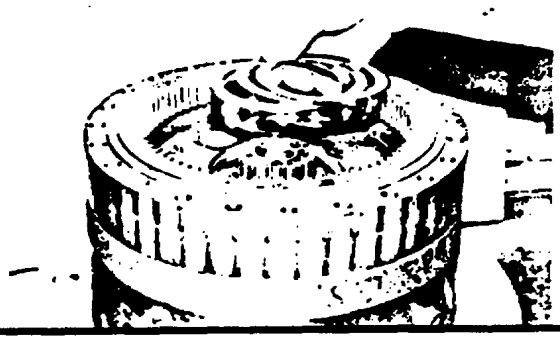
3. Ring Gear (4) is now correctly installed into Hub (1G). Care should be taken to insure that O'Ring (5) has remained in position before seating Ring Gear (4).



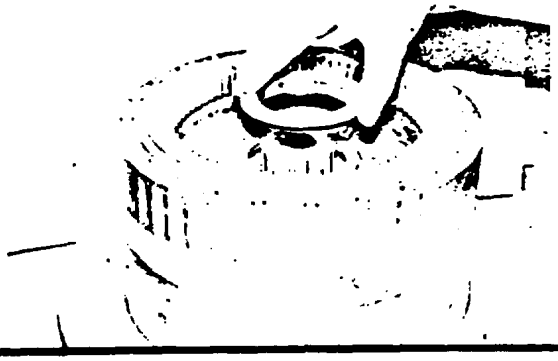
4. The Second Stage Sun Gear (11) is installed meshing with Planet Gears (2F) of the Second Stage Carrier Assembly (2A-G) and located on the internal end of Output Shaft (1A). NOTE: The reduced depth spline is up or to the outside of this assembly when correctly installed.



5. Sun Gear (11) should have this appearance when correctly installed.



6. Thrust Washer (14), Thrust Bearing (13) and Thrust Washer (12), in that order, are installed into the counterbore in the face of the Second Stage Carrier (2A). NOTE: Thrust Washer (14) is thicker than Thrust Washer (12) and locates in the counterbore. Use sufficient grease or petroleum jelly to hold these parts together and in place.

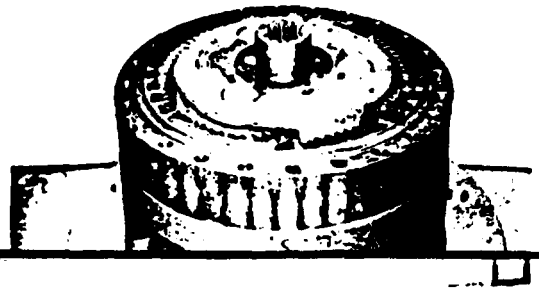


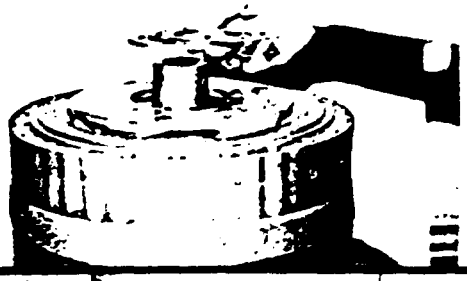
7. Thrust Bearing Carrier (10) is now installed into Thrust Bearing set (12; 13 & 14). The shoulder side of Carrier (10) is located down and into the bore of Thrust Washer Set (12; 13 & 14).

8. The First Stage Carrier assembly (3A-F) is installed with Spline bore shoulder side down. The Splined bore will mesh with the reduced depth spline end of the Second Stage Sun Gear (11) with the Planet Gears (3F) meshing with the teeth of Ring Gear (4).

9. Thrust Washer (9) is positioned and centered on the exposed end of the Second Stage Sun Gear (11). Use sufficient grease or petroleum jelly to Washer (9) in place. Input Gear (8) is then installed meshing with the teeth of Plat Gears (3F) and centering on Thrust Washer (9). NOTE: The teeth of Input Gear (8) rest on Thrust Washer (9) with the shoulder of the Input Gear (8) throug Washer (9).

10. The Assembly should have this appearance at this point during the assembly.



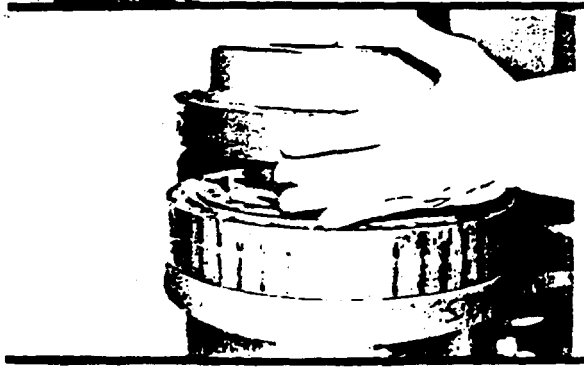


11. Thrust Washer (14), Thrust Bearing (13) and Thrust Washer (12), in that order, are installed into the counterbore in the face of the First Stage Carrier (3A). NOTE: Thrust Washer (14) is thicker than Thrust Washer (12) and locates in the counterbore. Use sufficient grease or petroleum jelly to hold these parts together and in place.

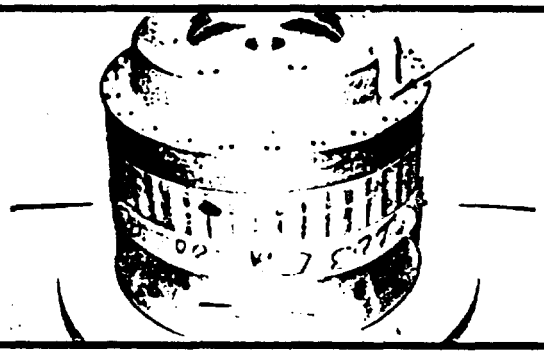
12. Thrust Washer (7) is now installed into the counterbore of internal side of Cover (6). Use sufficient grease or petroleum jelly to hold Washer (7) in place during installation of Cover (6) onto the assembly.

13. O'Ring (5) is installed into the counterbore of Cover (6). Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold O'Ring (5) in place.

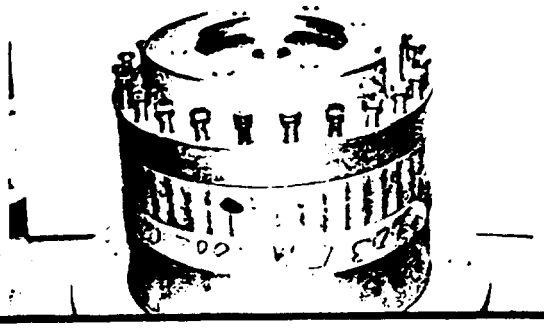
⚠ Beware of sharp edges in the counterbore while seating this O'Ring (5).



14. Cover (6) is installed onto this assembly, locating on Ring Gear (4) and centering on Input Gear (8). Align Bolt holes in Cover (6) with those in Ring Gear (4) before seating to reduce the chances of dislodging or moving O'Ring (5).

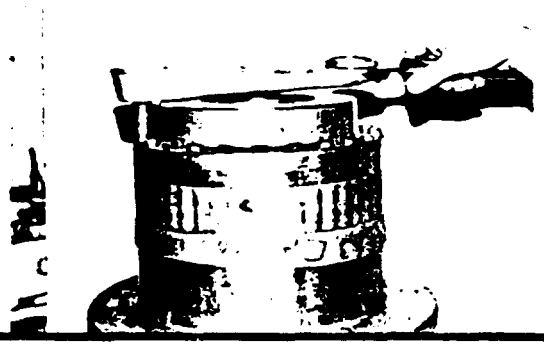


15. Care should be taken to align Pipe Plugs (1L or 1M) in Hub (16) at 90° to Pipe Plugs (15) in the Cover (6) when installing Cover (6). This allows the unit to be filled with lubricant through Pipe Plugs (1L or 1M) positioned at 12:00 and checked through Pipe Plugs (15) positioned at 3:00 or 9:00.



16. Install all Grade 8 Bolts (16) into the assembly and snug down.

17. Pipe Plugs (15) are installed into the holes in Cover (6). The use of some form of lubricant seal is recommended.



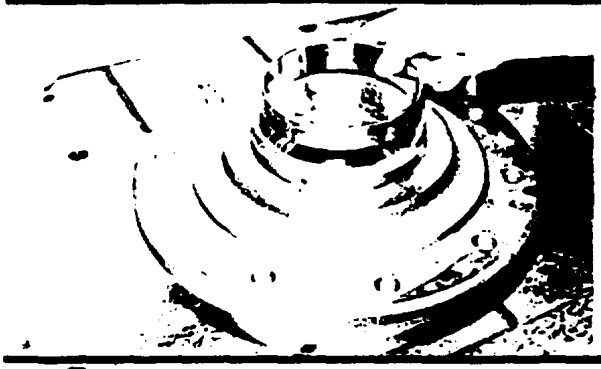
18. All Grade 8 Bolts (16) are now torqued to 47 ft. lbs. using the 180°-90° method

This completes the assembly. The unit must be filled one-half full of EP 90 lubricant before operation of the unit is mounted horizontally, and completely filled if mounted vertically. In vertical mounting application case oil circulation is recommended.

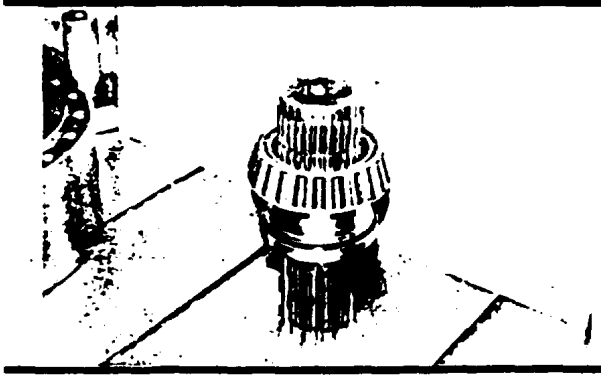
HUB SHAFT Sub-Assembly

1. With Hub (1G) located on the small diameter end, Bearing Cup (1E) is pressed into place. Care should be taken to insure this cup is started square with the counterbore of Hub (1G).

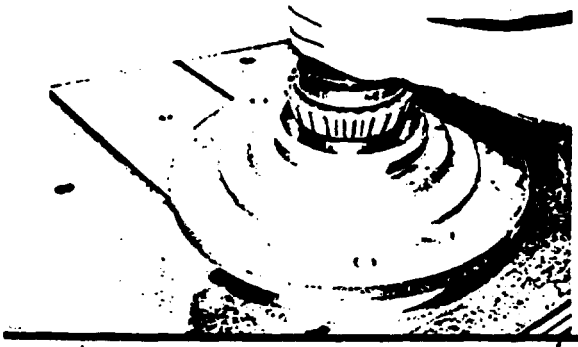
2. After inverting Hub (1G), Pipe Plugs (1K) are installed into the holes provided. These Pipe Plugs should not protrude into the Bearing Cup (1C) counterbore. The use of some form of Lubricant Seal is recommended.



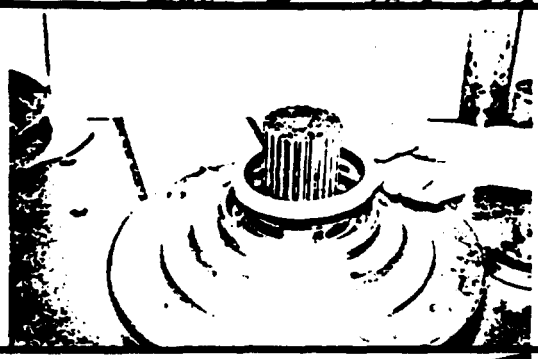
3. Bearing Cup (1C) is then pressed into position. Care should be taken to insure this Cup is started square with the counterbore of Hub (1G).



4. Bearing Cone (1D) is to be pressed onto Output Shaft (1A).

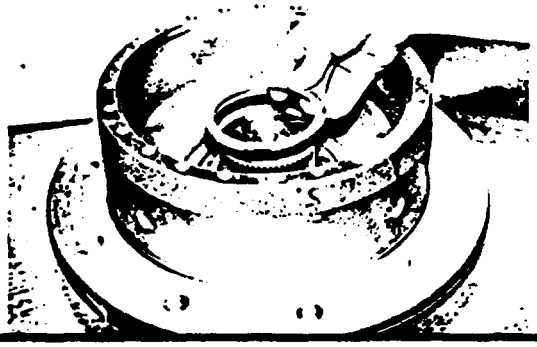


5. Output Shaft (1A), with Bearing Cone (1D) is installed into Hub (1G).

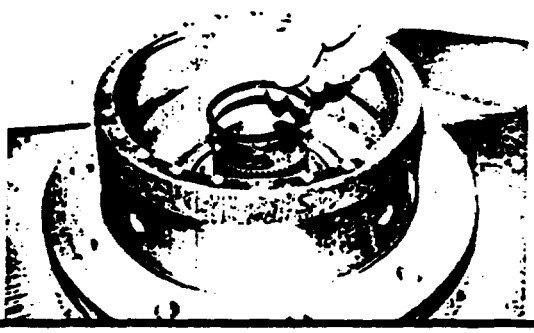


6. Shaft Seal (1B) is pressed into the Seal counterbore of Hub (1G). Care should be taken to insure this Seal (1B) is correctly installed (smooth side up) and located just flush with the face of Hub (1G).

7. After carefully inverting Hub (1G) taking care not to damage the Seal (1B), Bearing Cone (1F) is pressed into position.

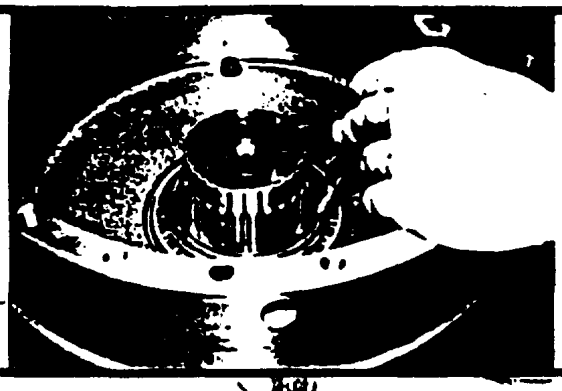


8. Bearing Spacer (1H) is installed over the spline of Output Shaft (1A) and onto the face of Bearing Cone (1F).



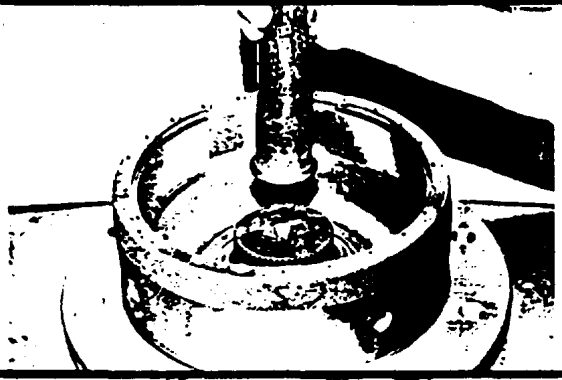
9. Retaining Ring (1J) is now installed over the spline of Output Shaft (1A) and into the groove provided.

⚠ Eye protection should be worn during this procedure.

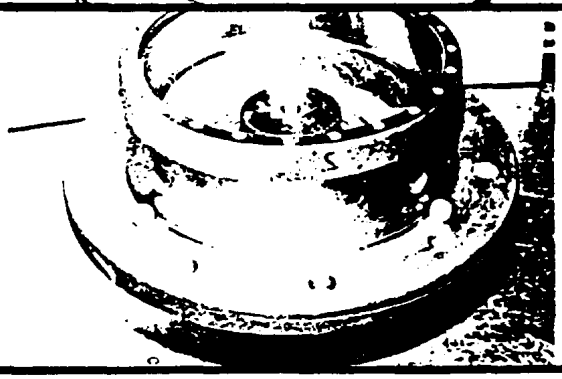


10. Care should be taken to insure that Retaining Ring (1J) is completely seated into the groove in the Output Shaft (1A). A soft metal punch can be used to insure proper seating.

⚠ Eye protection should be worn during this procedure.



11. The Output Shaft (1A) is now rapped sharply with a piece of soft metal bar. This action will release the pre-Load put on the Bearings during Steps 9&10.

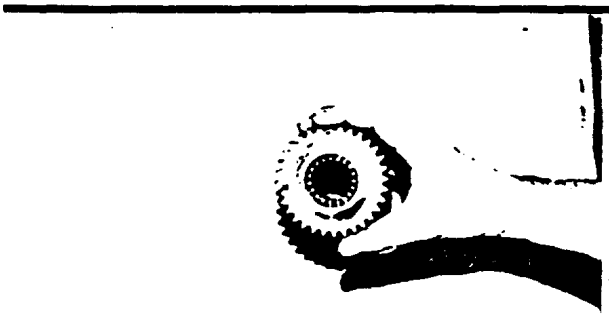


12. Pipe Plugs (1L & 1M) are now installed into place. The use of some form of Lubricant Seal is recommended.

This completes the Hub Shaft Sub-Assembly. If it is not going to be used right away, it should be oiled and covered to help prevent rust.

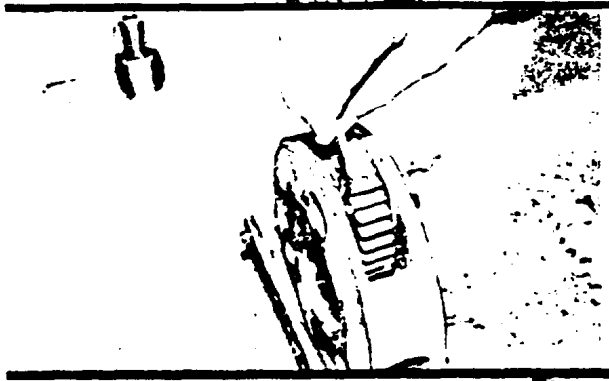
Carrier Sub-Assembly Procedure

First Stage Carrier Assembly

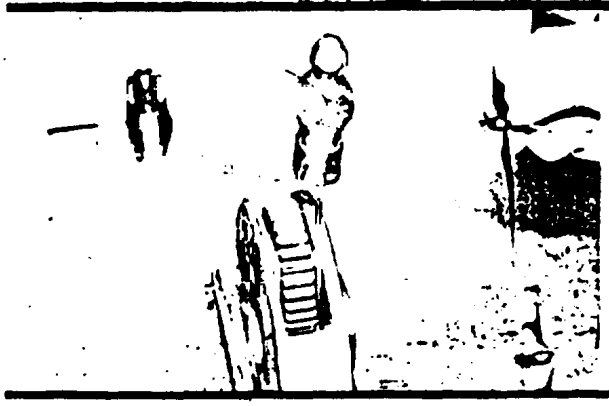


1. Starting with the Planet Gears (3F) anc using sufficient grease or petroleum jelly to hold in place, install 19 Needle Rollers (3C) in each.

2. With Carier (3A) standing on edge, sta: Planet Pins (3E) through the Planet Pir holes in Carrier (3A). Using sufficient grease or petroleum jelly to hold togethe and in place, install 2 Thrust Washers (3B) on the end of Planet Pin (3E).

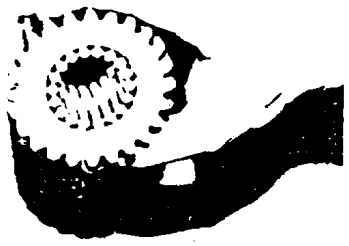


3. The Planet Gears (3F) are positioned an Planet Pins (3E) are pushed through a: 2 additional Thrust Washers (3B) are inserted. Once again, sufficient grease or petroleum jelly should be used to hold Thrust Washers (3B) together anc in place.

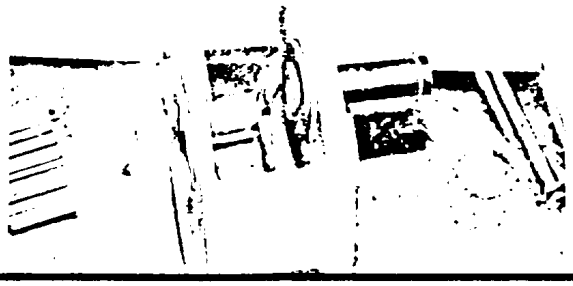


4. Planet Pins (3E) are pushed into locatio and the Roll Pin holes in the Carrier (3A) and Planet Pin (3E) are aligned. The Planet Pin (3E) Roll Pin hole is chamfered on one end only. This chan should be positioned at the top to allo easy installation of Roll Pin (3D) in cases of slight misalignment of the Ro Pin holes. Roll Pin (3D) is tapped into position flush with Carrier (3A) surfac

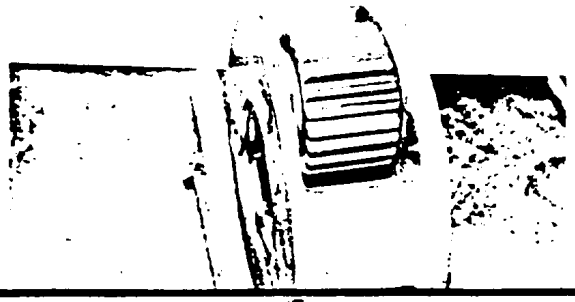
Second Stage Carrier Assembly



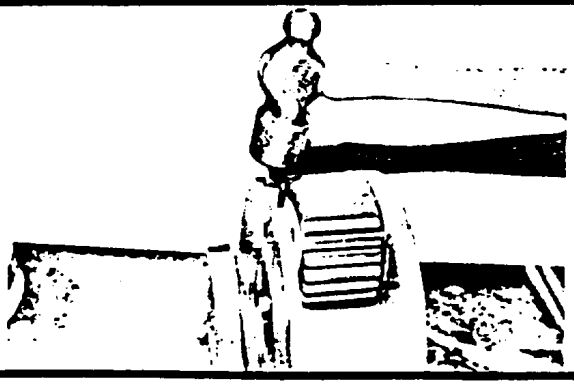
1. Starting with the Planet Gears (2F) and using sufficient grease or petroleum jelly to hold in place, install 18 Needle Rollers (2C) in each half of Planet Gears (2F) with Spacers (2D) in between them.



2. With Carrier (2A) standing on edge, start Planet Pin (2E) through the Planet Pin holes in carrier (2A). Using sufficient grease or petroleum jelly to hold together and in place, install 2 Thrust Washers (2B) on the end of Planet Pin (2E).



3. The Planet Gears (2F) are positioned and Planet Pins (2E) are pushed through as 2 additional Thrust Washers (2B) are inserted. Once again sufficient grease or petroleum jelly should be used to hold Thrust Washers (2B) together and in place.



4. Planet Pin (2E) is pushed into location and the Roll Pin holes in the Carrier (2A) and Planet Pin (2E) are aligned. The Planet Pin (2E) Roll Pin hole is chamfered on one end only. This chamfer should be positioned at the top to allow easy installation of Roll Pin (2G) in cases of slight misalignment of the Roll Pin holes (2G) are tapped into position flush with Carrier (2A) surface.

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	25
Quantity Required:	One
Description:	Winch Gear Set
Manufacturer:	American Gear
Part Number:	Special

Source: Brancart Development Corp.
17150 Butte Creek - Suite 219
Houston, Texas 77090

Tele #: 1-713-440-4661

DECKMASTER

GEAR SET SPECIFICATIONS

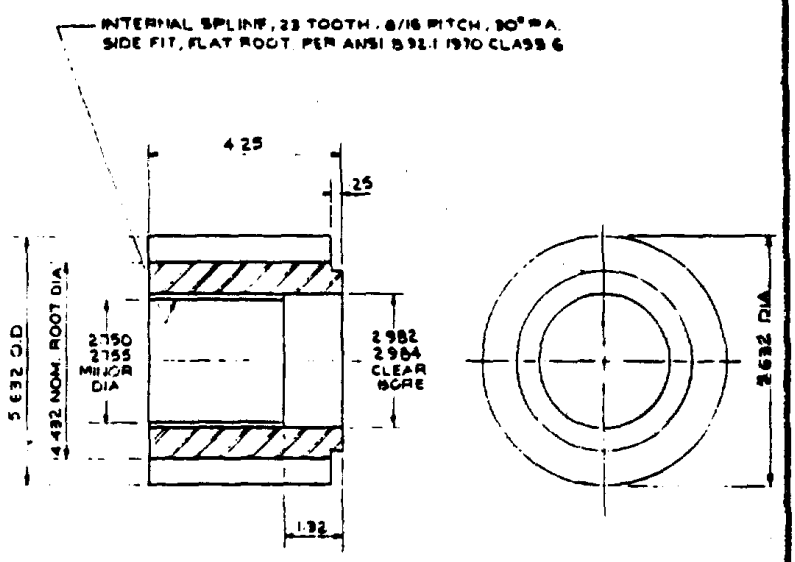
PINION GEAR

Pitch-3 DP 200PA Stub Tooth, with long Addendum.
No. of teeth - 15
Pitch Diameter - 5"
Face Width - 4"
Material 4140 H.T. To Rockwell (C) 32 to 35 with teeth flame hardened after cutting to approximately 50 R (c).
Internal Spline - 8/16 D.P., 30° P.A., 23 tooth, Side Fit

RING GEAR

Pitch - 3 DP, 20° P.A. Stub Tooth, with short addendum.
No. of teeth - 181
Pitch diameter - 60.333"
Face Width - 4"
Material 4140 H.T. to Rockwell (c) 32 to 35 (No flame harden)

Ratio of pair - 12.666 to 1
Center distance - -32.666"



PINION GEAR
SCALE: 6" = 1'-0"

RING GEAR MATERIAL: 4/40 HT. TO 32 TO 35 R (C)

PINION MATERIAL: 4/40 H T TO 32 TO 35 R (C)
FLAME HARDEN TEETH TO 47 TO 50 R (C)

PINION ADDENDUM LENGTHENED BY 0.050"

RING GEAR ADDENDUM SHORTENED BY 0.050"

RATIO OF PAIR - 12.066 TO 1

CENTER DISTANCE - 32.666"

BRANCART DEVELOPMENT CORP.

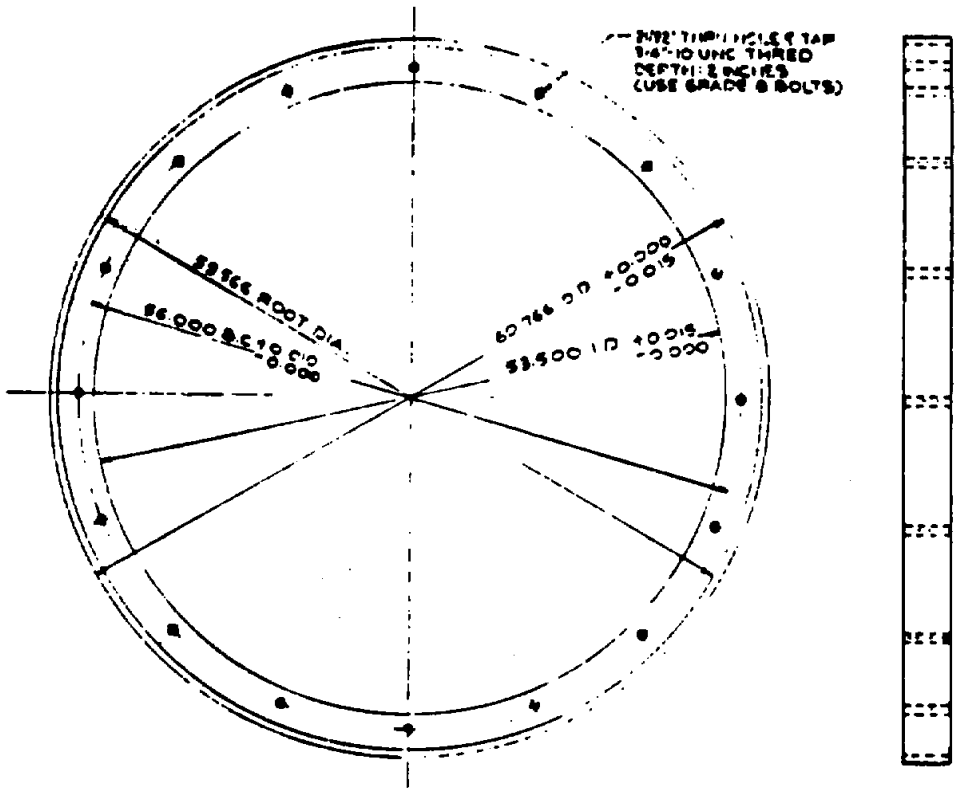
AS NTD

GEAR SET DETAILS

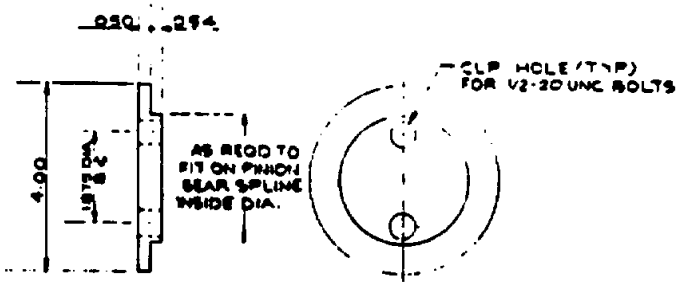
CSI/ROWPU WINCH

315-17-301

DECKMASTER



RING GEAR
SCALE 6"=1'-0"



PINION GEAR CAP
SCALE 6"=1'-0"

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	26
Quantity Required:	One
Description:	Levelwind Valve
Manufacturer:	BRAND
Part Number:	A0755-T4-LSR

Source: Brand Hydraulics Co., Inc.
2332 South 25th Street
Omaha, Nebraska 68105

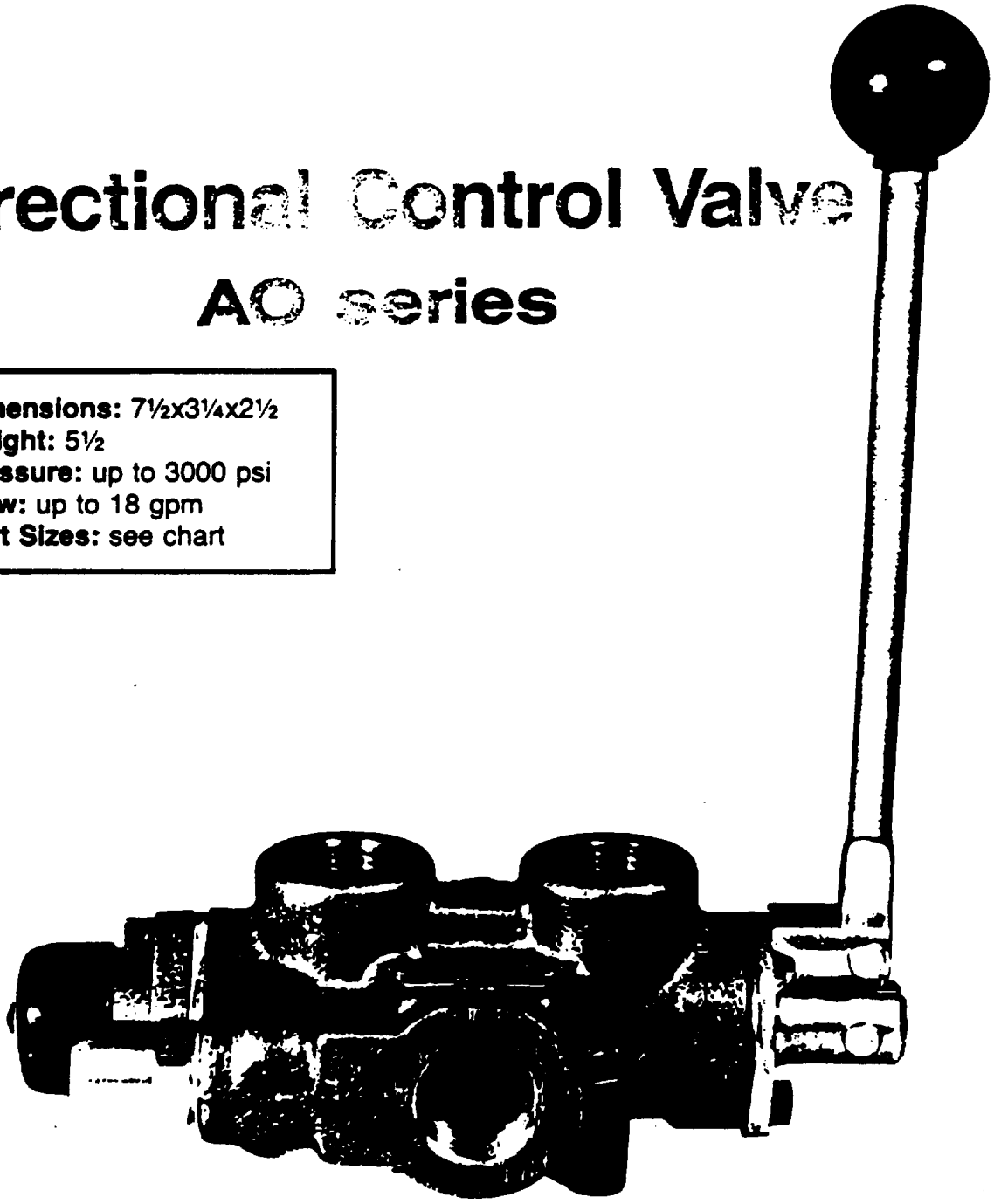
Tele #: 1-402-344-4434

TELEX #: 484587

Directional Control Valve

AO series

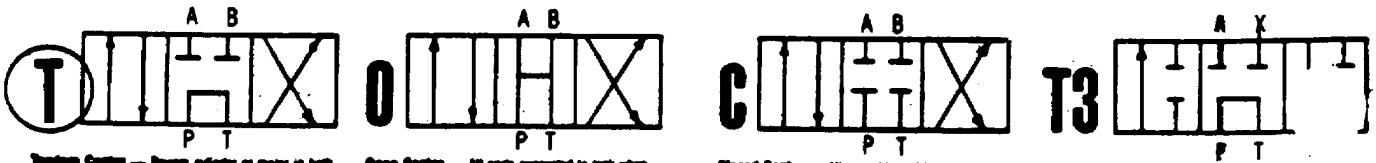
- **Dimensions:** 7½x3¼x2½
- **Weight:** 5½
- **Pressure:** up to 3000 psi
- **Flow:** up to 18 gpm
- **Port Sizes:** see chart



The = Brand = new AO series of directional control valves are small and compact. Designed for applications where size, weight & appearance are important. But performance is like valves that are larger. Superior capacity and pressure ratings . . . 18 GPM and 3000 psi.

The valve is available with various types of spools & options. Can be supplied as a three or four-way, with or without relief. Also the popular log splitting feature . . . spring centered in one direction, pressure released detent in other direction . . . automatically kicks back to neutral when cylinder completes stroke. For satisfactory operation we recommend 30 micron filtration or better.

Spools



Tandem Center — Powers cylinder or motor in both directions. Pump unloads to tank when spool in neutral. Cylinder or motor locked when spool in neutral.

Open Center — All ports connected to tank when spool is in neutral. Allows cylinder to move or motor to rotate when spool is in neutral.

Closed Center — All ports blocked in neutral. Locks cylinder or motor in neutral. Required for use with pressure compensated pumps.

Tandem Three Way — Powers the cylinder in one direction. Pump unloads to tank when spool is in neutral, or when cylinder is being overpod. Cylinder is locked when spool is in neutral. Port "B" is plugged.

Actuators

L

Lever Handle — A long handle gives effortless spool motion & fine modulating control. A large plastic knob makes for comfortable grasping. Pushing the handle toward the valve body connects pressure to "B" port.

J

Lever Handle — Similar to "L" except pushing the handle toward the valve body connects Pressure to "A" port

P

Pilot Operated — Used when spool actuation by hydraulic pressure is required. 25 PSI minimum pressure is required without springs. 65 PSI minimum pressure is required with springs.

N

No Actuator — Should be used when it is necessary to connect the spool to an external or remote actuator. Standard top (5/16-18 x ½) is available when no attachments are included on spool.

Attachments

D

Three Position Detent — Holds the spool in any of three positions when handle is released. Detent grooves indicate neutral and both active positions.

F1

Friction Detent (Ball-Spring) — Holds the spool in any position when handle is released. A detent groove clearly indicates neutral position. Friction drag is adjustable.

F

Friction Detent (Roll-Pin) — Similar function to the F1, however friction is created by use of manganese roll-pins. Drag is not adjustable.

H

Hydraulic Detent Release — The holding force of the detent is released when working pressure reaches a preset level. Spool then returns to neutral from either active position. The kick-out pressure is adjustable.

SH

Spring Centered - Hydraulic Detent Release — Valve has spring centering in one direction and a hydraulic detent release in the other. This is the most popular feature on the log-splitter valve.

SD

Spring Centering - Mechanical Detent Release — Valve has spring centering in one direction and a mechanical ball-spring detent in the other. Detent must be overcome by an external means.

S

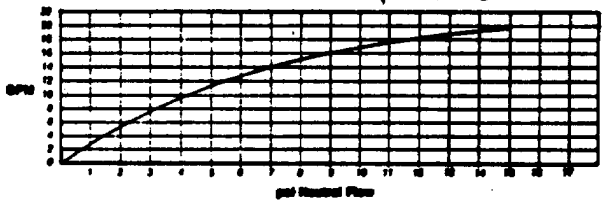
Spring Centering — The valve spool is returned to neutral whenever the handle is released. Standard on 3 and 4-way valves.

SO

Spring Offset — Spring holds spool in one active position (flow out port B) available with "L" & "P" actuators only.

*A hydraulic detent version that "kicks-out" in either direction will be available in the future.

Drop Curve



Model Number

Port Size Options		Spool Type	Valve Type	Actuator	Attachments
Inlet & Outlet	Work Port				
A0755 ¾ NPT	½ NPT	Tandem Open Closed	3 way valve 4 way valve	L Lever Handle J Lever Handle N No Actuator P Pilot Operated	D Three Pos. Detent F1 Ball Friction Detent F Roll-pin Friction Detent H Hydraulic Kick-out Detent SH Spring Centering/Hyd. Dt SD Spring Centering/Mech. Dt SO Spring Offset S Spring Centering R Adjustable Relief

AO — 755 — T — 4 — L — SR

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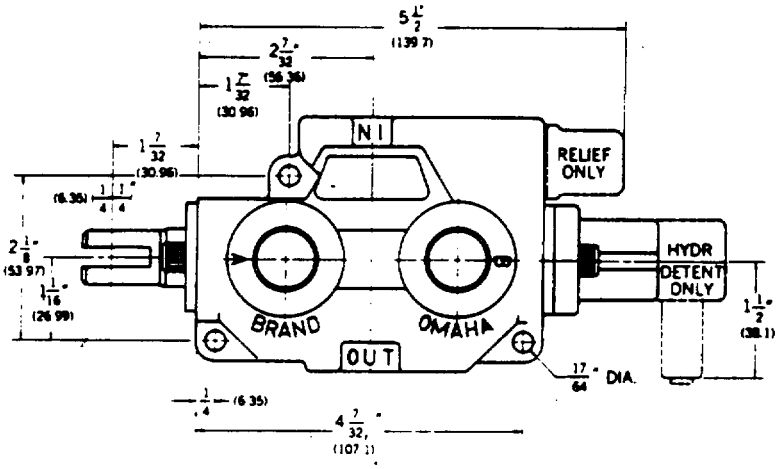
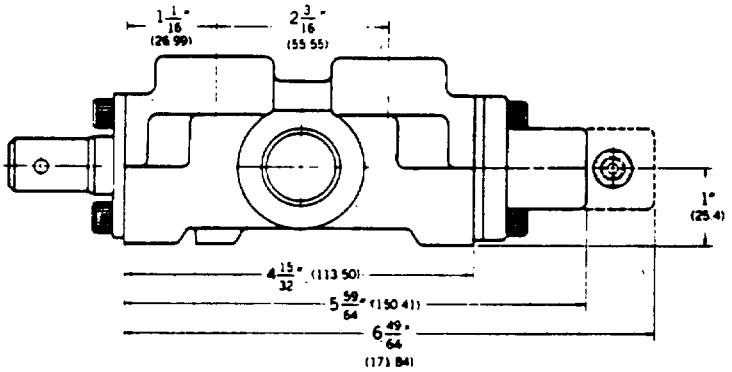
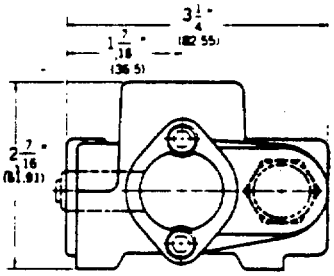
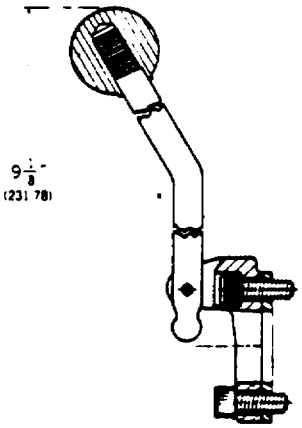


SEE CHART FOR PORT SIZES

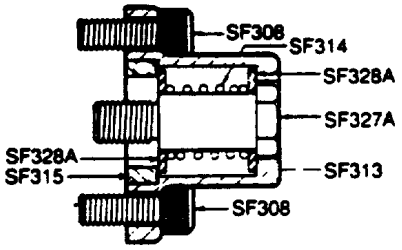






L HANDLE

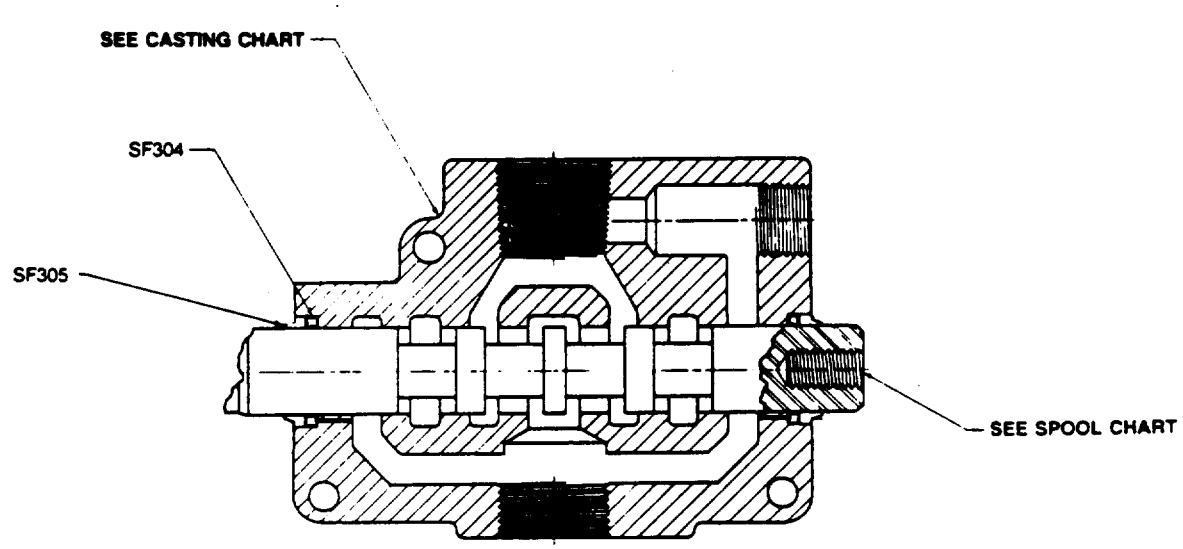
Port Size Options		
	Inlet & Outlet	Work Ports
50	½" NPT	½" NPT
755	¾" NPT	½" NPT

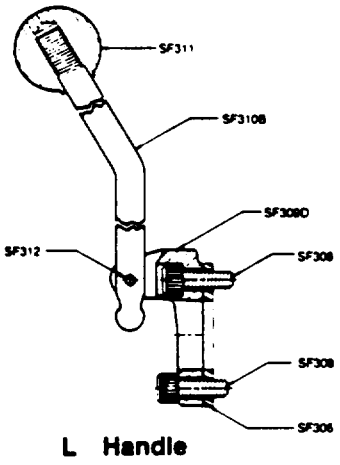


Option S
Spring Centering

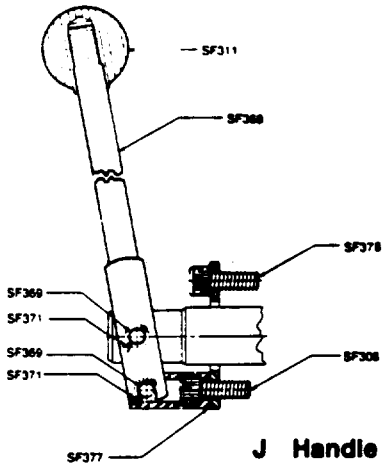
Parts List

DC3705	Detent Plunger	**SF313C**	End Cap, Hyd. Detent	**SF327B**	Spr. Centering Bolt	**SF334**	Alum Seal
DC7518	Relief Spring	**SF313D**	End Cap, 3 Pos Detent	**SF327C**	Bolt 5/16-18x2¼	**SF353A**	Detent Stop
DC7548B	Poppet	**SF314**	Centering Spring	**SF328A**	Washer	**SF355A**	Seal Retainer
DC7550	Set Screw 5/16-18	**SF314A**	Centering Spring	**SF331**	Spring	**SF356B**	Detent Housing
SF308	Cap Screw	**SF315**	Spacer	**SF332-2-08**	Detent Sleeve	**SF358**	Detent Spring
SF313	End Cap, Spr Cent.	**SF327A**	Spr Cent. Shoulder Bolt	**SF332-3**	Detent Sleeve	**SF366**	Adj Screw
SF313A	End Cap, Detent			**SF333B**	Detent Housing	**SF373**	Plug SAE
						SF374	Spacer, Spool

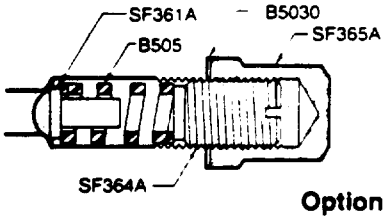




L Handle



J Handle



Option R Relief

Parts List

B505	Spring	**SF307**	Cap Screw	**SF311**	Ball Knob	**SF368**	Handle
B5030	Washer	**SF308**	Cap Screw	**SF312**	Roll Pin	**SF369**	Headed Pin
SF304	Quad Ring	**SF309D**	Clevis Bracket	**SF361A**	Poppet	**SF371**	Cotter Pin
SF305	Wiper	**SF310B**	Handle	**SF364A**	Adj Screw	**SF377**	Clevis Bracket
SF306	Seal Retainer			**SF365A**	Cap Nut	**SF378**	Cap Screw

Casting Chart

	Port Size			Attachments
AO	Model	Inlet Outlet	Work Ports	
	755	¾	½	

AO	755	—	

Spool Chart

Part No.	Spool
SF303C	Closed Center Spool
SF3030	Open Center Spool
SF303T3	Tandem Center 3 Way Spool
SF303T4	Tandem Center 4 Way Spool

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	27
Quantity Required:	One
Description:	Levelwind Motor
Manufacturer:	TRW ROSS
Part Number:	MAF-06-0-06-A1

Source: TRW ROSS GEAR DIVISION
800 Heath Street
Lafayette, Indiana 47902

Tele # 1-317-423-5377

TELEX #: 279413

DECKMASTER

Torqmotor™

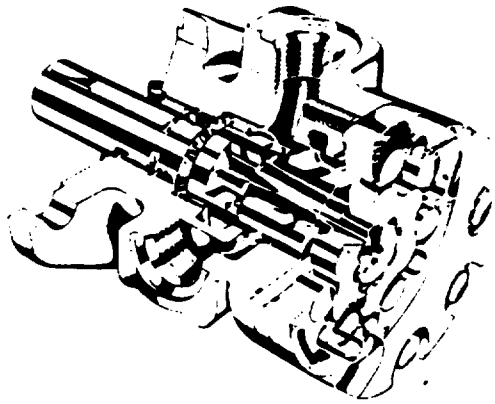
hydraulic motors

MAF

low-speed, high-torque

Features

- Roller vanes to reduce friction and internal leakage, and to maintain efficiency.
- Commutation radially independent of load-induced shaft movement, to allow a high level of side loading and minimize wear-induced commutation leakage.
- A needle-roller mounted coupling shaft and steel-caged thrust bearings, to withstand high thrust loads.
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing with motors run in series.
- Up to 250 lbs (113.4 kg) end thrust toward motor and 1000 lbs (453.6 kg) away from motor.
- Side load capacities of 500 lbs (226.8 kg) rated and 1000 lbs (453.6 kg) maximum, at center of output shaft.
- Up to 17 output horsepower.
- High output to weight ratios, and extra-compact design.



Options

- Choose among eight displacements, from 3.0 to 20 cubic inches/revolution (49 to 328 cm^3/rev);
- Choose Standard 4 bolt or SAE "A" Flange mount;
- Choose among three standard ports;
- Choose among seven shafts, to suit your application.

Notes

Differential pressure (ΔP) is the difference between inlet and outlet port pressures.

Peak (intermittent) operation rating applies to 10 percent of every minute.

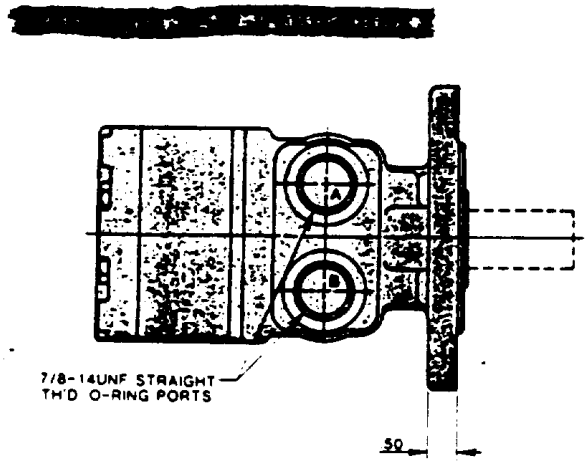
Maximum pressure at the motor inlet port (without regard to differential pressure or back pressure ratings or both) is 2500 PSI, (175.8 Kg/cm^2).

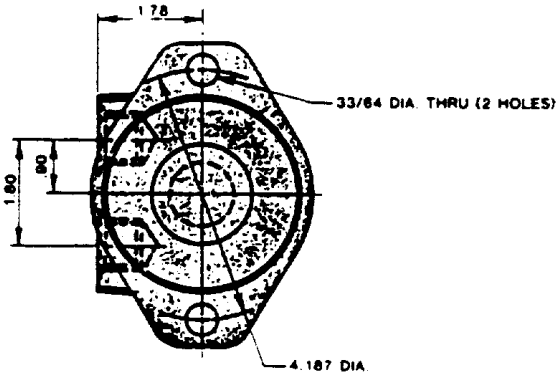
Specifications

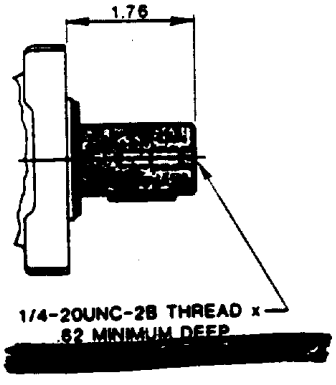
English										Metric							
MAF TOROMOTOR SERIES		08	12	16	20	24	32*	40*	06	08	12	16	20	24	32*	40*
DISPLACEMENT in³/rev. (cm³/rev.)		4	6	8	10	12	16	20	49	66	98	131	164	197	262	328
PRESSURE (P.S.I.) *Kg/cm²	Continuous (differential)	1750	1750	1750	1750	1750	1300	1050	123.1	123.1	123.1	123.1	123.1	123.1	91.4	73.8
	Peak (differential)	2500	2500	2500	2500	2500	1850	1500	175.8	175.8	175.8	175.8	175.8	175.8	130.1	105.4
	Back (Max.)	1750	1750	1750	1750	1750	1750	1750	123.1	123.1	123.1	123.1	123.1	123.1	123.1	123.1
THEO./100 P.S.I. (7 Kg/cm²)		63	95	127	159	190	254	318	5	7	1.1	1.5	1.8	2.2	2.9	3.7
TORQUE (In. Lbs.) (Kg-m)	@Rated pressure and flow	940	1420	1890	2360	2840	2640	2670	8.2	10.7	16.4	21.8	27.3	32.8	30.5	30.9
	@Peak pressure and rated flow	1350	2020	2700	3380	3810	3760	3810	11.7	15.6	23.3	31.2	39.1	44	43.5	44
FLOW (GPM) (liters/min.)	Con't. rated	12	12	12	12	12	15	15	34	46	46	46	46	46	57	57
	Peak	15	15	15	15	15	20	20	45	57	57	57	57	57	76	76
SPEED (RPM)	@Peak flow with no load	846	563	423	330	282	284	228	904	846	563	423	330	282	284	228
	@Con't. rated flow & pressure	609	406	305	244	203	194	155	610	609	406	305	244	203	194	155
"A" DIM	Inches (mm)	4.94	5.19	5.44	5.69	5.94	6.44	6.94	122.4	125.5	131.8	138.2	144.5	15-/0	163.6	176.3

*MAF 32 and MAF 40 Series will be available in late 1982.

DECKMASTER


7/8-14UNF STRAIGHT
TH'D O-RING PORTS
.50


1.78
33/64 DIA. THRU (2 HOLES)
.80
1.80
4.187 DIA.


1.76
1/4-20UNC-2B THREAD x
.62 MINIMUM DEEP

MAF
low-speed, high-torque

Torqmotor™
hydraulic motor

Performance graphs

Performance graphs are available as individual catalog sheets for each displacement in the MAF Series. Graphs include overall efficiency, volumetric efficiency, torque vs RPM, and flow vs. RPM. Please ask your TRW/Ross sales representative to provide these graphs for displacements of specific interest to your application.

Fluid/Filtration

SAE 10W40 API is recommended fluid.

Minimum recommended oil viscosity is 50 SSU with a minimum of .125 percent of zinc anti-wear additives.

Maximum operating temperature recommended is 200°F. (93.3°C)

Recommended nominal filtration is 20-50 micron.

Specification Guide

[redacted] - xx - 0 - xx

- [redacted] — Torqmotor Series
- Rotor Width (Displacement)
- 0 — 2 Synthetic fluid seals
- Mount, Port, Shaft, Combination

Rotor Width (Number of 1/16" Increments)	Displacement (in³/Rev.)	Displacement (cm³/Rev.)
xx	[redacted]	49
08	4.0	66
12	6.0	98
16	8.0	131
20	10.0	164
24	12.0	197
32	16.0	262
40	20.0	328

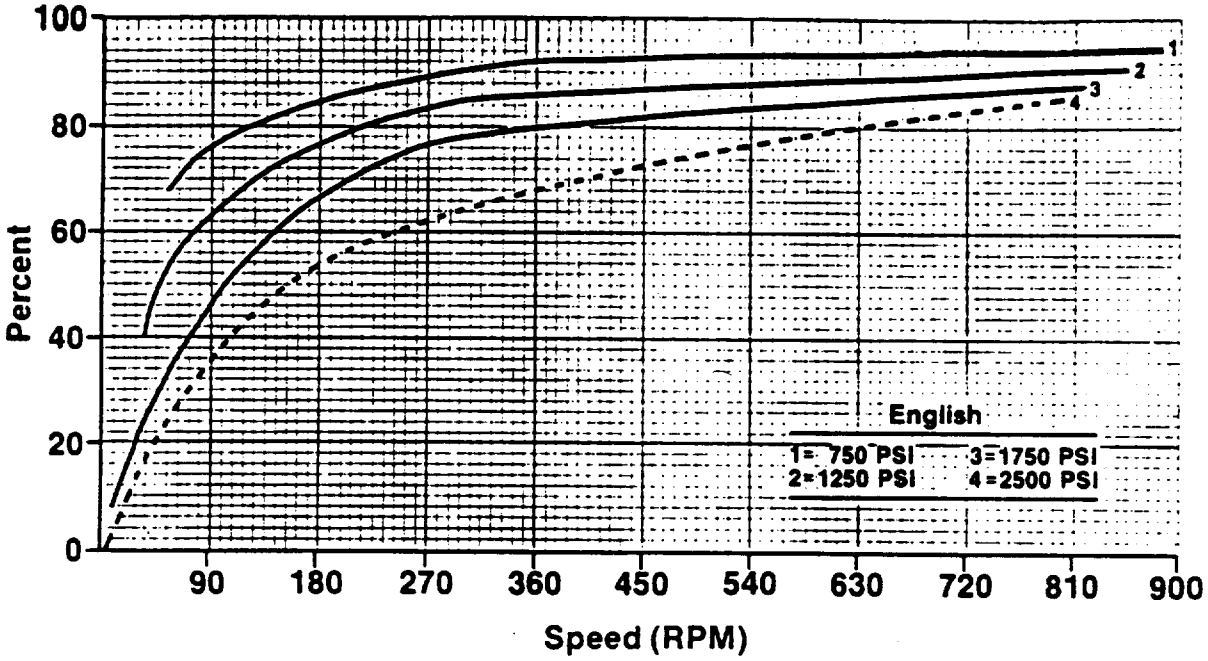
Mount	Port	Shaft: #15 Woodruff Key	1.00-6B Spline (Ret. Ring Groove)	Pin Hole	#15 Woodruff Key (Ret. Ring Groove)	Double Pin Hole	#15 Woodruff Key Internal Thread)	1.00-6B Spline (Ret. Ring Groove Internal Thread)
		xx	xx	xx	xx	xx	xx	xx
[redacted]	[redacted]	01	02	03	04	05	[redacted]	07
Standard	7/8" O-Ring	11	12	13	14	15	16	17
SAE "A" Flange	Manifold	21	22	23	24	25	26	27
Standard	Manifold	31	32	33	34	35	36	37
SAE "A" Flange	1/2" Pipe	41	42	43	44	45	46	47
Standard	1/2" Pipe	51	52	53	54	55	56	57

The 6B spline shaft and the woodruff key shaft are machined for use with a Waldes Truarc snap ring No. 5100-100 or equivalent.

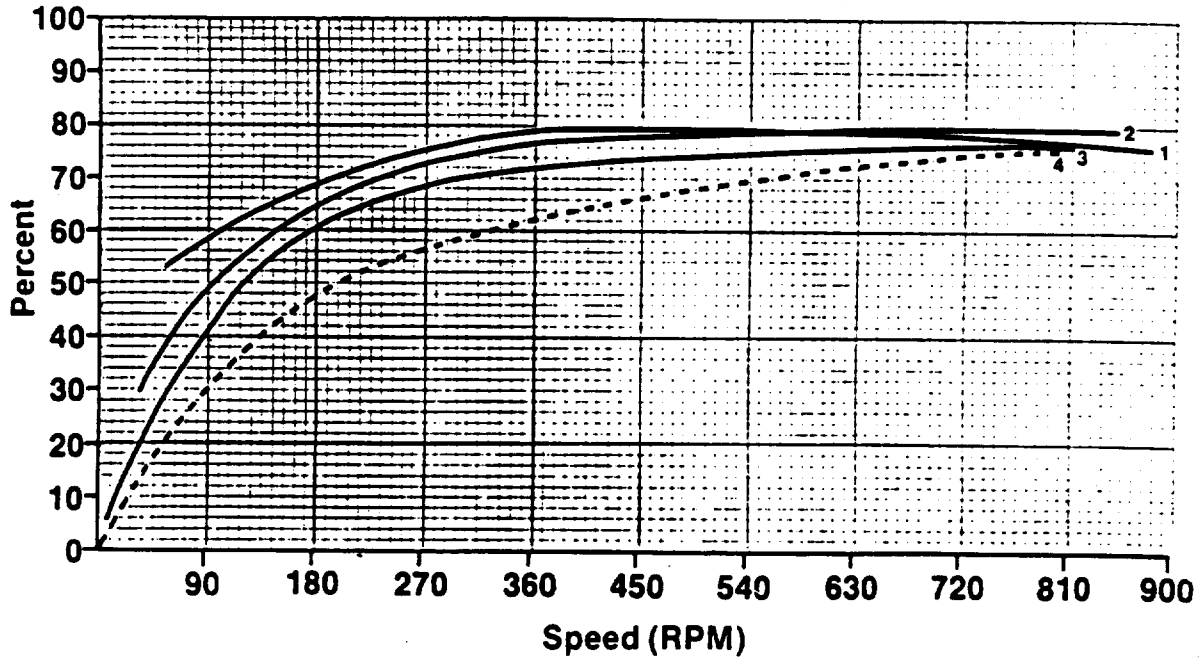
Torqmotor™ hydraulic motors

MAF 06
displacement
3 cu. in./rev.

Volumetric Efficiency



Overall Efficiency



——— Continuous - - - - - - Intermittent
(10 percent of every minute)

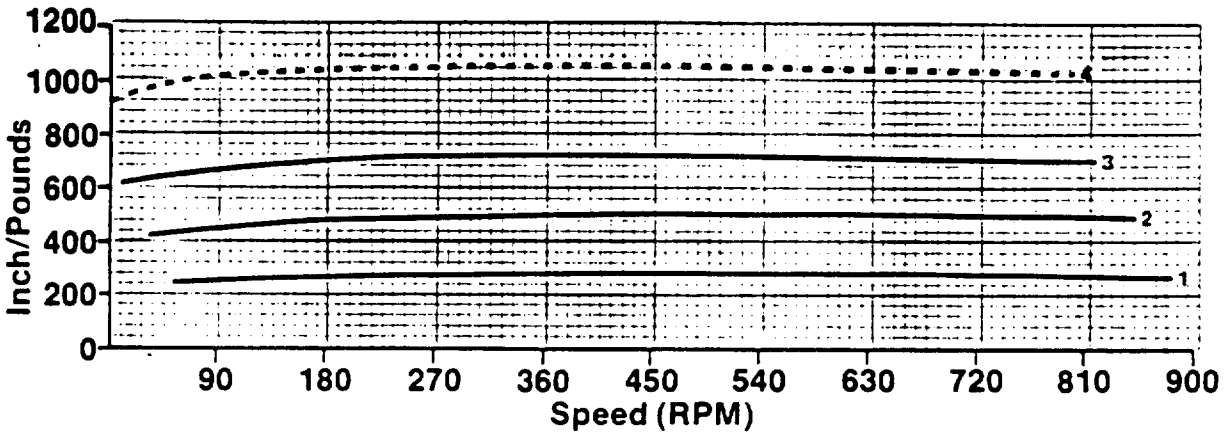
NOTE: Curve number "4" (2500 psi) is for intermittent-use pressure only

TRW ROSS GEAR DIVISION

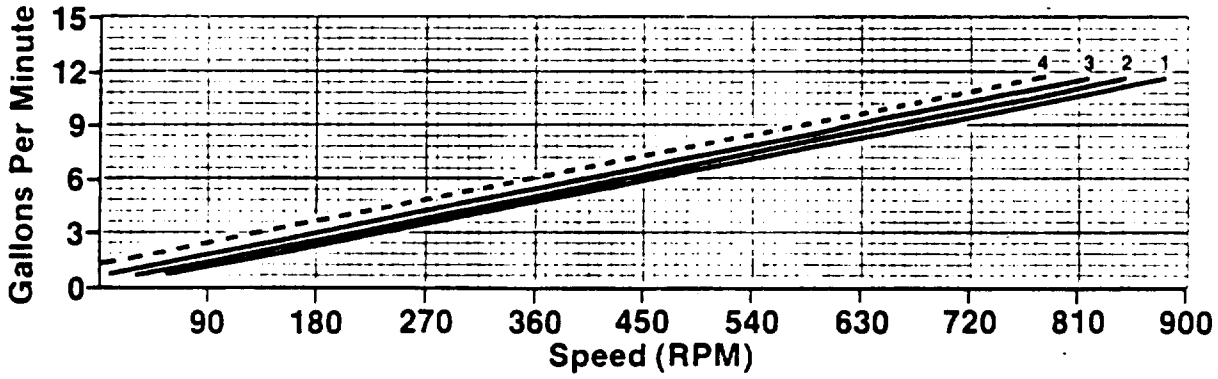
MAF 06 *Torqmotor*™ hydraulic motors

displacement
3 cu. in./rev.

Torque



Flow



Legend

——— Continuous - - - - - - - Intermittent
(10 percent of every minute)

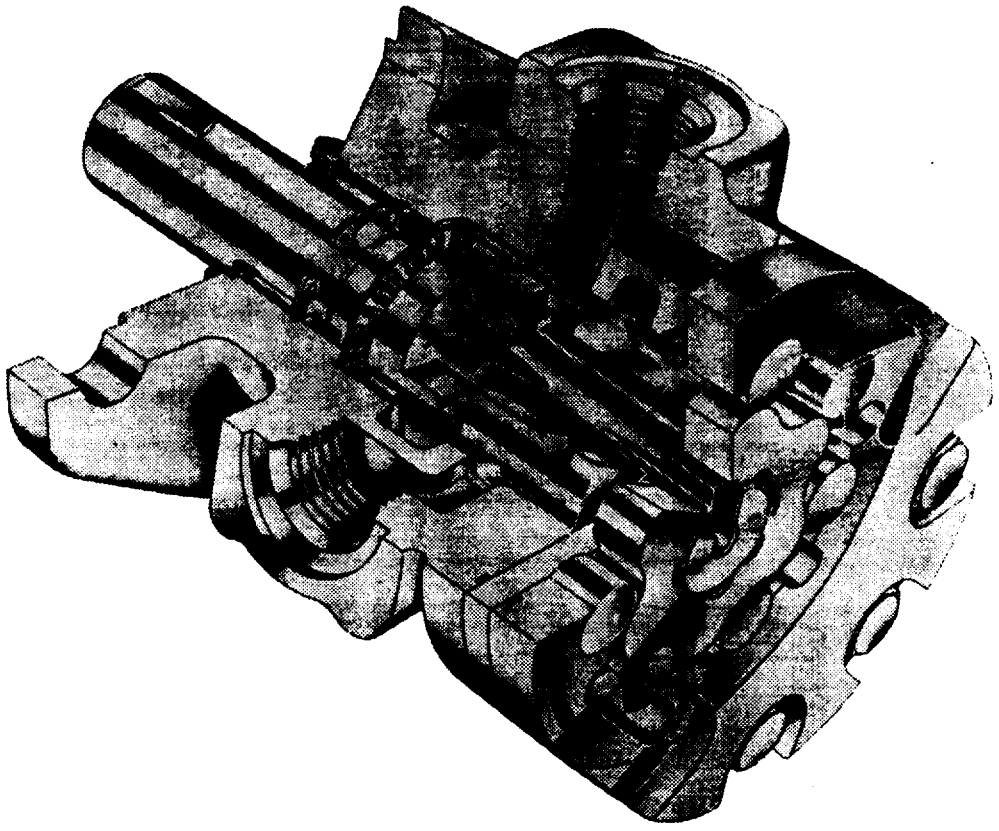
English	
1= 750 PSI	3=1750 PSI
2=1250 PSI	4=2500 PSI

TRW ROSS GEAR DIVISION

TRW

Torqmotor™

MAF Series Service Procedure

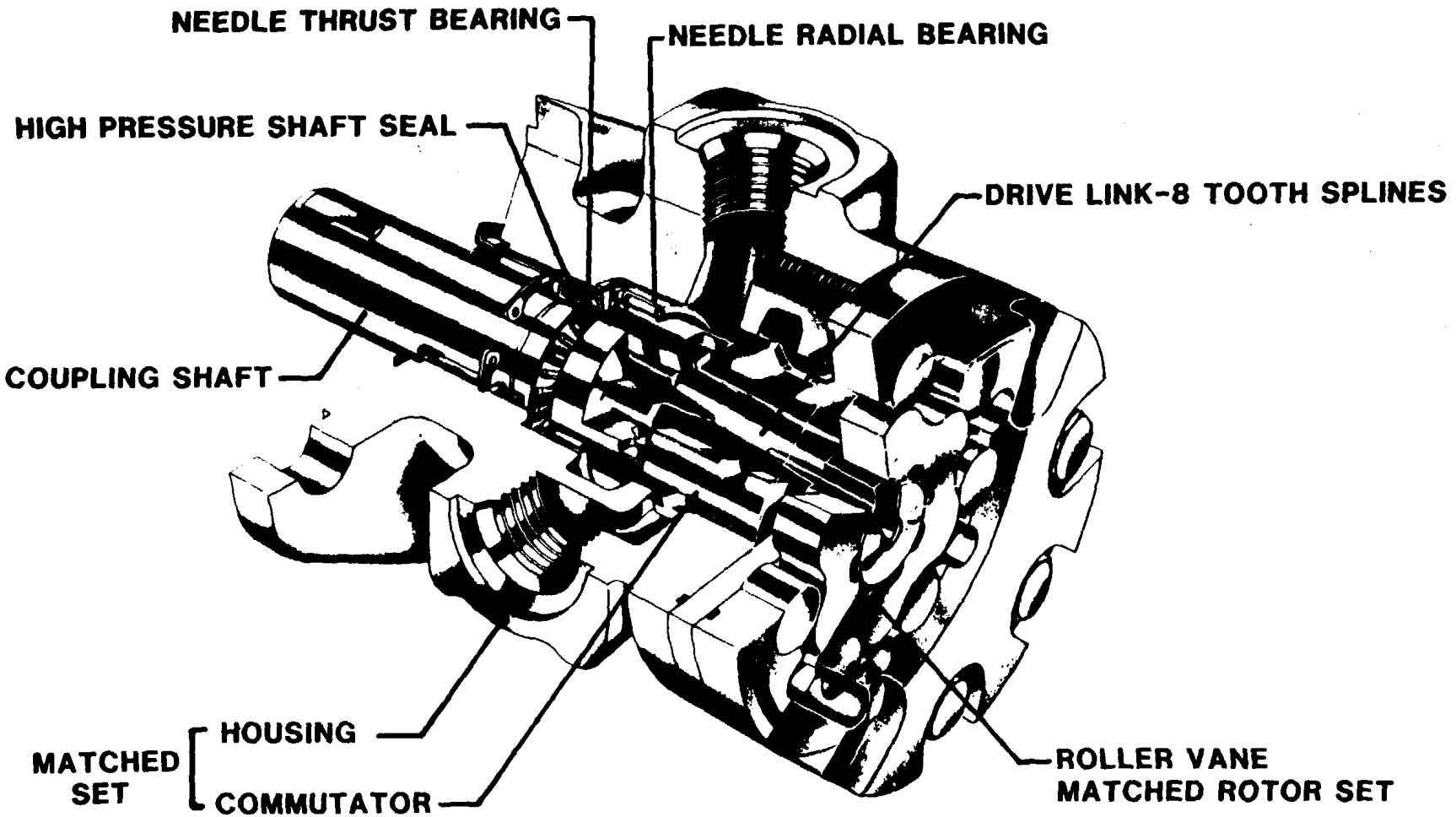


Ross Gear Division

Torqmotor™
MAF Design Features

- New standard for compactness and light weight relative to power output, increases installation design latitude.
- Displacements range from 20 cubic inches 1328 CM^3) down to 3 cubic inches (49 CM^3) per revolution.
- Continuous rated pressure up to 1750 psi (120.7 BAR), depending on displacement with fully competitive volumetric efficiency.
- Patented roller vanes for high performance and durability.
- Commutation radically independent of load induced shaft movement, minimizing wear induced commutation leakage.
- Coupling shaft mounted in steel caged needle radial and thrust bearings to withstand higher side and thrust loads.
- Optimized drive link contact with 8 tooth spline drive to reduce wear.
- Unique high pressure shaft seal allows MAF Torqmotors to be run in series without need for case drains. Only simple direct-line circuitry required.
- Standard SAE porting and mounting configurations.
- Fewer parts reduced maintenance, while maintaining quality performance.

MAF Design Features



Definitions

NOTE: A NOTE provides key Information to make a procedure easier or quicker to complete.

CAUTION: A CAUTION refers to procedure that must be followed to avoid damaging the MAF or other system components.

WARNING: A WARNING REFERS TO PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE EQUIPMENT OPERATOR AND THE PERSON INSPECTING OR REPAIRING THE MAF

Patents

Ross Gear Division products and systems described in this manual are protected by one or more of the following United States patents: 3,289,602: 3,460,481. In addition, patent applications have been filed in Brazil, Canada, Denmark, France, Italy, Japan, Sweden, the United Kingdom, and West Germany.

Table of Contents

Introduction

Service Manual for Model MAF

This service manual has one purpose: to guide you in maintaining, troubleshooting, and servicing the MAF Torqmotor™ (low-speed, high-torque hydraulic motor, MAF).

Material in this manual is organized so you can work on the MAF and get results without wasting time or being confused. To get these results, you should read this entire manual before you begin any work on the MAF.

This manual also contains troubleshooting information and checklist. If you must service the MAF, the checklist will help you to determine where the problem may be.

The three-column format of the Disassembly and Inspection, and Assembly sections will make it easier for you to conduct major work on the MAF. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Pay special attention to the notes, cautions, and warnings.

A foldout page with an MAF exploded assembly view is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly and assembly procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly and assembly procedures.

An MAF service part list chart is also provided in this manual with the part names and exploded view item numbers cross referenced to Ross Gear service part numbers.

Service parts are available through the Original Equipment Manufacturer (OEM) or Ross approved MAF Distributors.

As you gain experience in servicing the MAF, you may find that some information in this manual could be clearer or more complete. If so, let us know about it. Do not try to second guess the manual; if you are stuck, contact us. Servicing the MAF should be a safe and productive procedure, in order for the unit to deliver the reliable, long-life operation engineered into it.

Troubleshooting Guide

NOTE:

Before troubleshooting any system problem, check service literature published by the equipment and/or component manufacturers. Follow their instructions, if given, for checking any component but the MAF TorqmotorTM unit.

preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted place;
- have proper tools and materials nearby;
- have an adequate supply of clean petroleum-based solvent.

WARNING:

SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING:

WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

preliminary checks

Hydraulic systems are often trouble free. The problem an operator complains of could be caused by something other than the hydraulic components. Thus, once you have determined that a problem exists, start with the easy-to-check items, such as:

- parts damaged from impact not properly repaired, or that should have been replaced; and
- improperly spec'd replacement parts.
- mechanical linkage problems such as binding, broken, or loose parts or slipping belts.

hydraulic components

If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any useable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings. Replace any hoses or lines that don't meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Check the filter(s). A filter with a maximum 50 micron filtration is recommended for the MAF system.

Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

Excessive heat in a hydraulic system can create problems that can easily be overlooked. Every system has its limitation for the maximum amount of temperature. After the temperature is attained and passed, the following can occur:

- oil seal leaks
- loss of efficiency such as speed and torque
- pump loss of efficiency
- pump failure
- hoses become hard and brittle
- hose failure

A normal temperature range means an efficient hydraulic system.

It may be necessary that you run hydraulic tests on the performance of the hydraulic components. To do so, consult the manuals published by the equipment or component manufacturers.

Troubleshooting Checklist

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged.	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (5) deteriorated by excess heat	Replace oil seal rings by disassembling MAF unit.
	3. Special bolt (21 loose or its sealing area deteriorated by corrosion	(a) Loosen then tighten single bolt to 22-26 ft.-lbs. (30-35 N m) (b) Replace bolt.
	4. Internal shaft seal (16) worn or damaged	Replace seal by disassembling MAF unit.
	5. Worn coupling shaft (11) and internal seal (16)	Replace coupling shaft and seal by disassembling MAF unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty- relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.
	2. High Internal motor leakage	(a) Replace worn rotor set by disassembling MAF unit.
	3. Severely worn or damaged internal splines	Replace rotor set, drive link and coupling shaft by disassembling MAF unit.
	4. Excessive heat	Locate excessive heat source in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate MAF unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble MAF unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system	Locate source and eliminate cause.

CAUTION: IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED [IN EXCESS OF 200°F (93.30C.)], SEALS IN THE SYSTEM CAN SHRINK, HARDEN OR CRACK, THUS LOSING THEIR SEALING ABILITY.

Tools and Materials Required for Servicing

MAF service manual

Clean, petroleum-based solvent .

Emery paper

Vise with soft jaws

Air pressure source

Arbor press

Screw driver

Retaining ring pliers (internal)

Breaker bar

1/2 inch thin wall socket

Torque wrench - foot pounds

Adjustable crescent wrench or hose fitting wrenches

Marking pencil or chalk

SAE 10W40 oil

Clean grease

Feeler gage .005 inch (.127 mm)

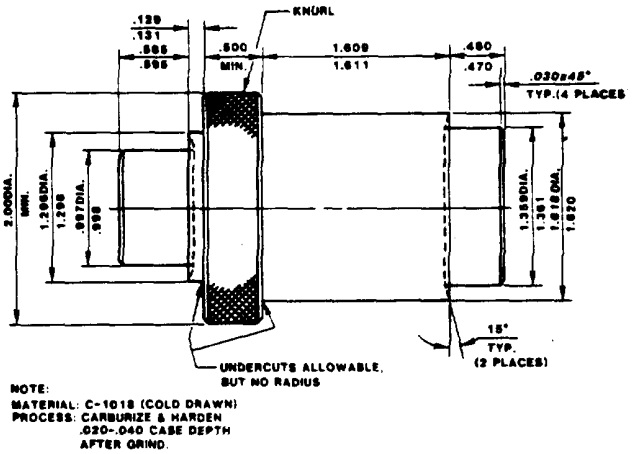
Blind hole bearing puller for 1 inch (25.4 mm) and 1.38 inch (35.1 mm) diameter bearing,

Special bearing mandrel (SEE FIGURE 1)

Special rotor set assembly tool (See FIGURE 2) or large locking pliers and two 16 penny nails or equivalent #8 US gage (.162 Dia. [4.1 mm]) metal rods (See FIGURE 62)

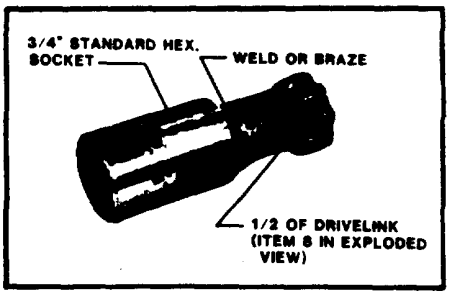
CONVERSIONS

INCHES	mm	INCHES	mm
.020	.51	.998	25.35
.030	.76	1.296	32.92
.040	1.02	1.298	32.97
.129	3.28	1.359	34.52
.131	3.33	1.361	34.57
.460	11.68	1.609	40.87
.470	11.94	1.611	40.92
.500	12.70	1.618	41.10
.585	14.86	1.620	41.15
.595	15.11	2.00	50.8
.997	25.32		



Bearing Mandrel
(Fabricate if considered necessary)

FIGURE 1



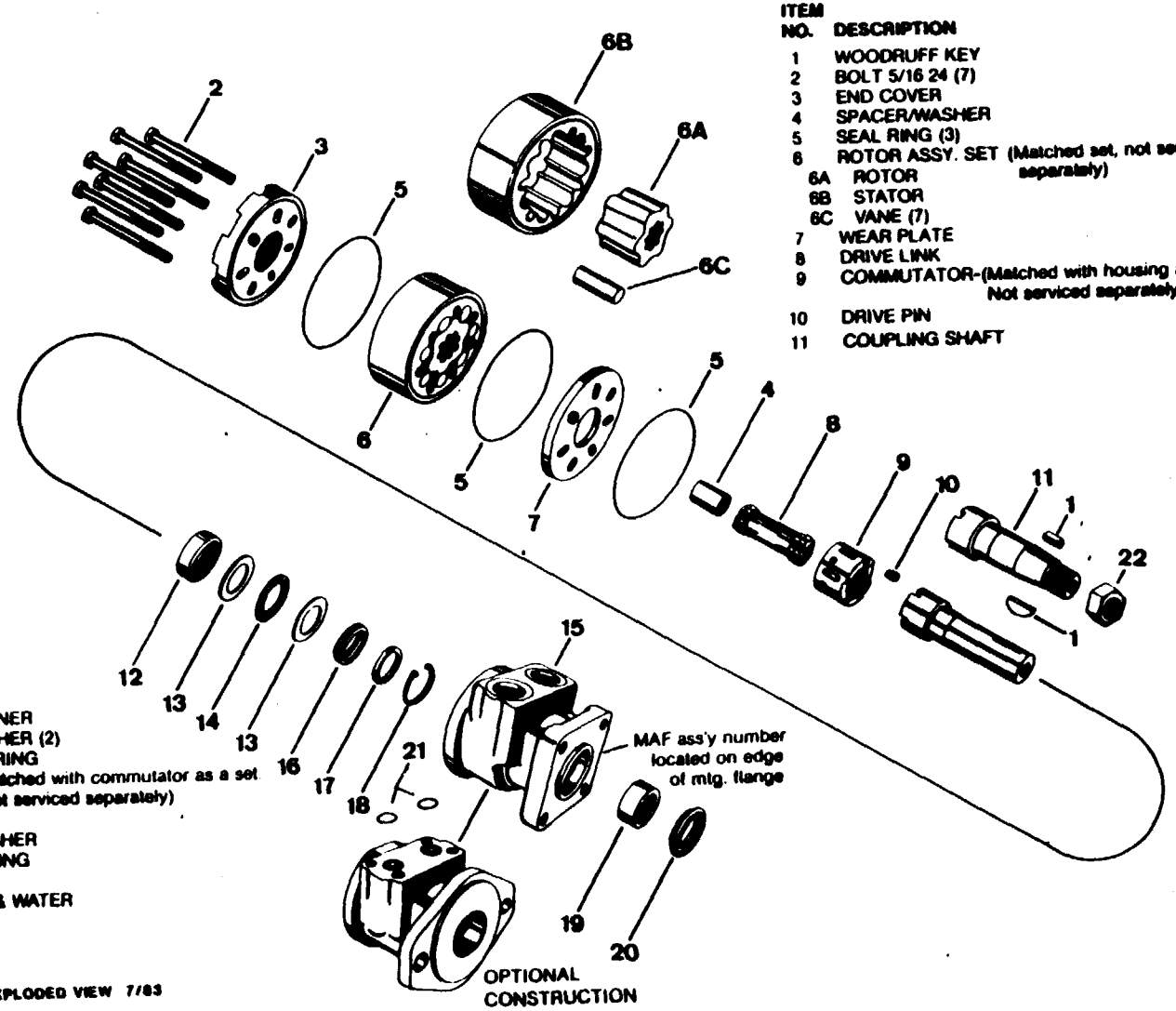
Rotor Set Assembly Tool
(Fabricate if considered necessary)

FIGURE 2

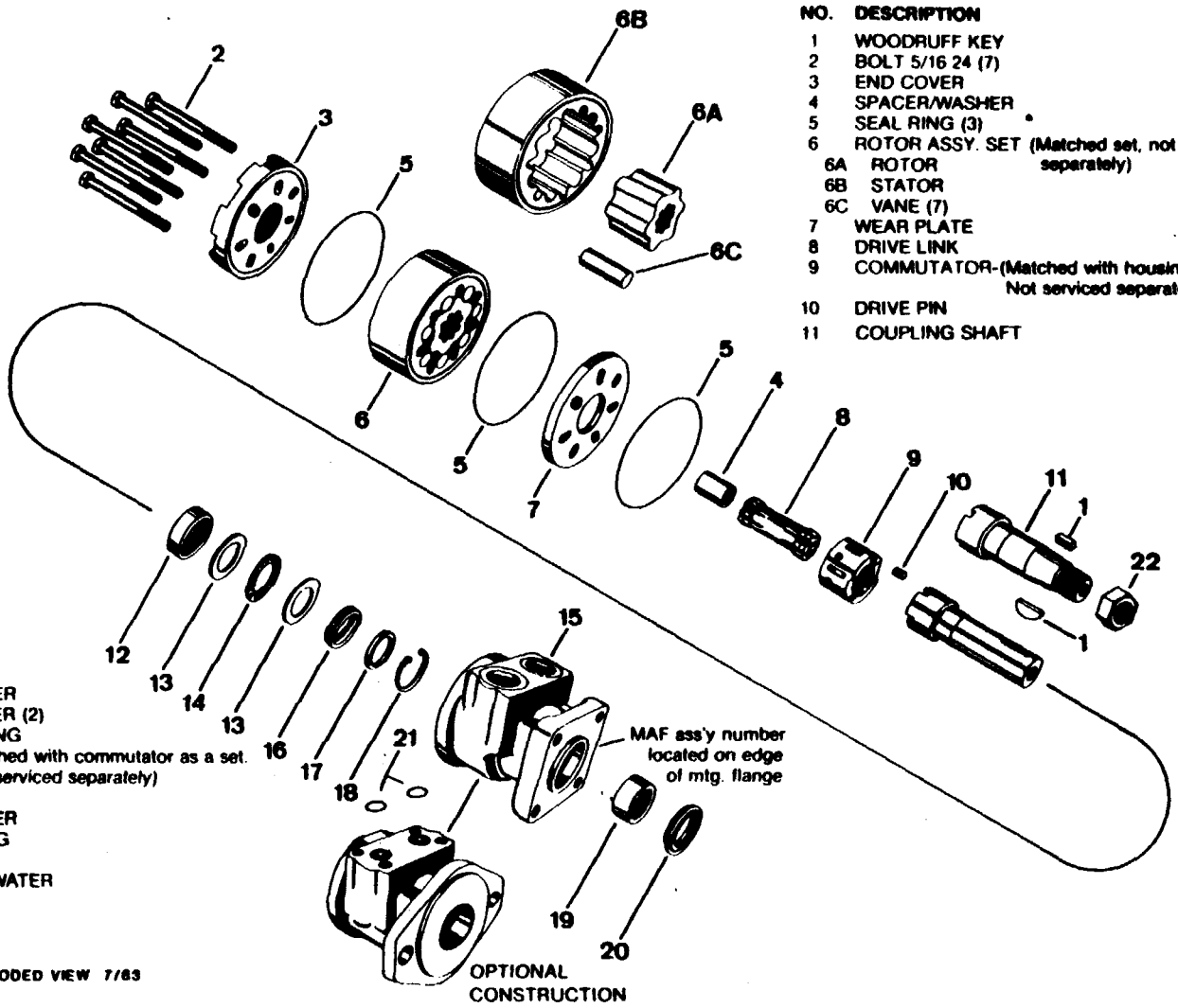
Torque Chart

Part Name	Item Number	Torque
bolt 5/16 24	2	22-26 ft. lbs. (30-35 Nm)

MAF Torqmotor™ Exploded Assembly View - Typical



MAF Torqmotor™ Exploded Assembly View - Typical



ITEM NO.	DESCRIPTION
1	WOODRUFF KEY
2	BOLT 5/16 24 (7)
3	END COVER
4	SPACER/WASHER
5	SEAL RING (3)
6	ROTOR ASSY. SET (Matched set, not serviced separately)
6A	ROTOR
6B	STATOR
6C	VANE (7)
7	WEAR PLATE
8	DRIVE LINK
9	COMMUTATOR-(Matched with housing as a set. Not serviced separately)
10	DRIVE PIN
11	COUPLING SHAFT
12	BEARING - INNER
13	THRUST WASHER (2)
14	THRUST BEARING
15	HOUSING-(Matched with commutator as a set. Not serviced separately)
16	SEAL - INNER
17	BACKUP WASHER
18	RETAINING RING
19	BEARING
20	SEAL - DIRT & WATER
21	O-RING (2)
22	NUT

MAF TORQMOTOR EXPLODED VIEW 7/83

MAF Service Parts List Chart REVISED 7-7-83

CHART USE EXAMPLE: MAF06001 TORQMOTOR™ INCLUDES PART NUMBERS LISTED TO THE RIGHT OF MAF, 06- AND -001 SHOWN IN LEFT HAND COLUMN OF CHART.

NOTE: REFER TO INDIVIDUAL SERVICE PARTS LIST FOR TORQMOTORS NOT COVERED IN THIS CHART.

	EXPLODED VIEW ITEM #	3	5	8	9*
	DESCRIPTION	End Cover	Seal Ring	Drive Link	Commutator
MAF	SERVICE PART #	402400	032753 (3)	MAF013001	MAF014000

	EXPLODED VIEW ITEM #	10	12	13	14	16
	DESCRIPTION	Drive Pin	Bearing	Thrust Washer	Thrust Bearing	Seal
MAF	SERVICE PART #	040145	060025	020403	065000	032377

	EXPLODED VIEW ITEM #	17	18	19	20
	DESCRIPTION	Backup Washer	Retaining Ring	Bearing	Seal-Shaft
MAF	SERVICE PART #	020404	401300	065007	032539

	EXPLODED VIEW ITEM #	2	6	7	4
	DESCRIPTION	Bolts (7)	Rotor Set	Wearplate	Spacer
06-	SERVICE PART #	021353	MAF067002-A1	477318	020405
08-	SERVICE PART #	021354	MAF087002-A1	477293	020405
12-	SERVICE PART #	021355	MAF127002-A1	477293	477294
16-	SERVICE PART #	021356	MAF167002-A1	477293	477295
20-	SERVICE PART #	021306	MAF207002-A1	477293	477302
24-	SERVICE PART #	021357	MAF247002-A1	477293	477296
32-	SERVICE PART #	021358	MAF327002-A1	477293	477298
40-	SERVICE PART #	021359	MAF407002-A1	477293	477299

	EXPLODED VIEW ITEM #	11	1	15*
	DESCRIPTION	COUPLING SHAFT	WOODRUFF KEY	HOUSING
-001	SERVICE PART #	091471	G124553	MAF012000
-002	SERVICE PART #	091469		MAF012000
-003	SERVICE PART #	091472		MAF012000
-004	SERVICE PART #	091470	G124553	MAF012000
-005	SERVICE PART #	091473		MAF012000
-006	SERVICE PART #	091477	G124553	MAF012000
-007	SERVICE PART #	091478		MAF012000
-008	SERVICE PART #	***091485	G124553	MAF012000
-011	SERVICE PART #	091471	G124553	MAF012001
-012	SERVICE PART #	091469		MAF012001
-013	SERVICE PART #	091472		MAF012001
-014	SERVICE PART #	091470	G124553	MAF012001
-015	SERVICE PART #	091473		MAF012001
-016	SERVICE PART #	091477	G124553	MAF012001
-017	SERVICE PART #	091478		MAF012001
-018	SERVICE PART #	***091485	G124553	MAF012001
-021	SERVICE PART #	091471	G124553	**MAF012002
-022	SERVICE PART #	091469		**MAF012002
-023	SERVICE PART #	091472		**MAF012002
-024	SERVICE PART #	091470	G124553	**MAF012002
-025	SERVICE PART #	091473		**MAF012002
-026	SERVICE PART #	091477	G124553	**MAF012002
-027	SERVICE PART #	091478		**MAF012002
-028	SERVICE PART #	***091485	G124553	**MAF012002

(continued)

	EXPLODED VIEW ITEM #	11	1	15*
	DESCRIPTION	COUPLING SHAFT	WOODRUFF KEY	HOUSING
-031	SERVICE PART #	091471	G124553	**MAF012005
-032	SERVICE PART #	091469		**MAF012005
-033	SERVICE PART #	091472		**MAF012005
-034	SERVICE PART #	091470	G124553	**MAF012005
-035	SERVICE PART #	091473		**MAF012005
-036	SERVICE PART #	091477	G124553	**MAF012005
-037	SERVICE PART #	091478		**MAF012005
-038	SERVICE PART #	***091485	G124553	**MAF012005
-041	SERVICE PART #	091471	G124553	MAF012004
-042	SERVICE PART #	091469		MAF012004
-043	SERVICE PART #	091472		MAF012004
-044	SERVICE PART #	091470	G124553	MAF012004
-045	SERVICE PART #	091473		MAF012004
-046	SERVICE PART #	091477	G124553	MAF012004
-047	SERVICE PART #	091478		MAF012004
-048	SERVICE PART #	***091485	G124553	MAF012004
-051	SERVICE PART #	091471	G124553	MAF012003
-052	SERVICE PART #	091469		MAF012003
-053	SERVICE PART #	091472		MAF012003
-054	SERVICE PART #	091470	G124553	MAF012003
-055	SERVICE PART #	091473		MAF012003
-056	SERVICE PART #	091477	G124553	MAF012003
-057	SERVICE PART #	091478		MAF012003
-058	SERVICE PART #	***091485	G124553	MAF012003

NOTES: Seal Kit #SK000012 includes items #5, #16, #20.

Seal Kit #SK000016 is available for MAF units (not shown on this chart) that use special fire retardent fluids.

Bearing Kit #SK000013 includes items #5, #12, #13, #14, #16, #17, #18, #19, #20.

* Housing, item #15 and commutator, item #9, cannot be serviced individually. Item #15 part number with -X1 suffix, is the housing/commutator service kit number. EXAMPLE: MAF012000-X1. This matched set service kit includes items #9, #10, #12, #13, #14, #15, #16, #17, #18, #19, #20 and if required, two of item #21.

** MAF Torqmotors with this housing require two #032200-10 O-Rings, item #21 on the exploded assembly view.

*** MAF Torqmotors with this shaft also require #025136 nut, item #22 on the exploded assembly view.

MAF: Disassembly and Inspection
(Preparation Before Disassembly)

- Before you disassemble the MAF Torqmotor™ unit or any of its components, read this entire manual. It provides important information on parts and procedures you will need to know to service the MAF.

- Refer to page 7A for tools and other items required to service the MAF, and have them available.

- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the MAF. Remove rust or corrosion from coupling shaft.

- Remove coupling shaft connections and hose fittings, and immediately plug port holes and fluid lines.

- Remove the MAF from system, drain it of fluid and take it to a clean work surface. (A piece of wrapping paper makes an excellent disposable top.) Clean and dry the MAF before you start to disassemble the unit.

- As you disassemble the MAF, clean all parts, except seals, in clean petroleum based solvent, and blow them dry.

WARNING **WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.**

WARNING **WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.**

CAUTION **CAUTION: Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.**

- Keep parts separate to avoid nicks and burrs.

- Discard all seals and seal rings as they are removed from the MAF. Replace all seals, seal rings and any damaged or worn parts with genuine Ross or OEM approved service parts.

Disassembly and Inspection

position TorqmotorTM in a vise

1. Position the MAF assembly in a soft jawed vise, with coupling shaft (11) pointed down, the vise jaws clamping firmly on the sides of the housing (1 5) mounting flange. SEE FIGURE 3.

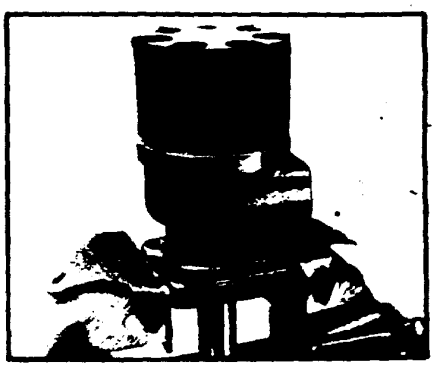


Figure 3

CAUTION
housing port area between the vise jaws as it might distort the housing around the commutator 19), preventing the disassembly of the commutator.

CAUTION: Do not clamp the

WARNING

WARNING: IF THE MAF ASSEMBLY IS NOT FIRMLY HELD IN THE VISE, IT COULD FALL AND INJURE SOMEONE.

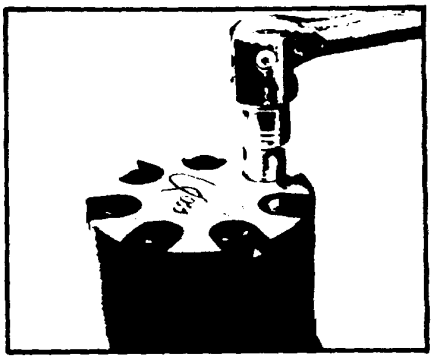


Figure 4

remove special bolts & inspect bolts

2. Remove the seven special ring head bolts (2) using a Y2 inch thin wall socket to enter the end cover bolt head recess. SEE FIGURE 4. Inspect bolts (2) for damaged threads, or sealing ring, under the bolt head. Replace damaged bolts. SEE FIGURE 5.

Figure 5

remove end cover & seal ring

3. Remove end cover (3) and seal ring (5). Discard seal ring (5). SEE FIGURE 6.

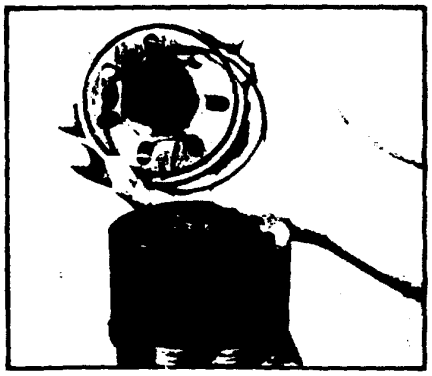


Figure 6

Inspect end cover

4. Inspect the end cover (3) for severe wear, nicks, burrs and spalling on the ground surface that has the seal ring groove. Inspect the bolt head recesses where the bolt head sealing ring makes contact for damage that would prohibit good sealing contact. Replace cover if any of these conditions exist.

Figure 7

NOTE

NOTE: A polished pattern on the cover surface from rotation of the rotor (6A) is normal. Discoloration would indicate excess fluid temperature, thermal shock or excess speed and require system investigation for cause, and very close inspection of end cover, rotor set, and wearplate.

remove & inspect drive link spacer/washer

5. Remove drive link spacer/washer (4). Inspect it for badly burred or nicked ends that would interfere with rotor and drive link rotation. Replace if necessary. SEE FIGURE 7.

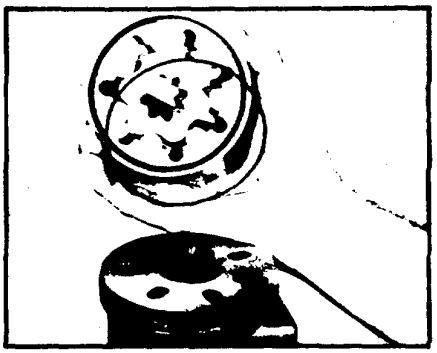


Figure 8

remove & inspect rotor set and seal ring

6. Remove rotor set (6), retaining it in its assembled form, if possible, to avoid an involved reassembly procedure. Inspect the rotor set in its assembled form, for nicks, scoring, or spalling, on any surface, and broken or worn rotor splines. If any of the rotor set components require replacement, the complete rotor set must be replaced as it is a matched set. SEE FIGURE 8. Discard seal ring (5).

Figure 9

check clearance

7. Using a feeler gage, check the rotor (6A) to vane (6C) clearance. The rotor should be centered at the pencil point. SEE FIGURE 9. If there is more than .005 inches (.13 mm) of clearance, replace rotor set.

remove & inspect wearplate

8. Lift off wearplate (7) and inspect it for scoring or brinelling (dinging) on the rotor and commutator contact and sealing surfaces. Replace wearplate if any of these conditions exist. SEE FIGURE 10.

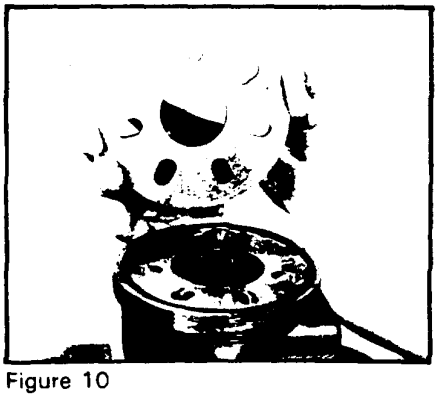


Figure 10

NOTE

NOTE: A polished pattern from rotor or commutator rotation is normal.

remove drive link

9. Remove drive link (8) and inspect it for cracks and for chipped or damaged splines. No perceptible lash (play) should be noted between mating spline parts. Replace, if necessary SEE FIGURE 11.

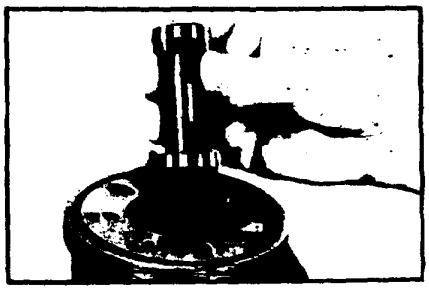


Figure 11

remove & discard seal ring

10. Remove seal ring (5) from housing (15) seal ring groove and discard seal ring. SEE FIGURE 12.

Figure 12

remove & inspect commutator

11. Remove commutator (9) which is a close slip fit into housing (15), by inserting two fingers into its center cavity and lifting. SEE FIGURE 13. The commutator drive pin (10) will probably be in the commutator when the commutator is removed. Inspect the commutator for nicks, burrs, or brinelling on the outside diameter surface. Inspect for broken edges on the commutation slots. Inspect the exposed area of the drive pin slot for extreme wear or damage. Only the commutator drive pin can be serviced separately. A worn or damaged commutator will require a new matched housing and commutator service assembly set.

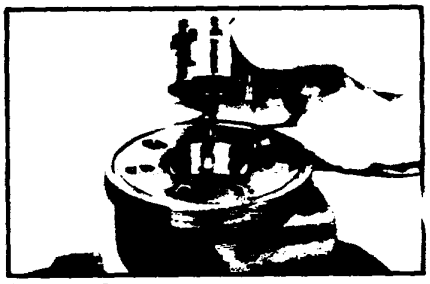


Figure 13

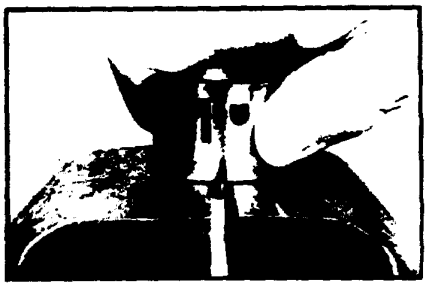


Figure 14

remove commutator drive pin

12. Remove commutator drive pin (10) only if it must be replaced. If the pin does not readily pull out of the commutator, clamp the exposed portion of the drive pin in a vise and twist the commutator from the drive pin by hand only. SEE FIGURES 14 and 15.

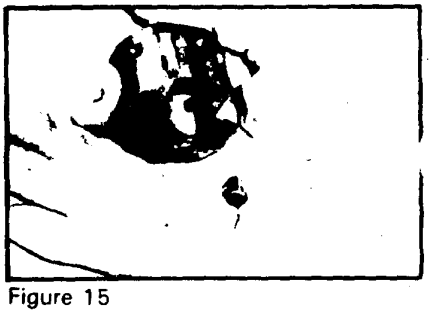


Figure 15

check thrust bearing operation

13. Replace drive link (8) into mesh with coupling shaft (11) and -exert a downward force on it with the palm of one hand while pulling down and rotating the coupling shaft with the other hand; SEE FIGURE 16. A damaged thrust bearing (14) package would be indicated by roughness "felt" or heard during this procedure and would require thrust bearing and thrust washer (13) removal for further inspection in subsequent procedures. Remove drive link.

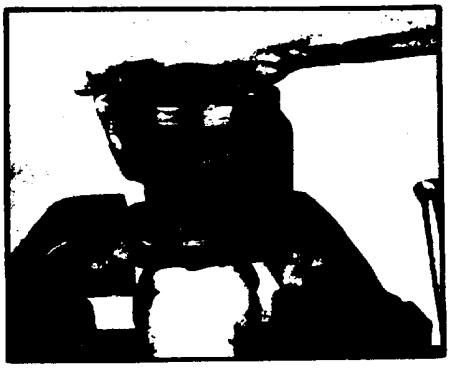


Figure 16

check coupling shaft for rust or corrosion

14. Check exposed portion of coupling shaft (11) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal. Crocus cloth or fine emery paper may be used. SEE FIGURE 17.

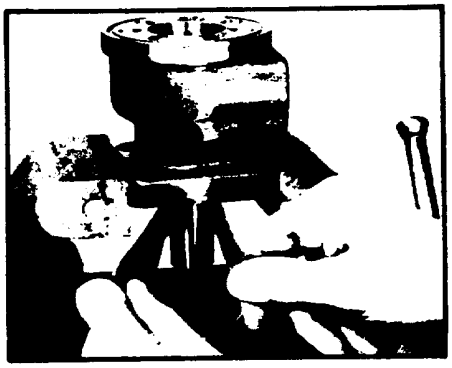


Figure 17

remove & inspect coupling shaft

15. Remove coupling shaft (11), by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. SEE FIGURE 18. Inspect for damaged or worn internal and external splines, drive pin slot, and keyway. SEE FIGURE 19. Replace coupling shaft if any of these conditions exist.

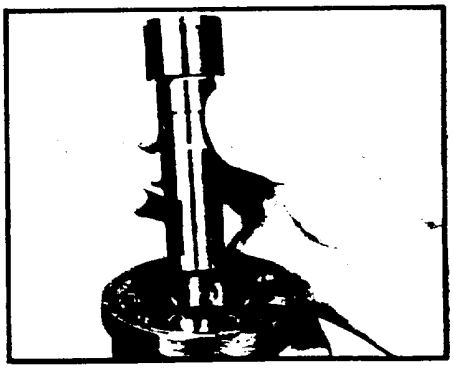


Figure 18

NOTE

NOTE: Minor shaft wear in seal (17) area is permissible. If wear exceeds .020 inches (.51mm) diametrically, replace coupling shaft.

A slight "polish" is permissible in the shaft bearing areas. Anything more would require coupling shaft replacement.

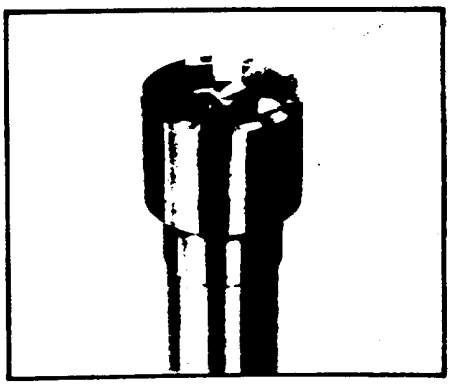


Figure 19

NOTE

NOTE: If commutator (9) was discarded as worn or damaged in Step 10, discard housing (15) assembly as well. If this is the case, the disassembly of the MAF TorqmotorTM is now complete. If, however, the commutator passed inspection, continue the disassembly procedures.

remove seals

16. Remove housing (15) from vise and place it on a clean flat work surface with wearplate end down. Pry out and discard the dirt and water seal (20) and inner seal (16) using a dull-edged screw driver. Be careful not to gouge or nick other components during the process. SEE FIGURE 20 and 21.

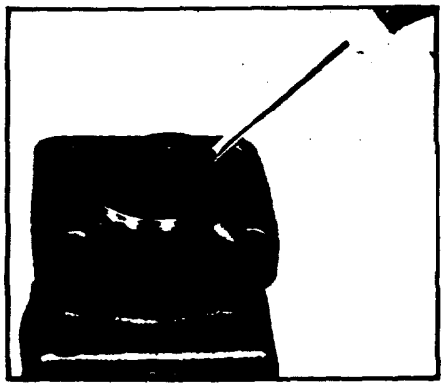


Figure 20

inspect housing assembly

17. Inspect the housing (15) assembly for cracks, the housing machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect the tapped holes for thread damage. SEE FIGURE 22. If the housing is defective in these areas, discard the housing (15) assembly and commutator (9) assembly and the disassembly of the MAF TorqmotorTM is completed. If the housing assembly passed inspection to this point, continue the inspections per Step 18.

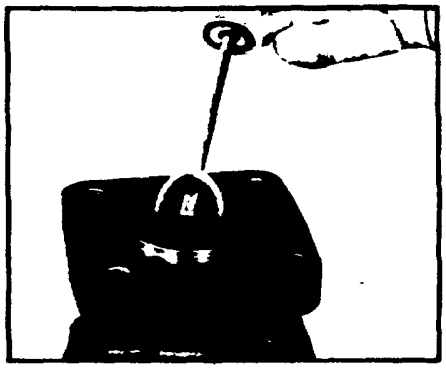


Figure 21

inspect housing bearings, thrust washers & backup washer

18. Inspect the outer bearing (19), the inner bearing (12), the thrust bearing (14), thrust washers (13), and back-up washer (17), while assembled in the housing (15). The bearing rollers should be firmly retained in the bearing cages, but must turn and revolve freely. The full complement of bearing rollers and the thrust washers must be free of brinelling and corrosion. Seal back-up washer must be free of cracks, chipped edges or burrs. SEE FIGURE 23. If the housing assembly passed this inspection, and the inspections in Step 13 and 17, the disassembly of the MAF TorqmotorTM is completed.

If only the bearings, thrust washers, or back-up washer show deterioration, they can be replaced. Go to the next step.

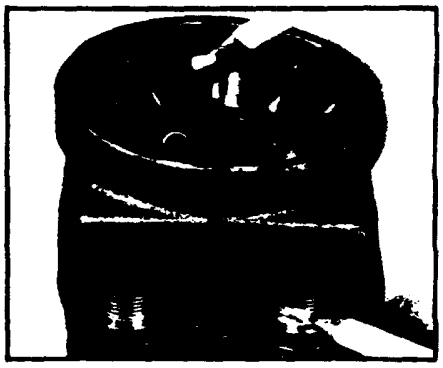


Figure 22

Figure 23

remove inner bearing

19. If the inner bearing (12), thrust washers (13), thrust bearing (14), or back-up washer (17), need replacement, place housing back into the vise as in disassembly Step 1. Insert a puller for a 1.38 inch (35.lmm) diameter bearing, through the wearplate end of the housing, through bearing (12). SEE FIGURE 24. Expand bearing puller and remove bearing (12) and discard. SEE FIGURE 25.

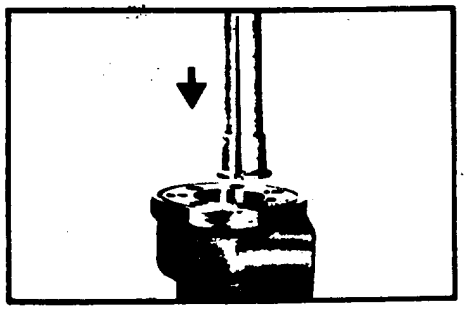


Figure 24

CAUTION

CAUTION: Use care when pulling the bearing, that the commutator bore in the housing is not scored or damaged during the process.

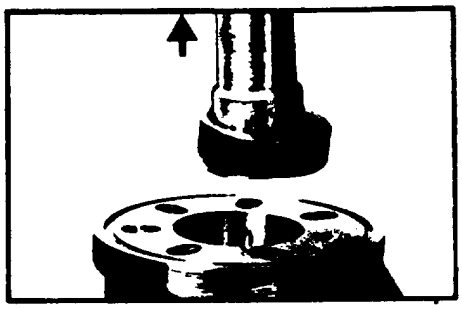


Figure 25

remove & inspect thrust washers, thrust bearings, & back-up washer

20. Remove and inspect thrust washers (13), thrust bearing (14), and back-up washer (17), again per Step 18. These parts can be retained for reassembly if they pass this inspection, but it is recommended that they be replaced if removed. These are included in the bearing service kit. SEE FIGURE 26.

Figure 26

remove retaining ring

21. If the outer bearing is to be removed, remove retaining ring (18) using the appropriate retaining ring pliers. SEE FIGURE 27. A damaged or deformed retaining ring should be replaced.

remove outer bearing

22. Invert housing (1 5) in the vise, clamping on the mounting flange. Insert a puller for a 1.00 inch (25.4mm) diameter bearing, through outer bearing (19) from the flange end of the housing, expand puller and remove and discard bearing. SEE FIGURE 28.

The MAF TorqmotorTM disassembly is now complete.

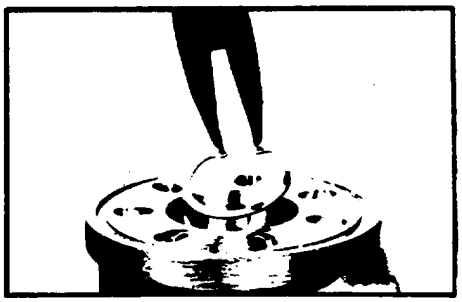


Figure 27

NOTE

NOTE: A service bearing package kit is available which includes inner bearing (12), thrust washers (13), thrust bearings (14), inner seal (16), back-up washer (17), retaining ring (18), outer bearing (19), and dirt and water seal (20). If a housing bearing or thrust bearing requires replacement, it is recommended that all the housing bearings and relative components be replaced that are available in this service kit.

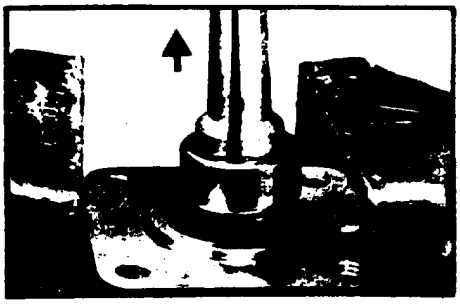


Figure 28

MAF Assembly

- Replace all seals and seal rings with new ones each time you reassemble the MAF unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.
- NOTE: Individual seals and seal rings as well as a complete seal kit are available. SEE FIGURE 29. The parts should be available through most OEM parts distributors or Ross approved MAF distributors. (Contact your local dealer for availability).
- NOTE: Unless otherwise indicated, do not oil or grease parts before assembly.
- Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, stator, wearplate and housing and from port and sealing areas.

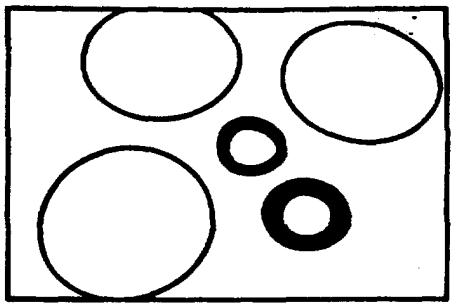


Figure 29

WARNING

WARNING: SINCE THEY ARE FLAMMABLE BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

service housing and commutator replacement

1. If a service housing and commutator assembly set has been procured for the MAF unit being serviced, the housing components are already installed. Start the assembly procedure with Step 9.

housing seal replacement only

2. If the housing assembly (15) is being reused with original bearings intact, place housing on a clean work surface with the housing wearplate surface up. Apply a small amount of clean grease to a new inner seal (16). Deform the seal between two fingers and insert the seal into the housing seal cavity between the back-up washer (17) and a thrust washer (13). SEE FIGURE 30. The seal must be properly seated and against the back-up washer (17), with the seal lip facing the thrust washer (13). The back-up washer (17) must be seated against the retaining ring (18). Go directly to assembly procedure #8.


Figure 30

NOTE

NOTE: You will probably have to pick-up the housing and use fingers through each end of the housing to seat the seal into the correct position.

install retaining ring

3. If the housing (15) has been completely disassembled, place the housing, mounting flange end down, on a clean work surface. Install retaining ring (18) into the housing retaining ring groove. Be sure the rounded edge of retaining ring is facing in toward the larger housing cavity. Use appropriate retaining ring pliers. SEE FIGURE 31,

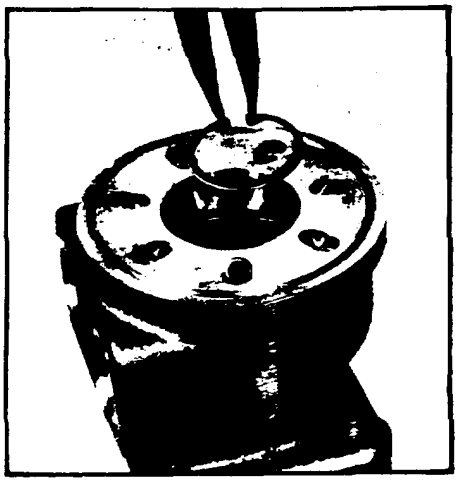


Figure 31

press in bearing

4. Thoroughly grease the rolls of a NEW bearing (19) with clean wheel bearing. grease. Press the bearing into housing (15) from the mounting flange end of the housing bore, using bearing mandrel (special tool FIGURE 1, Page 7A) against the lettered end of the bearing shell. SEE FIGURES 32 and 33. Take care during this procedure that the housing is square with the press base and that the bearing is not cocked. The bearing mandrel will control the bearing (19) press depth to the required .135/.125 inches (3.43/3.18 mm) from the flange end of the housing.

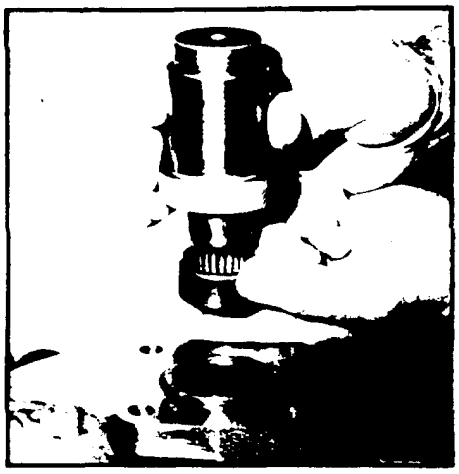


Figure 32

NOTE:

NOTE: If the bearing mandrel shown is not available, alternate methods may be used to press in the bearing but the bearing depth location must be maintained.

CAUTION

CAUTION: The controlled press depth of bearing (12) and (19) into the housing is required to ensure adequate bearing support, and correct bearing relationship to adjacent components when assembled.

Figure 33

CAUTION

CAUTION: Because bearings (12) and (19) have a press fit into the housing, they must be discarded if removed from the housing. They must not be reused.

install backup washer & seal

5. Place housing (15), wearplate surface up, on a clean work surface. Apply a small amount of clean grease to inner seal (16). Install back-up washer (17) then seal (16) into housing coupling shaft bore from the wearplate end of the housing (15). Seat the back-up washer against the retaining ring (18) and the seal against the back-up washer, with the seal lip facing away from the back-up washer. SEE FIGURE 34.

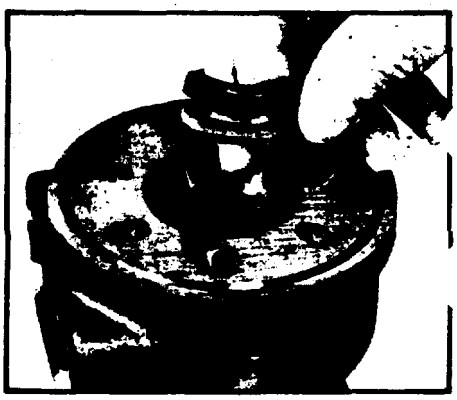


Figure 34

Install thrust washers & thrust bearing

6. Install a thrust washer (13), the thrust bearing (14) and then another thrust washer (13) into the housing (15) inner bearing bore until they are seated at the bottom of the bore. SEE FIGURE 35.

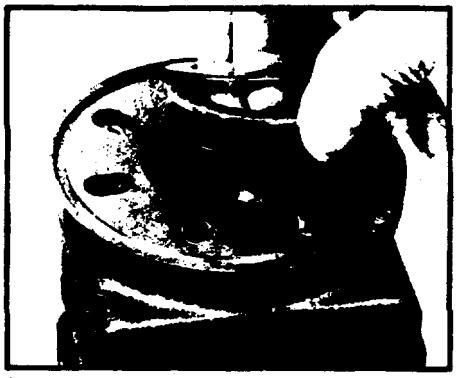


Figure 35

press in bearing

7. Press a new bearing (12) into the housing (15) inner bearing bore, from the wearplate face end, using bearing mandrel (special tool SEE FIGURE 1, Page 7A) against the lettered end of the bearing shell. Take care during this procedure that the housing is square with the press base and that the bearing is not cocked. The bearing mandrel will control the bearing press depth to the required 1.618/1.598 inches (41.10/40.59mm) from the wearplate face of the housing. SEE FIGURES 36 and 37.

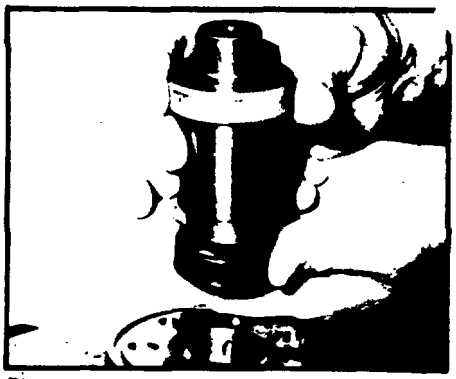


Figure 36

Figure 37

NOTE

NOTE: If the bearing mandrel shown is not available, alternate methods may be used to press in the bearing but the bearing depth location must be maintained.

insert dirt & water seal

8. Place housing (15), wearplate surface down, on a clean work surface. Apply a small amount of clean grease to a new dirt and water seal (20) and press the seal into the housing seal cavity. The end of a hammer handle would be an appropriate tool. Be sure the seal is not cocked or deformed as it enters housing seal bore. SEE FIGURE 38.

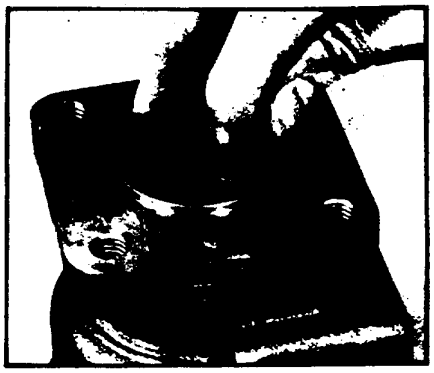


Figure 38

place housing assembly into vise

9. Place housing (15) assembly into a soft-jawed vise with coupling shaft bore down, and clamp the vise jaws against the edges of the mounting flange. SEE FIGURE 39.

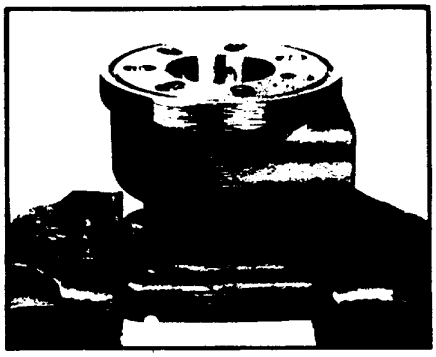


Figure 39

CAUTION

CAUTION: Clamping on the body of the housing in the area of commutator bore could distort the housing and prevent the assembly of the commutator (9).

NOTE

NOTE: The assembly of the rotor set (6) components, if required, should be done at this time in order to utilize the housing in the vise, as a rotor set assembly "Fixture". SEE "Rotor Set Component Assembly Procedure" on page 23.

NOTE

NOTE: The coupling shaft (11) has a timing mark on the small (output) end that is radically in line with two internal spline teeth and a "commutator drive pin slot" that transverses the opposite end of the coupling shaft, SEE FIGURE 40. The "commutator drive pin slot" indicated by the timing mark is the only slot of two oil passage slots across the large end of the coupling shaft, wide enough to engage the commutator drive pin (10) at assembly. This orientation of the coupling shaft splines aid drive pin slot is important to subsequent assembly procedures that will produce the required rotor (6A) lobe and commutator (9) "fixed" radial relationship at assembly.

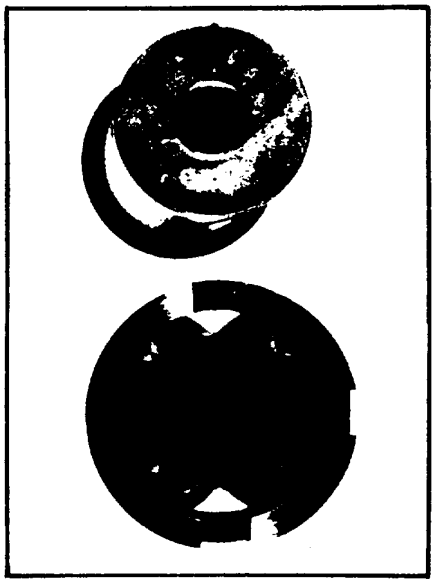


Figure 40

NOTE

NOTE: FIGURE 40, shows two coupling shafts to better illustrate the relative positioning of the timing mark, drive pin slot and internal spline tooth.

extend timing mark

10. Using chalk or marking pencil, extend the timing mark that is on the end of coupling shaft (11) up the side of the coupling shaft so that the timing mark location will be visible for alignment purposes when the coupling shaft is assembled into the housing held in the vise. SEE FIGURE 41.

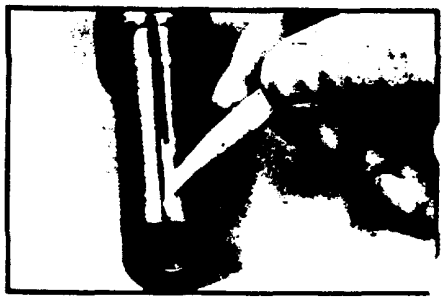


Figure 41

install coupling shaft

11. Be-sure that a generous amount of clean wheel bearing grease is applied to housing bearing (19) then install coupling shaft (11) into housing (15) seating it against thrust washer (13). SEE FIGURE 42. The coupling shaft must rotate smoothly on the thrust bearing package.

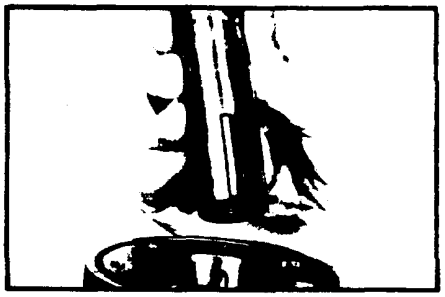


Figure 42

insert new drive pin

12. Insert new drive pin (10) if it was removed, into the commutator (9) drive pin hole until it bottoms out. SEE FIGURE 43.

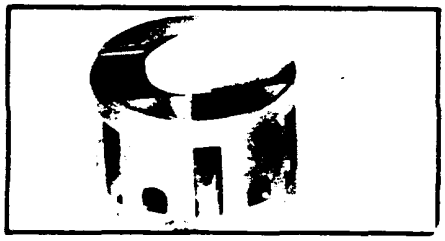


Figure 43

install commutator assembly

13. Install commutator (9) assembly into housing (15) commutator bore. SEE FIGURE 44, The commutator must not be cocked as it enters the bore and the drive pin (10) must be in line with the coupling shaft (11) commutator drive pin slot indicated by the timing mark. Engage the drive pin (10) protruding from the commutator into the coupling shaft drive pin slot, rotating the coupling shaft if necessary. The commutator must be below the housing wearplate surface when correctly seated. SEE FIGURE 45.

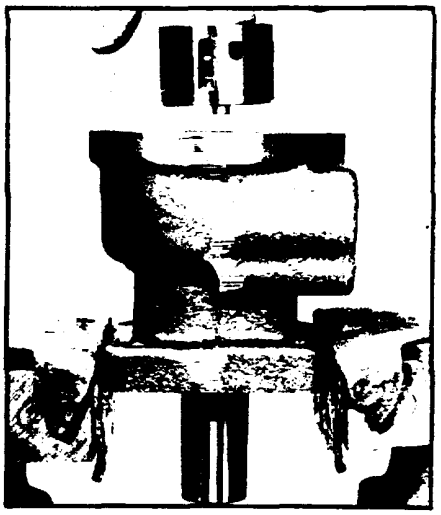


Figure 44

NOTE

NOTE: The commutator drive pin (10) and coupling shaft (11) drive pin slot, at this point in the assembly, are visible through the commutator center cavity for coupling pin engagement purposes in addition to the timing mark.

CAUTION

CAUTION: Do not force commutator into bore. It is a close slip fit and must rotate.

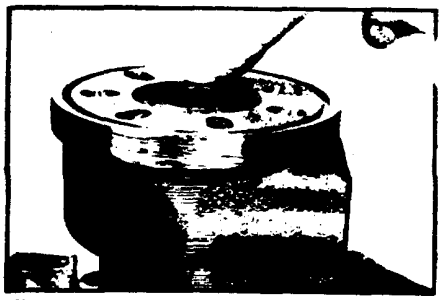


Figure 45

install drive link

14. Install either end of the drive link (8) through the commutator (9) cavity and engage the lower drive link splines into mesh with the internal splines in the coupling shaft (11). SEE FIGURE 46. A spline valley on both ends of the drive link will now be in line with the commutator drive pin (10) and coupling shaft timing mark.

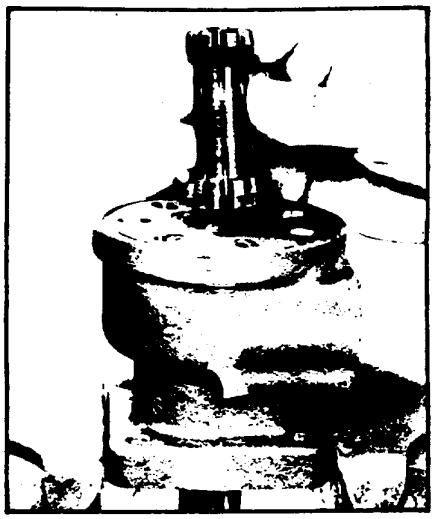


Figure 46

insert seal ring into housing

15. Apply a small amount of clean grease to a new seal ring (5) and insert the seal ring into housing (15) seal ring groove. SEE FIGURE 47.

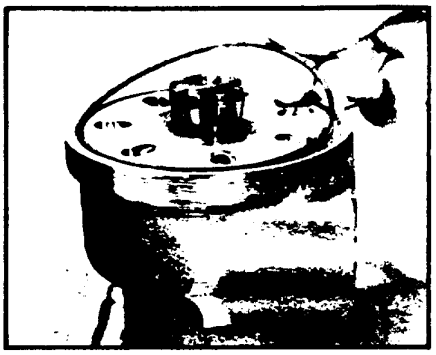


Figure 47

insert seal ring into stator

16. Place assembled rotor set (6) on a clean work surface with the stator (6B) seal ring groove up. Apply a small amount of clean grease to a new seal ring (5) and insert the seal ring into the stator (6B) seal ring groove. SEE FIGURE 48.

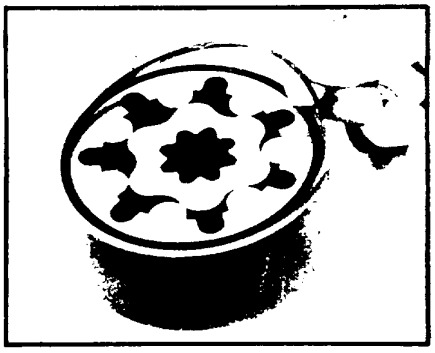


Figure 48

place wearplate on rotor set

17. Place wearplate (7) either side up, onto the rotor set (6) and align wearplate bolt holes with the stator (6B) bolt slots. SEE FIGURE 49.

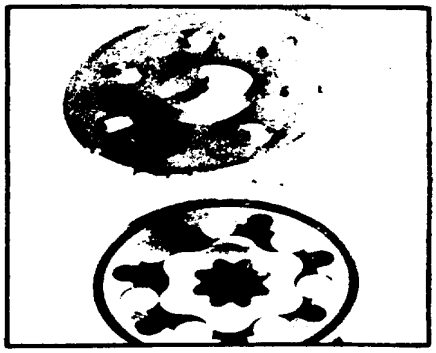


Figure 49

install rotor set & wearplate on housing

18. Locate on the rotor (6A) the only two spline teeth, 1800 apart, that are diametrically aligned (on the same center line) with two rotor lobes. SEE FIGURE 50. Take the rotor set (6), seal ring (5) and wearplate (7) as a unit and align these two just located rotor spline teeth to mesh with the two drive link (8) spline valleys that are diametrically aligned with the timing mark on the coupling shaft (11) and install this unit onto the housing (15) with the wearplate against the housing. SEE FIGURE 51. With the rotor set (6) now correctly in mesh with the drive link, rotate the rotor set (6) wearplate (7) drive link (8) and coupling shaft (11) to align the stator (6B) and wearplate bolt holes with the bolt holes in the housing. SEE FIGURE 52.

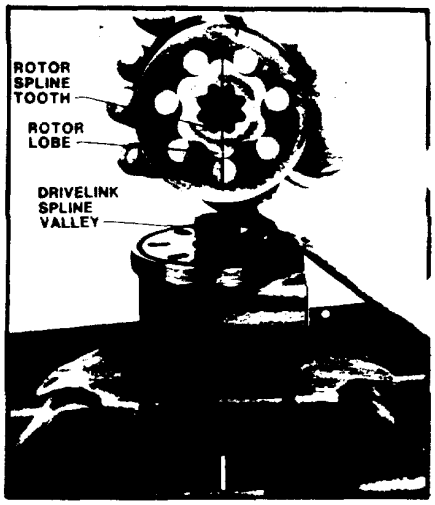


Figure 50

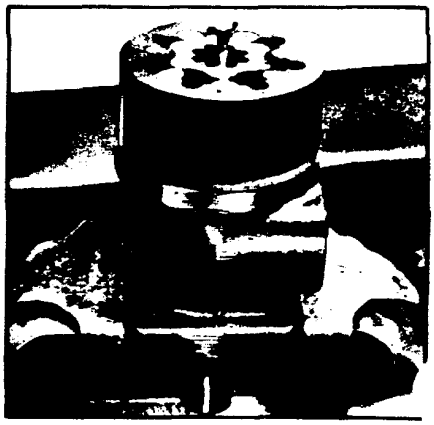


Figure 51

CAUTION

CAUTION: Be careful not to disengage the rotor, drive link or coupling shaft while aligning bolt holes as this could affect the timing you just achieved.

CAUTION

CAUTION: The meshing of the precise rotor (6A) teeth with the precise drive link (8) spline valleys as described above is absolutely crucial to a correctly timed and functional MAF Torqmotor™. Misalignment by one spline tooth will be indicated by the timing mark on the coupling shaft (11) being radically 450 from the specified rotor lobe. Refer to "Final Checks" Page 25.

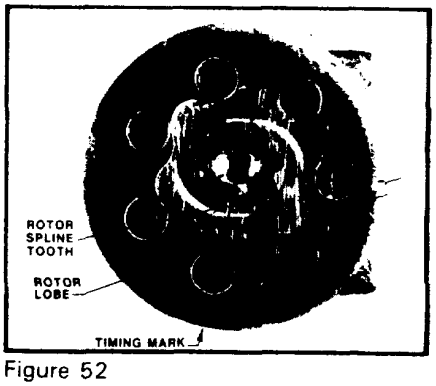


Figure 52


Figure 53

install drive link spacer/washer

19. Install drive link spacer/washer (4) into the rotor spline cavity onto the end of the drive link (8). SEE FIGURE 53.

insert seal ring

20. Apply a small amount of clean grease to a seal ring (5) and insert the seal ring into the end cover (3) seal ring groove. SEE FIGURE 54.

Figure 54

install end cover

21. Install end cover (3) assembly onto the rotor set (6) with seal ring (5) against the stator (6B) and align the end cover bolt holes with the stator (6B) bolt holes. SEE FIGURE 55.

Figure 55

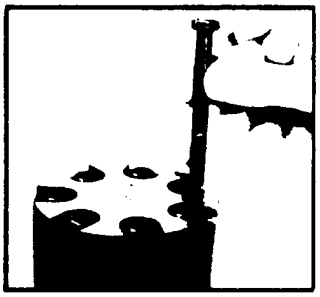


Figure 56

install & torque bolts

22. Install 7 bolts (2) into the assembly bolt holes finger tight, then torque the bolts to 22-26 foot pounds, (30-35Nm), in the sequence shown, using the appropriate torque wrench. SEE FIGURES 56, 57 and 58.

    The assembly of the MAF Torqmotor™ is now complete, except for the woodruff key (1), port manifold o-rings (21) or nut (22), if required, at TorqmotorTM installation. See Page 25 for final checks.

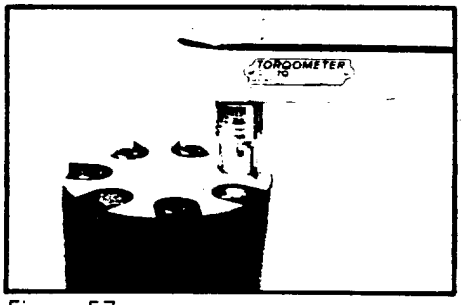


Figure 57

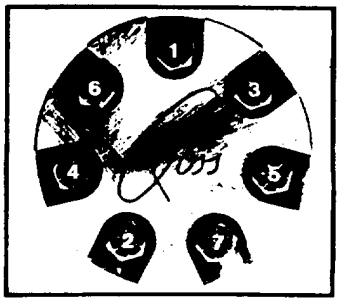


Figure 58

Rotor Set Component Assembly Procedure

place housing in vise

1. Place housing (15) in a vise per MAF motor assembly procedure #9 and FIGURE 39 (Page 18).

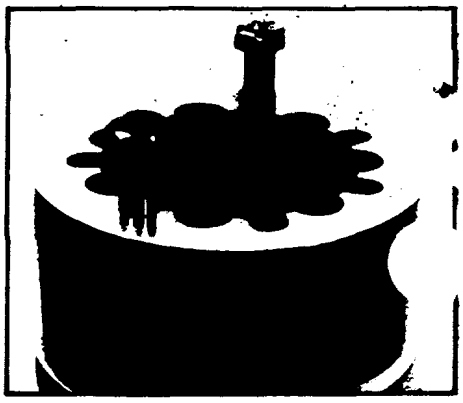


FIGURE 59

place wearplate & stator on housing

2. Place wearplate (7) and then stator (6B) on the housing (15) and align the bolt holes of the three parts.

insert two bolts

3. Insert two bolts (2) into bolt holes finger tight, approximately 180° apart to retain the stator (6B) and wearplate (7) stationary on the housing (15). SEE FIGURE 59.

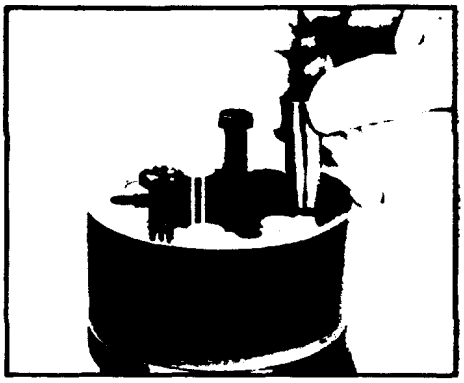


Figure 60

assemble six stator vanes & rotor

4. Assemble the rotor (6A) into the stator (6B) with six vanes (6C) or as many vanes that will readily fit into the stator vane pockets. SEE FIGURE 60 and 61.

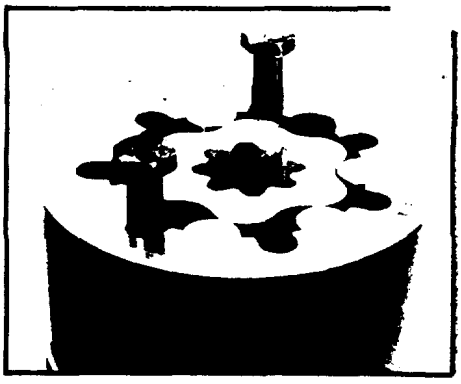


Figure 61

NOTE

NOTE: A special tool (See Page 7A) or the drive link (8) held in large locking pliers between two rods or nails to protect the drive link splines (SEE FIGURE 62) will be required to rotate the rotor in the following procedure.

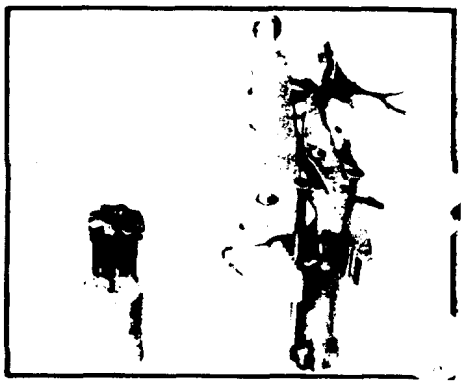


Figure 62

assemble seventh stator vane

5. Rotate the rotor (6A) using the tool described above to seat the rotor and assembled vanes (6C) into the stator (6B) and to create necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force. SEE FIGURE 63.

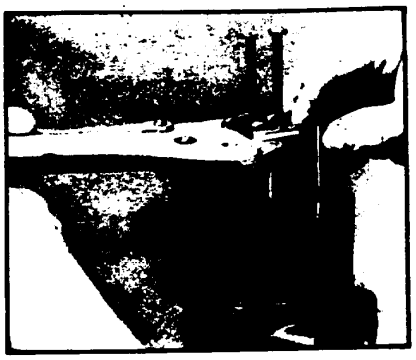


Figure 63

CAUTION

CAUTION: Too much force used to push the rotor vanes into place could shear off the coating applied to the stator vane pockets. Use care during this procedure to prevent damage to rotor set and the drive link splines, if you use your drive link as the assembly tool as shown in FIGURE 63.

remove tool, bolt, rotor set & wear plate

6. Remove drive link tool, the two bolts, then the assembled rotor set (6) and wearplate (7) as a unit from the housing and set them aside for subsequent TorqmotorTM assembly procedures. SEE FIGURE 64.

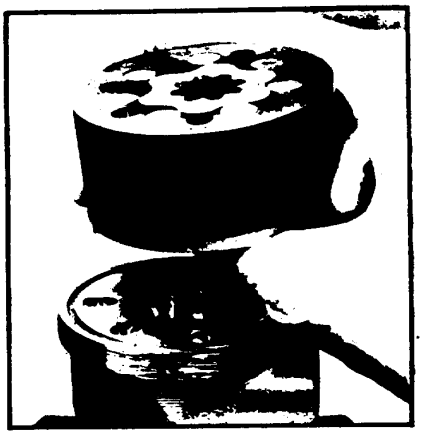


Figure 64

NOTE

NOTE: Go to the notes preceding Step 10 of the MAF Assembly Procedure if the MAF Assembly Procedure was interrupted after MAF Assembly Step 9, to assemble the rotor set.

Pressure port with "A" cast under it on housing (15) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for counter clockwise coupling shaft rotation.

CAUTION: If the MAF Torqmotor™ is reassembled with rotor and coupling shaft internal splines one tooth (45°) or three teeth (135°) out of phase in either direction, the MAF will not function.

If the MAF Torqmotor™ is reassembled with rotor and coupling shaft internal splines two teeth (90°) out of phase, in either direction, it is fully functional but, the direction of rotation of coupling shaft will be reversed to what is designated for a pressurized port "A" or port "B".

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

- 10W40 SE or SF manufacturers suggested oil.
- Hydraulic fluid as recommended by equipment manufacturer, but the viscosity should not drop below 50 SSU or contain less than .125% zinc anti-wear additives.

  CAUTION: DO NOT MIX OIL TYPES. ANY MIXTURE, OR AN UNAPPROVED OIL, COULD DETERIORATE THE SEALS. MAINTAIN THE PROPER FLUID LEVEL IN THE RESERVOIR. WHEN CHANGING FLUID, COMPLETELY DRAIN OLD OIL FROM THE SYSTEM. IT IS SUGGESTED ALSO THAT YOU FLUSH THE SYSTEM WITH CLEAN OIL.

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

Maximum operating temperature 2000F (93.3°C).

- Adjust fluid level in reservoir as necessary.
- Encourage all operators to report any malfunction or accident that may have damaged the hydraulic system or component.
- Do not attempt to weld any broken Torqmotor™ component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any Torqmotor™ part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around and the filler caps before checking oil level.
- Investigate and correct any external leak in the hydraulic system, no matter how minor the leak.
- Comply with manufacturer's specifications for cleaning or replacing the filter.

Cautions required for Proper Torqmotor™ Hydraulic System Operation

CAUTION: Do not weld, braze, solder or any way alter any Torqmotor™ component.

CAUTION: Maximum operating pressure must not exceed recommended TorqmotorTM pressure capacity.

CAUTION: Always carefully inspect any system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

CAUTION: Do not force any coupling onto the Torqmotor™ coupling shaft as this could damage the unit internally.

Ross Gear extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact our Ross Service Department or local Ross approved Distributor. Our phone number and telex number and address are on the back cover of this manual.

English

MAF TORQMOTOR SERIES		06	08	12	16	20	24	32	40
DISPLACEMENT IN³/REV.		3	4	6	8	10	12	16	20
PRESSURE (P.S.I.)	Continuous (differential)	1750	1750	1750	1750	1750	1750	1300	1050
	Peak (differential)	2500	2500	2500	2500	2500	2500	1850	1500
	Back (Max.)	1750	1750	1750	1750	1750	1750	1750	1750
TORQUE (In. Lbs.)	THEO./100 P.S.I.	47	63	95	127	159	190	254	318
	@Rated pressure and flow	710	940	1420	1890	2360	2840	2640	2670
	@Peak pressure and rated flow	1010	1350	2020	2700	3380	3810	3760	3810
FLOW (GPM)	Con't. Rated	9	12	12	12	12	12	15	15
	Peak	12	15	15	15	15	15	20	20
SPEED (RPM)	@Peak flow with no load	904	846	563	423	330	282	284	228
	@Con't. rated flow & pressure	610	609	406	305	244	203	194	155

Metric

MAF TORQMOTOR SERIES		06	08	12	16	20	24	32	40
DISPLACEMENT CM³/REV.		49	66	98	131	164	197	262	328
PRESSURE (BAR)	Continuous (differential)	120.7	120.7	120.7	120.7	120.7	120.7	89.6	72.4
	Peak (differential)	172.4	172.4	172.4	172.4	172.4	172.4	127.6	103.4
	Back (Max.)	120.7	120.7	120.7	120.7	120.7	120.7	120.7	120.7
TORQUE (Nm)	THEO./6.9 BAR	5.3	7.1	10.7	14.3	18.0	21.5	28.7	35.9
	@Rated pressure and flow	80.2	106.2	160.4	213.5	266.6	320.9	298.3	301.7
	@Peak pressure and rated flow	114.1	152.5	228.2	305.1	381.9	430.5	424.8	430.5
FLOW (LPM)	Con't. Rated	34	45	45	45	45	45	57	57
	Peak	45	57	57	57	57	57	76	76
SPEED (RPM)	@Peak flow with no load	904	846	563	423	330	282	284	228
	@Con't. rated flow & pressure	610	609	406	305	244	203	194	155

Notes

Differential pressure (ΔP) is the difference between inlet and outlet port pressures.

Peak (intermittent) operation rating applies to 10 percent of every minute.

Maximum pressure at the motor inlet port (without regard to differential pressure or back pressure ratings or both is 2500 PSI (172.4 BAR).

Peak side load— 1000 lbs (453.6 kg) at center of output shaft.

Rated side load— 500 lbs (226.8 kg) at center of output shaft

Max. end thrust— 250 lbs (113.4 kg) toward motor 1000 lbs (453.6 kg) away from motor

Write or call for information and added details
concerning your installation and applications:
Phone: 317.423.5377
Telex: 279413
Write: Ross Gear Division
800 Heath Street
Lafayette, Indiana 47902

MAF-101
WAP 10M 2/84

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	28
Quantity Required:	One
Description:	Levelwind Reducer
Manufacturer:	Eurodrive
Part Number:	FAF 70A1669.31
Source:	Eurodrive, Inc. 2001 West Main Street Troy, Ohio 45373

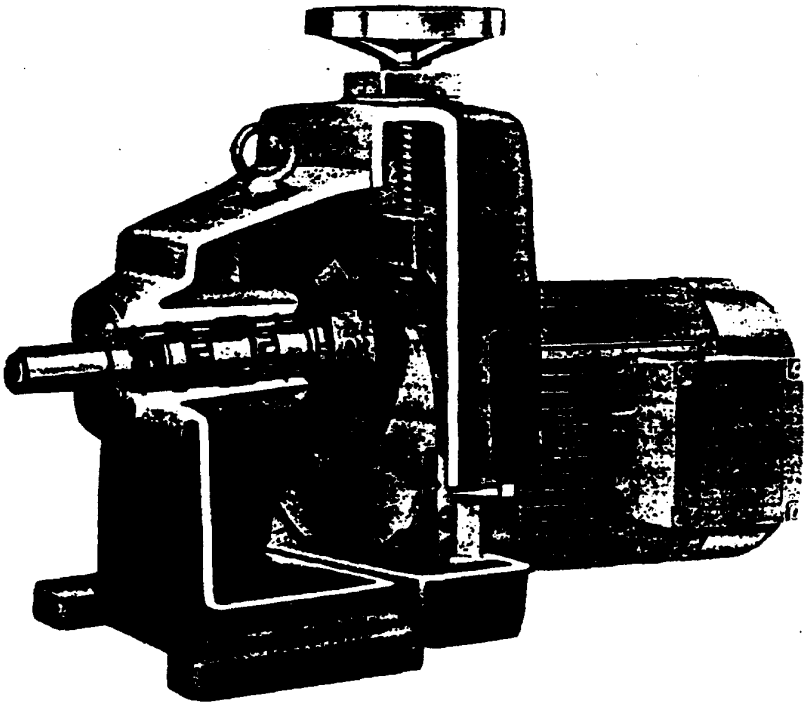
Tele #: (513) 335-0036
TELEX #: 28-8262

EURODRIVE, INC.

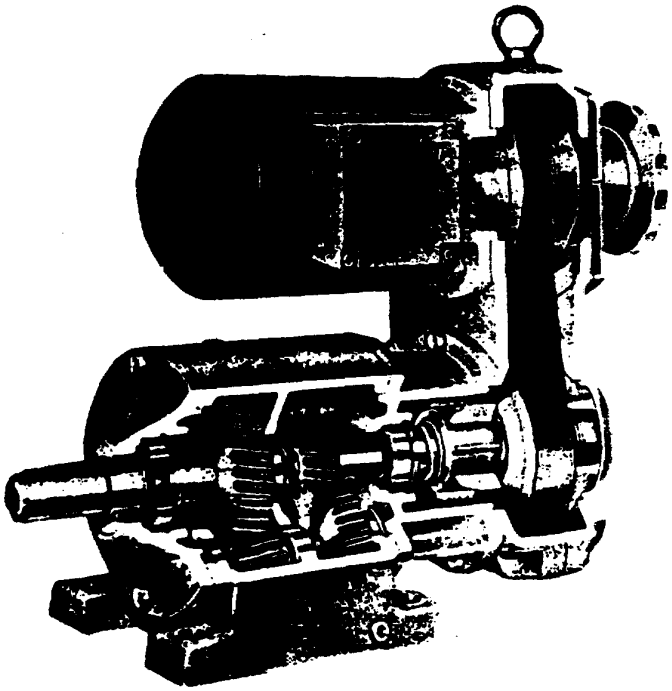
SERVICE MANUAL

EURODRIVE

Eurodrive, Inc. | Eurodrive, Inc. | Eurodrive, Inc.
2001 West Main Street [illegible] | [illegible] San Antonio Rd. | [illegible] Spartanburg [illegible]
Troy, Ohio 45373 | Hayward, CA 9454[illegible] | [illegible], SC 29[illegible]
513-3[illegible] | 415-4[illegible] | 803-4[illegible]
Telex [illegible] (Home Office) | Telex [illegible] | Telex 80-55[illegible]



VARIMOT®



VARIGEAR® in U-flow

EVERY UNIT IS SUPPLIED WITH 1 (ONE) COPY OF THE SERVICE MANUAL.
Eurodrive can supply multiple copies of the service manual to OEM customers upon request.
The maximum limit is 10 copies per order. When more than 10 copies are required reproducibles may be supplied.

Index

Terms and Conditions of Sale*

CONTRACT
Any acceptance by the Company of the Buyer's order is expressly made, conditional on the Buyer's assent to any additional or different terms than contained herein or set forth on the Company's order acknowledgment or elsewhere. All orders are received subject to acceptance and may be accepted only at the Company's headquarters at Troy, Ohio, Hayward, California or Lyman, S.C.

TAXES
The Company's prices do not include any applicable sales, use, excise or similar taxes; and the amount of any such tax which the Company may be required to pay or collect will be added to each Invoice unless the Buyer has furnished the Company with an appropriate to exemption certificate.

TERMS
Terms are cash net 30 days. Amounts past due are subject to a service charge of 2% per month (or fraction thereof). If the Company deems that, by reason of the financial condition of the Buyer or otherwise, the continuance of production or shipment on the terms specified herein Is not justified, the Company may requite full or partial payment In advance.

DELIVERY
Any indicated dates of delivery are approximately only, but-the Company will attempt to meet them where possible. The Company shall not be liable for delays In manufacturing or delivery or failure to manufacture or deliver due to any event In the nature of force majeure or any cause beyond the Company's reasonable control. The Company will not be bound by any penalty clause contained in any specification or order submitted by the Buyer unless such clause is specifically agreed to in writing by the Company.

SHIPPING CHARGES
Shipments are F.O.B. Factory. Freight will be collect. Freight prepaid and billed as a separate item on the product Invoice can be made upon request.

PACKING
The Company makes no charge for Its standard packing for domestic shipment. The Buyer will be charged for export packing or other special packing required.

PRODUCT WARRANTY
The Company warrants all its' products against defects In material and workmanship for a period of 4000 operating hours or for a period not to exceed two years from date of shipment, whichever comes first. Parts subject to replacement due to operational wear and tear, viz. Varigear belts, Varimot traction elements and gear unit oil seal assemblies are not covered by this extended warranty. - This warranty is In effect provided:

(a) the Buyer notifies the Company in writing of the alleged defect immediately after It becomes known to the Buyer and (b) no alterations, repairs or services have been performed by the Buyer or third parties on the equip ment without the written approval of the Company. The Company's obligation under this warranty is limited to the replacement FOB Factory of any part or parts found by the Company to be defective in materials or workmanship.

This warranty does not cover damage or defect due to normal wear and tear, misuse, alteration, neglect or accident or use of the equipment above rated capacity. The Company shall In no event be liable to the Buyer under this warranty or otherwise, for claims, expenditures or losses arising from operational delays or work stoppages or damage to property caused by defective equipment, or for consequential damages of any nature whatsoever.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

PRODUCT SAFETY
Company products are designed and manufactured to high quality Industrial standards. No geared unit is fail-safe within Itself however. When risk to person or property may be involved, a fall-safe device should be an integral part of the driven equipment.

INDEMNITY
The Company agrees to Indemnify the Buyer and hold It harmless from and against any direct damage suffered or liability incurred on account of bodily injury to persons (including death) or damage or destruction of property whenever such loss or liability is directly due to bodily injury (including death) to any person or damage to any property occurring In the course of, and caused by the act or omission of the Company In the performance of any work on the premises of Buyer hereunder. This Indemnity shall Include attorneys fees and settlements of claim or suit reasonable under the circumstances.

REGULATORY LAWS AND/OR STANDARDS
The Company makes no promise or representation that Its products will conform to any federal, state or local laws, ordinances, regulations, codes or standards, except as otherwise specified and agreed upon In writing as a part, of the contract between Buyer and the Company. The Company’s prices do not Include the cost of any related inspections or permits or Inspection fees.

READ BEFORE INSTALLING AND OPERATING GEARMOTOR

CHECK OIL LEVEL BEFORE OPERATION

The oil level should be checked by removing the red painted screwed plug, the correct level being that when the surface of the oil is level with the lowest point of the tapped hole. Since the quantity of lubricating oil and the position of the oil level, oil drain and breather are dependent upon the mounting position, correct lubrication will be obtained only if the unit is mounted In the position as indicated on the relevant order.

The breather plug b painted blue and the air vent hole is closed by a plastic plug during transportation. This plastic plug must be removed prior to putting the unit into service.

INSTALLATION

Inspection - Check gearmotor for shortage and damage immediately upon arrival. Note damage or shortage on freight (bill of lading); immediately file claim with carrier. Notify Eurodrive Inc.

Handling - Handle with care. Dropping or jarring can seriously damage bearings or break unit parts. Lift with device with capacity for unit weight, and use eye bolt or rig a double strap around motor frame and gearmotor casing.

Standby service & Storage - Standby gear units which are operated very intermittently should be run briefly at least once a month to protect the gears and bearings by circulating the lubrication. When units are stored for future use, they should be completely filled with oil containing a rust preventative which is soluble in lubricating oil or they should be drained of oil and cleaned, and a rust preventative applied to the gears, bearings and shafts. When taken out of storage for use, the gear unit should be cleaned out and refilled with regular lubricating oil prescribed.

Mounting - The gearbox should be mounted on a level vibration-free support and should be accurately aligned with the driven unit. Particular care should be taken where the power Is being transmitted by gear wheels or chains. The gear case must not be subjected to any additional external forces during installation, e.g. being mounted on an uneven baseplate.

GENERAL

Every EURODRIVE motor Is tested before being ship ped. If a motor must be stored for a long period of time the motor must be stored dry and in the same way as the mounting position. For trouble free functioning; proper installation and operation are essential.

ELECTRICAL CONNECTION

The motor must be installed and connected by a qualified electrician who is knowledgeable with the NEC article 430 and local regulations and he must make sure that the voltage and frequency of the electrical supply correspond with the data stamped on the motor data plate before connecting the motor in accordance with the wiring diagram which can be found In the terminal box.

At installation the electrician must make sure that the terminal block jumpers are positioned correctly and that all electrical connections including the ground connection are secure. In order to effectively protect the motor from overloads appropriate motor protection must be provided. Fuses do not always represent adequate motor protection. For motors which are required to operate with a very high start-stop frequency the con

conventional motor protection, heaters, are totally insufficient and it is advisable in such applications to provide' the motors with temperature sensors (thermistors) in the windings and to monitor them by means of an external tripping device. In this way the motors will then be fully protected against practically all possible overloads.

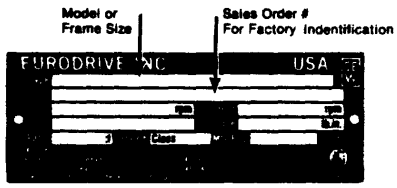
When using motors outdoors or in washdown applications the cable entries into the terminal must be directed downwards to prevent water from entering the conduit box.

RETURN OF EQUIPMENT:

Equipment returned to Eurodrive for repair or inspection must be shipped prepaid and marked with, a RGA number (Returned Goods Authorization). This number must be obtained from Eurodrive, Inc.

REPAIR PARTS

Parts lists are available from Eurodrive upon request. When ordering parts, supply S.O. No. or Serial No. which is listed on the name plate.



WARRANTY REPAIRS

In case of failure of equipment within the warranty period, contact the closest Eurodrive facility before disassembling the equipment.

When Eurodrive has to be called for a repair, supply the S.O. NUMBER (Serial Number) as shown on the nameplate.

Eurodrive will advise the user how to proceed with the repair and designate a repair facility.

The user may be advised:

1. To ship the unit to a Eurodrive facility.
2 . To deliver the unit to the closest EASA repair shop. In both cases the user Is responsible for the freight charges Involved.

Eurodrive uses the EASA (Electrical Apparatus Service Association) repair shops where necessary to get the equipment repaired as quickly as possible.

If a unit is delivered to an EASA shop, please indicate which Eurodrive group must be contacted for a Put chase Order prior to the repair.

PLEASE NOTE: ALTHOUGH EURODRIVE USES EASA SHOPS FREQUENTLY, IT DOES NOT MEAN THAT EVERY SHOP IS FAMILIAR WITH THE PROCEDURES. FOR WARRANTY REPAIRS. PLEASE SUPPLY THEM WITH THE APPROPRIATE TELEPHONE NUMBER LISTED.

LUBRICATION INFORMATION

IMPORTANT
EURODRIVE recommended lubrication schedule should be followed if possible. If any other lubricant is used please consult with the factory about any harmful effects of certain lubricants or applications.

LUBRICATION SCHEDULE FOR EURODRIVE GEAR UNITS

Application	Lubrication type	Ambient air temperature range ϑ_U	kinematic viscosity at 40° C (cSt) approx.	GULF Oil Co.	CHEVRON Oil Co.	AMERICAN Oil Co.	MOBIL Oil Co.	SHELL Oil Co.	TEXACO Oil Co.
Helical Gear Units, Helical Geared Motors, Bevel Gear Units, Bevel Geared Motors	Oil	+ 104 to + 32	210	Gulf E P Lubricant S 100	Chevron Non-Leaded Gear Compound 220	SPARTAN EP 220	Mobilgear 630	Shell Omala Oil 220	Meropa 220
		+ 77 to + 5	145	Gulf E P Lubricant S 80	Chevron Non-Leaded Gear Compound 150	SPARTAN EP 150	Mobilgear 629	Shell Omala Oil 100	Meropa 150
Worm Gear Units, Worm Geared Motors	Oil	+ 104 to + 32	630	Gulf E P Lubricant HD 680	Chevron Non-Leaded Gear Compound 680	SPARTAN EP 680	Mobilgear 636	Shell Omala Oil 680	Meropa 680
		+ 77 to + 5	210	Gulf E P Lubricant HD 220	Chevron Non-Leaded Gear Compound 220	SPARTAN EP 220	Mobilgear 630	Shell Omala Oil 220	Meropa 220
General	Synth. Oil	+ 176 to − 40	Consult Factory For Use Of Synthetic Oils				MOBILE SHC 629 or 634		
	Synth. Grease	+ 200 to − 40	Consult Factory For Use Of Grease Filled Reducers						
Hydraulic start - up coupling	Oil	≧ + 32		Gulf Harmony 43 AW	Chevron E P Hydraulic Oil 32	NUTO H 32	Mobil D T E 24	Shell Tellus Oil T32	Rando Oil 32
		> + 32		Gulfspin 38	Chevron E P Hydraulic Oil 12	NUTO H 15	Mobil D T E 11	Shell Tellus Oil T15	Rando Oil 10
Ball and Roller Bearings	Grease Used for normal application temp. range − 20° F to 250° F			Gulfcrown Grease E P No. 2	Chevron Dura-Lith BEACON 3	ESSO Multipurpose Grease BEACON 2	Mobilux EP2	Shell Alvania Grease R 3	Gresando FT 3
	Grease	High Temp Grease	Use for all brake motor bearings Texaco Premium RB Grease						
		Low Temp Grease	Gear Reducer & Motor Bearings Aeroshell 17 - Shell Oil Co (For operation in very low temperatures (− 40° F))						

LUBRICANTS
For recommended oil and grease see the lubrication schedule.

All gearunits supplied by EURODRIVE are shipped with oil and grease. The units are ready to be operated after being properly installed and aligned.

OIL LEVELS
The amount of oil in each gear unit depends on the mounting position of the gear unit. The oil level can be checked by removing the red painted oil plug. The oil level must be even with the bottom of the threaded hole.

Note that the required oil level changes when the mounting position is changed from the originally ordered position.

Check oil level required, on the different mountings, in the catalog.

Please make sure that the plastic stop in the vent plug is removed before operating the gear unit. This will assure us that no pressure build up will take place inside the gear unit.

Gear units can only be operated in a non-ventilated condition when approved by the factory.

MAINTENANCE OF GEARUNITS
All EURODRIVE units require a minimum of maintenance.

For a long-life operation we suggest the following:

1. All oil levels and oil quality must be checked every 5000 hours. If the oil is contaminated, burned or waxed, change the oil immediately and flush out the box if necessary.
2. Under normal operating conditions we recommend an oil change every 10,000 hours of operation or 2 years.
3. When a synthetic oil is used change the oil every 40,000 hours or 4 years.
4. Grease packed bearings must be cleaned and regreased every 10,000 hours. The bearing grease area must be filled to approximately 1/3 of the available area to avoid overheating of the bearing.

   The above suggestions are however, subject to change if the units are running in high temperature, high humidity or corrosive environments. If any of these situations exist the lubricant may have to be changed more frequently.

OVERHUNG LOAD
To prevent excessive loads on the input or output shaft and bearings please make sure that the load on the shafts does not exceed the limitations of the gear unit.
Consult with the factory if necessary.

THE INSTALLATION OF A COUPLING, SPROCKET, GEAR OR SHEAVE When installing one of the items listed above please make sure that the proper tools or procedures are used.

Do not hammer on the shafts.
Hammering on the shafts can cause brinelling of the bearings and a considerable reduction in bearing life.

Instead of "hammering on" the components we suggest heating up the items if possible to approximately 175°F. This will eliminate any damage to the bearings.

It should be noted that the EURODRIVE units with shafts up to 1-1/2" diameter are machined to a tolerance of +.0000"; -.0005"; and the larger diameter shafts are machined to a tolerance of +.0000";-.0010".

LUBRICATION INFORMATION

Gear reducer
Oil capacities in (US) gallons

Helical Reducer

FRAME SIZE		Mounting Positions								
		B3 B5/B6	B6	B8 B5/B6	B7* B7/B6*	B8* B5/B6*	V1	V3	V5	V6
R, RF	30									
R, RF	40	0.08	0.08	0.15	0.18	0.16	0.29	0.26	0.29	0.26
R, RF, RUF	60	0.16	0.13	0.42	0.45	0.29	0.53	0.55	0.66	0.66
RX, RXF	61	0.21	0.13	0.13	0.13	0.21	0.16	0.13	0.26	0.13
R, RF, RUF	70	0.32	0.37	0.58	0.66	0.61	0.98	0.92	1.00	1.00
RX, RXF	71	0.45	0.24	0.34	0.34	0.42	0.26	0.26	0.53	0.26
R, RF, RUF	80	0.74	0.74	1.27	1.27	1.06	2.03	2.03	2.30	2.30
RX, RXF	81	0.58	0.45	0.48	0.59	0.58	0.63	0.42	0.84	0.53
R, RF, RUF	90	1.45	1.19	2.11	2.24	1.77	3.43	3.06	3.51	3.56
R, RF, RUF	100	1.32	1.19	3.56	3.56	2.84	5.44	4.86	5.68	5.26
RX, RXF	101	1.64	0.90	1.03	1.66	1.93	1.29	0.98	2.14	1.37
R, RF	120	1.85	1.72	5.63	5.41	5.20	7.52	8.98	8.45	8.50
R, RF, RUF	130	1.80	1.58	4.75	3.38	4.51	7.70	7.92	8.06	8.00
R, RF, RUF	140	2.64	2.77	6.81	7.75	6.86	11.09	11.62	12.67	12.46
R, RF, RUF	150	4.36	4.36	9.77	11.35	9.74	16.76	17.82	16.90	17.42
R, RF, RUF	160	5.68	4.49	12.01	12.54	11.46	18.46	19.67	19.40	20.86

Helical- Bevel Reducer

FRAME SIZE		Mounting Positions											
		B3, H1 B5I	B3I B5H*	B5	B5H	B5HI	H5	B6	V1 V1I	V5	H2	H3*	H4	H5, H6
K, KF, KA	60	0.24	0.90	0.63	0.90	0.79	0.63	0.79	0.87	0.77	0.87	0.61	0.84	
K, KF, KA	70	0.45	1.84	1.32	1.89	1.56	1.29	1.50	1.80	1.74	1.45	1.58	1.24	1.88
K, KF, KA	80	0.86	2.51	2.11	2.81	2.51	2.06	2.40	2.75	2.84	2.27	2.38	1.93	2.51
K, KF, KA	90	1.27	4.75	3.84	4.91	4.38	3.56	4.22	5.17	5.02	4.09	4.62	3.43	4.88
K, KF, KA	100	2.11	8.45	6.47	8.71	7.66	6.34	7.39	8.71	8.45	7.13	8.18	6.07	8.18
K, KF, KA	120	3.70	15.84	16.37	14.26	11.62	13.73	16.90	16.37	13.20	15.31	11.09	15.84	
K, KF, KA	150	7.13	26.93	19.54	27.98	24.29	19.01	23.23	28.78	27.72	22.70	26.40	18.48	27.19
K	140	7.39	31.68	–	31.68	–	–	–	25.06	–	–	–	–	–
K	180	13.73	51.48	–	51.48	–	–	–	42.24	–	–	–	–	–

Helical - Worm Reducer

FRAME SIZE		Mounting Positions										
		B3 B5I	B3I* B5H*	B5	B5I	B5H*	B5HI	B6 B5I	B8*	$V1_A$	$V1_B$	V5 V5I
S, SF	30	0.07	0.07	0.09	0.09	0.09	0.09	0.07	0.07	0.09	0.09	0.07
S, SF	40	0.05	0.26	0.32	0.09	0.34	0.21	0.29	0.16	0.21	0.16	0.16
S, SF	50	0.08	0.40	0.37	0.11	0.45	0.32	0.42	0.29	0.29	0.21	0.24
S, SF	60	0.16	0.74	0.95	0.21	1.06	0.61	0.66	0.42	0.61	0.55	0.42
S, SF	76	0.29	1.32	1.80	0.34	1.83	1.27	1.40	0.87	1.14	1.03	0.82
S, SF	80	0.55	2.64	2.90	0.79	2.80	1.58	2.85	1.58	1.77	1.48	1.48
S, SF	90	1.00	5.15	5.73	1.32	5.61	3.59	5.41	2.90	3.04	2.86	2.77
S, SF	100	2.11	10.56	11.35	2.38	11.35	6.86	10.96	6.07	6.86	6.07	6.07

		H1	H2	H3*	H4	H5, H6
SA	40	0.09	0.21	0.32	0.33	0.18
SA	50	0.11	0.29	0.40	0.40	0.24
SA	60	0.21	0.61	0.92	0.87	0.53
SA	70	0.34	1.06	1.58	1.48	0.92
SA	80	0.79	1.50	2.64	2.75	1.58
SA	90	1.32	3.30	5.28	5.28	3.17
SA	100	2.38	6.07	11.09	11.09	5.81

Parallel - Helical
Shaft Mounted Reducer
The Snuggler®

FRAME SIZE		Mounting Positions					
		H1	H2	H3	H4	H5*	H6*
FA, FAF	40	.40	.29	.45	.37	.45	.45
FA, FAF	60	.74	.86	1.00	.90	1.06	1.06
FA, FAF	70	1.72	1.11	1.75	1.50	2.14	1.87
FA, FAF	80	2.85	1.79	3.03	2.48	3.33	3.01
FA, FAF	90	5.12	3.03	5.88	4.62	6.52	6.12
FA, FAF	100	8.87	5.36	8.84	7.81	12.01	10.82

*GEAR REDUCERS IN THE INDICATED MOUNTING POSITIONS ARE NON-VENTILATED.

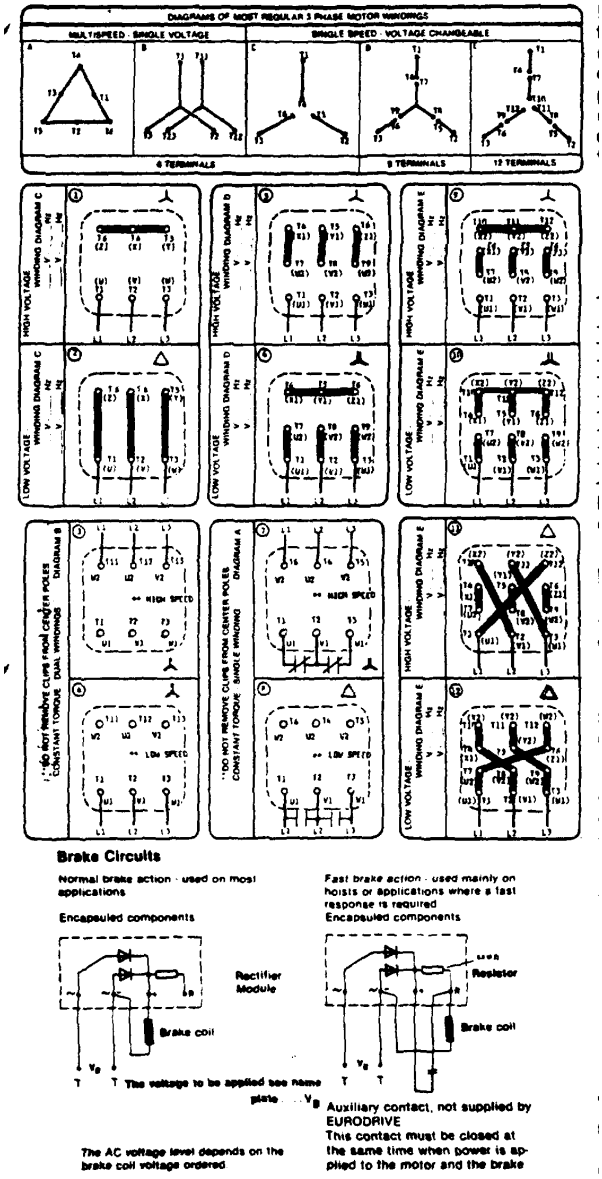
VENTILATED GEAR REDUCERS

Ventilated gear reducers may be supplied with breather plugs in 2 ways;

1. A breather plug is installed In the reducer and the reducer has a red sticker on the reducer indicating instructions to remove closing wire before operating the reducer.

2. Gear reducers ordered for certain mounting positions are shipped out of the factory with a temporary yellow plug. This plug is installed to prevent leakage during shipment of the unit. A breather plug is located in the conduit box which replaces the yellow plug. (The reducer will have a yellow sticker which indicates instructions.)

MOTOR CONNECTIONS



FAST BRAKE ACTION IS ESSENTIAL FOR HOIST APPLICATIONS

The voltage V_B must be applied and removed at the same time as the power to the motor.

- Voltage to the rectifier energizes the brake coil and releases the brake.
- Removal of the voltage V_B de-energizes the brake coil and allows the brake to be applied.

The AC voltage V_B will be rectified to a DC level of 50% of the AC voltage applied.

MECHANICAL PROPERTIES

EURODRIVE gear motors are designed and manufactured with totally enclosed fan cooled squirrel cage induction motors which are designed for continuous operation under difficult conditions. The windings are protected with a special Insulating material Class B equivalent or better. The brake motors incorporate a DC disc brake and the supply is taken from a half-wave rectifier mounted inside the motor terminal box.

Motor Winding Connections

Number of Poles	Synchronous speed RPM	Connection	
2	3 600	Y/YY	
4	1 800	Y/YY	
6	1 200	Y/YY	
8	900	Y/YY	
4/2	1 800/3 600	Δ/YY	Single winding, constant torque
8/4	900/1 800	Δ/YY	Single winding, constant torque
6/2	1 200/3 600	Y/Y	2 separate windings, constant torque
8/2	900/3 600	Y/Y	2 separate windings, constant torque
12/2	600/3 600	Y/Y	2 separate windings, constant torque
6/4	1 200/1 800	Y/Y	2 separate windings, constant torque

For voltages other than 2301460V, 60HZ; check decal in conduit box.

BRAKE COIL VOLTAGES

Motors with dual voltage connections: 230/460V, 60HZ will be supplied with a 230V brake coil. In each case, whether the motor voltage is 230 or 460 VAC, the brake rectifier is connected to T7-T8 where 230VAC will be tapped oft the terminal block.

See motor connection diagram number 5 for 460VAC, 60HZ and number 6 for 230VAC, 60HZ power supplies.

For Brake Motors Operating On: 200V/208V, 575V, 60HZ or 220/380V, 415V, 50HZ, the above does not apply. In all cases the brakes will be connected for the requested operating voltage.

MAINTENANCE

The only maintenance, normally, required is to ensure that the area between the cooling fins and the area through which the air is drawn in the fan guard is kept clean and that an audible check is made on the bearings. If the motor is being overhauled the bearings must be cleaned and repacked. If the motor has to operate in moist or wet surroundings then it is very important that on reassembly of the motor the end shield tenons are coated with a sealing compound such as loctite.

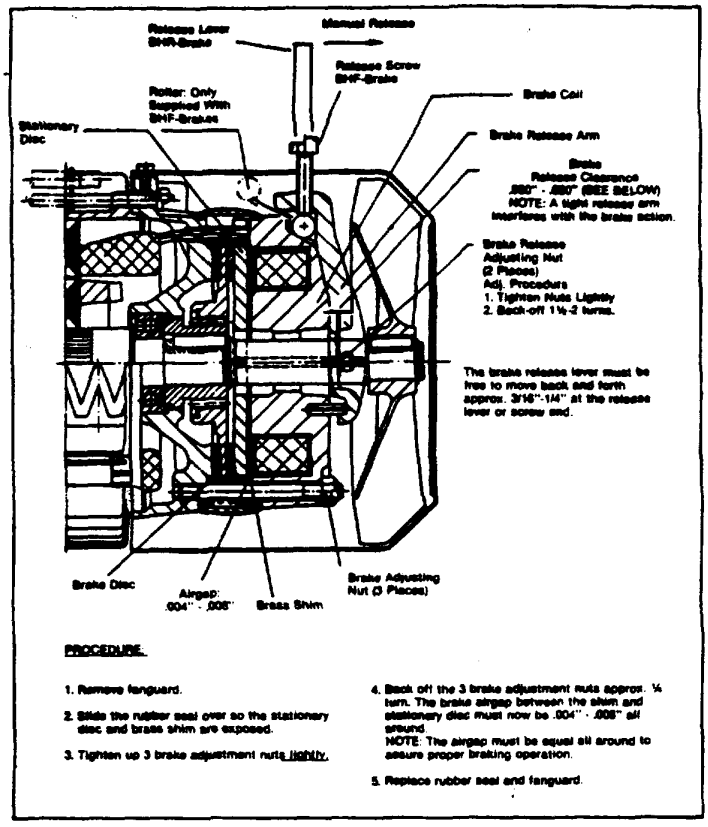
VOLTAGE REGULATION--Motors will operate successfully under the following conditions of voltage and frequency variation, but not necessarily in accordance with the standards established for operating under rated conditions:

a. When the variation in voltage does not exceed 10% above or below normal, with all phases balanced.

b. When the variation in frequency does not exceed 5% above or below normal.

c. When the sum of the voltage and frequency variations does not exceed 10% above or below normal (provided the frequency variation does not exceed 5%).

MOTOR/BRAKE INFORMATION



IN CASE OF A BRAKE FAILURE CHECK FIRST FOR AN OPEN BRAKE COIL. IF THE BRAKE COIL IS OKAY, FOLLOW THE BELOW LISTED SUGGESTIONS

Fault	Cause	Remedy		Cause	Remedy
Brake does not disengage	Wrong voltage on the rectifier module	Apply correct voltage (check from the name plate)	Motor does not brake	Brake lining completely worn	Replace brake disc.
	Rectifier dead	Replace rectifier		The air gap has increased to a point where the adjusting nuts are not up tight	Reset brake
	The maximum permissible air gap exceeded due to brake lining wear	Readjust brake. If brake lining is completely worn out replace the brake disc		The hand brake is not properly adjusted	The adjusting nuts must be properly adjusted
	Voltage drop in the line too high	Ensure correct line voltage	Braking action is too slow	The brake is actuated with the normal brake action circuit	The brake to be actuated with fast brake action circuit
				During the reassembly the brass shims were omitted	Install the brass shims

BEARING SIZES

The following bearings are used for the appropriate motor frames sizes.

Motor Size	Driving End A	Fan - side End B
DT 71/80	6303C3-Z	6203C3-Z
DT 90/100	6306C3-Z	6205C3-Z
DT 112/132S	6307C3-Z	6207C3-Z
DT 123/DT160M	6309C3-Z	6209C3-Z
DT 160L	6312C3-Z	6213C3-Z
DT 180	6312C3-Z	6213C3-Z
DT 200	6314C3-Z	6214C3-Z
DT 225	6314C3-Z	6214C3-Z
D 250	NU314	6314C3

Bearing must be repacked after approximately 10,000 hours of operation. For proper bearing lubrication fill the bearing cavity with grease for approximately 1/3 of its cavity.

Non-brake motors bearings are packed with: Mobilux EP2 Grease.

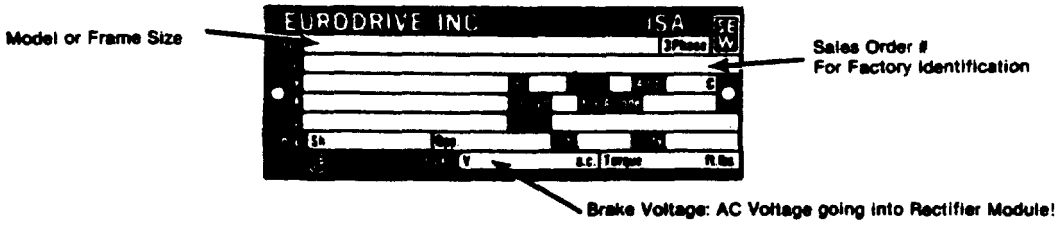
Brakemotor bearings are packed with: Texaco Premium RB Grease.

SEVERE DUTY MOTORS

Severe duty motors have double sealed (2RS) bearings on the fan side end.

Severe duty motors have drain holes drilled in the stator end shields at the lowest points to allow condensation to drain out of the motor. The same applies to the conduit box.

CAUTION: THE DRAIN HOLES ARE INSTALLED FOR THE MOUNTING POSITION LISTED ON THE NAMEPLATE. CHANGING THE MOUNTING POSITION WILL ALSO RELOCATE THE DRAIN HOLES IN WHICH CASE WATER MAY NOT BE ABLE TO DRAIN OFF AND PREMATURE MOTOR FAILURE MAY OCCUR.



BRAKE COIL RESISTANCES IN OHMS

Motor Frame Size	DT71/80	DT90/100	DT112/132S	DT132M/160M	DT160L/225
230 V Brake Coil:	218	138	100	79	73
460 V Brake Coil:	1000	670	487	369	300

NOTE: 230 V Brake Coil means - 230 VAC into rectifier.

VARIMOT® INFORMATION

GENERAL INSTRUCTIONS

Each drive Is tested before it leaves the factory. Proper installation and operation are essential for good performance.
The drive must be fastened on a solid base, free of vibration and according to the mounting position indicated on the nameplate. Feet or flanges can be damaged if the unit is not mounted on a solid and even mounting base. Shim, if necessary.
Do not hammer on sprockets, couplings, etc. when mounting these items on the output shalf. Severe damage can be done to the bearings.
The shaft diameters have tolerances of +.000"-.0005" for diameters smaller than 1.500", and + .000"-.001" for diameters
larger than 1.500". Tolerances for metric shafts are listed in Eurodrive's catalogs.
Each Varimot is equipped with a friction disc (driven disc) and a driving disc. Varimots D12, D22, D32, and D42 have a friction disc from a phenolic material.

REPLACEMENT OF A PHENOLIC FRICTION DISC:

- Remove four (4) bolts - #9
- Split the traction housings
- Mark the friction disc/hollow shaft assembly so the lobe cams at the end of the shaft assembly can later be engaged at the same place
- Remove the friction ring screws - #11
- Replace the friction disc - #10
- Before assembling the housing, clean the driving disc face so it is completely free from oil and grease

On Varimot models D23, D33 and D43, the friction disc cannot be separated from the hollow shaft assembly because the carbon disc is an integral part of the shaft assembly.
When the friction disc is checked or replaced, perform the following regreasing of the bearings and lobe cams:

1. Pull out hollow shaft assembly - #3
2. Regrease needle bearings - #7 (Shell Alvania R3 or equivalent)
3. Grease lobe cams - #8 (Lubriplate Grease GR-132)

When regreasing, do not overfill cavity. Too much grease generates an excess amount of heat.
If the lobe cams are worn excessively and can't function properly by sliding over each other, replace both shafts involved.

ASSEMBLING THE TRACTION HOUSING

1. When assembling the unit, make sure the cams are engaging the same way as they came out.
2. The cams must be properly engaged. Push the shaft assembly "in" against the spring force.
3. Tighten bolts #9 diagonally making sure that the cams are properly engaged.

Upon completion of the assembly, run the Varimot, under power, through the whole speed range checking for noise or vibration.
If due to operation problems, (jamming of the driven machine) the friction disc has stalled-out and the disc is damaged or has become noisy: Remove the hollow shaft assembly with friction disc completely. Face off the friction disc on a lathe. Remove enough material to clean up the face. Reinstall the shaft assembly.

REMOVAL OF THE DRIVING CONE

The driving cone can be removed in 2 ways:

1. By using a wheelpuller
2. Pressing the rotor out of the driving cone.

When method 1 is used make sure the fingers of the puller don't fracture the cast iron driving cone. Use a spacer between the puller fingers and the driving cone. This will reduce the possibility of fractures.
Method 2 requires complete disassembly of the motor.

1. Remove the fan guard, enshield and stator.
2. Remove the snapring which holds the bearing behind the driving cone in its' place.
3. Press out the rotor shaft.

For assembly of the unit:

1. Install rotor shaft with bearing.
2. Install snapring.
3. Press on the driving cone.
4. Assemble stator, end shields, fan guard.

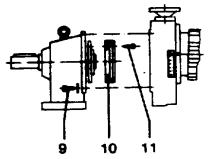
VARIMOT® UNITS SUITABLE FOR OUTDOOR DUTY OR WASHDOWN APPLICATIONS

The units are equipped with drain hoes at the lowest point for the mounting position listed on the nameplate.

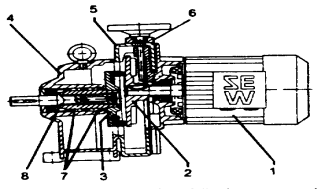
If the mounting position gets changed, please make sure new drain holes are drilled so the water or condensation can drain off properly.

Options:

Varimots can be supplied with (See Diagram):
Electric remote control motor - 23C0460V,3 Phase, or 115V, Single Phase
Remote speed indicator (percentage speed indicator, 20100%)
Handwheel with speed position indicator (HS Option). HS Option can only operate with the handwheel shaft horizontal.



The torque is transmitted from the driving disc to the friction disc. Torque demand at the output shaft is transformed into axial load against the driving disc through a set of cams called the "torque compensator." By that means, wear is avoided at no load.



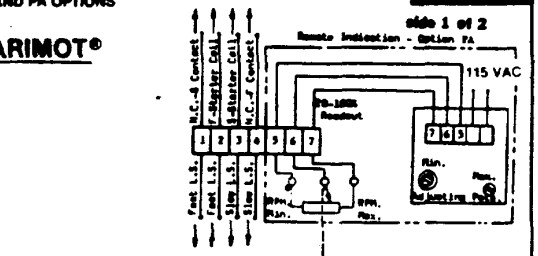
This variable speed drive consists of the following components:

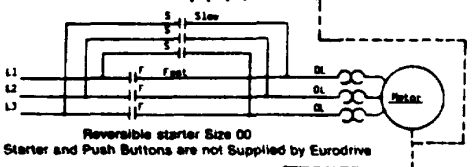
1) Motor with dove tail slide
2) Driving disc
3) Hollow shaft with friction ring and output shaft
4) Housing
5) Traction housing
6) Speed adjustment
7) Needle bearings
8) Torque compensator (lobe cams)

VARIMOT® INFORMATION

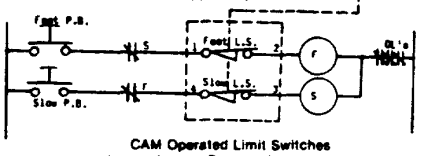
WIRING DIAGRAM FOR 3 PHASE REMOTE SPEED CONTROL MOTORS
EF AND PA OPTIONS

VARIMOT®

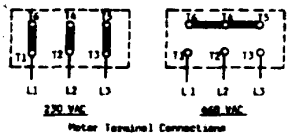




Reversible starter Size 00
Note: Starter and Push Buttons are not Supplied by Eurodrive



CAM Operated Limit Switches
Located in the Reducer Terminal Box
For the Proper Setting of L.S. see Adjusting Instructions



Motor Current for Varimot Sizes:
D/DF11-21
D/DF12-22/23 @ 230V/460V: .4A/.2A
D/DF31-41 @ 230V/460V: .55A/.32A
D/DF32/33-42/43

ADJUSTING INSTRUCTIONS FOR THE REMOTE SPEED INDICATION "PA"

To be able to install the "PA" option, the speed control motor must be equipped with the necessary hardware to accept this option.

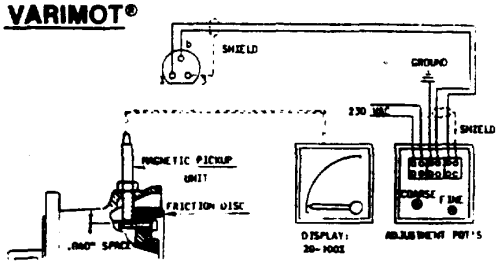
The indicator will be installed in a panel and will display the speed in a percentage of the maximum speed. Range of display is from 20% to 100% on the D11/D12, D21/D22/D23, and D31/D32/D33. The minimum setting on a D41/D42/D43 is 25%.

The minimum setting of 20% (25%) is adjusted through the "Min" potentiometer when running at minimum speed. The potentiometer is located on the back of the display unit.

The maximum setting of 100% is adjusted through the "Max" potentiometer when running at maximum speed.

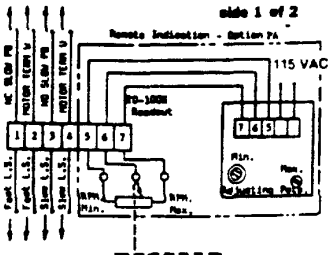
MAGNETIC PICK-UP UNIT WITH REMOTE INDICATION
FL-OPTION
ADJUSTING INSTRUCTIONS
230 VAC

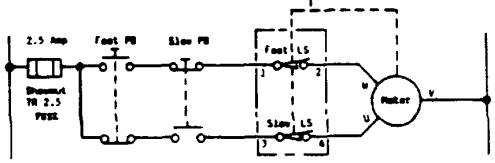
VARIMOT®

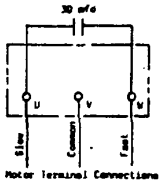


WIRING DIAGRAM FOR SINGLE PHASE REMOTE SPEED CONTROL MOTORS
EF AND PA OPTIONS

VARIMOT®







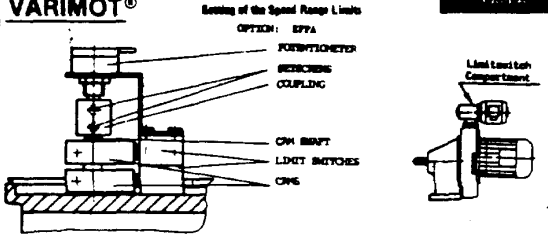
CAM Operated Limit Switches Located in the Reducer Terminal Box

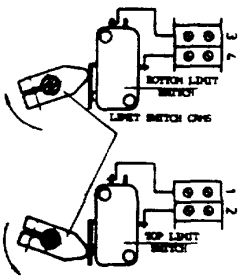
For the proper setting of LS see Adjusting Instructions.

NOTE: FUSE & PUSHBUTTONS ARE NOT SUPPLIED BY EURODRIVE

Motor Current for all Varimot Sizes
@ 115V:2.1 Amps.

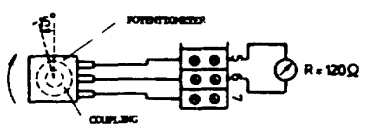
VARIMOT®



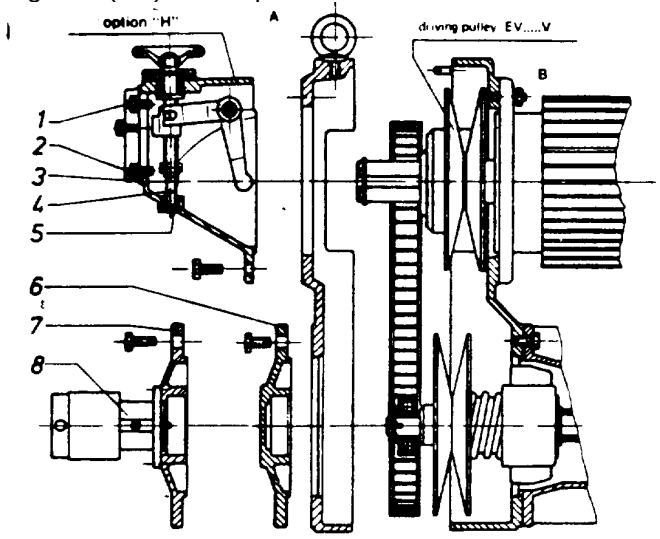


The Limitswitches are located under the black cover on the speedcontrol motor.
Adjusting Instructions:

1. Check out the wiring in the Drive Motor and speed control motor Terminal Boxes.
2. Remove black cover.
3. Run the Drive Motor "UP" to the maximum out put speed.
4. Rotate the CAM for the top Limitswitch C.W. until it trips the Limitswitch. Tighten up the Locking Screw.
5. Run the Drive Motor "DOWN" to the Min. out put speed.
6. Rotate the CAM for the bottom Limitswitch C.C.W. until it trips the Limitswitch.
7. Adjust the potentiometer as follows: Turn the potentiometer C.W. until it runs against the stop (Variable Speed Unit must be at min. speed). Turn the potentiometer approx. 15° C.C.W. Between terminals 5 & 6 there must be a resistance of 120 OHMS.
8. Tighten the coupling setscrews.



Varigear® (VU) With Option H



BELTCHANGE PROCEDURE: VU1-VU6, VZ1.VZ4

1. Run the unit to its maximum speed by: Rotating the handwheel CCW to its' maximum limit.
2. Disconnect the electrical power from the motor controls.
3. Remove the side ventilating louvers or covers
4. Remove cover items #2 and #3.
5. Remove the 4 or 6 bolts which hold the 2-beltcase halves together.

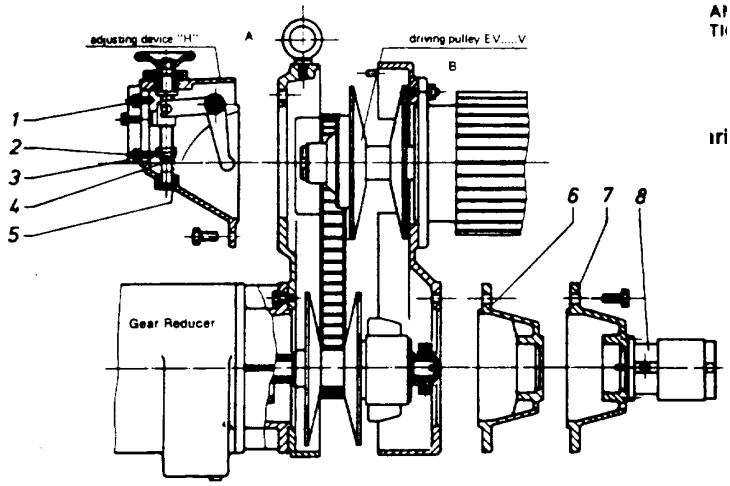
5a Support motor before separating belicase halves. (VZ1-VZ4 models only).

6. Split the beltcase. (VU1-VU6)

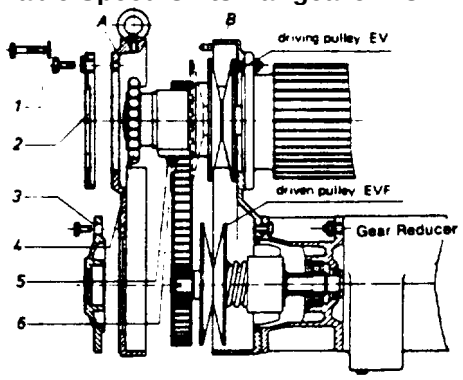
6a Separate the beltcase halves by a few inches. (VZ1-VZ4 models only.)

7. Press a wooden block between the 2-pulley halves of the M lower (driven) pulley. (The pulley halves must now be opened to their maximum position.) The wooden block will keep the driven pulley open when the belt is removed. DO NOT use a tapered wedge. A tapered wedge may fly out and cause bodily harm.

Varigear® (VZ) With Option H



Std. Supplied Varigear®
Variable Speed Units Varigear® VU1-VU6



8. Open-up the upper (driving) pulley halves to their maximum position, remove belt.
9. Install the new belt. First wrap the belt around the driven pulley and secondly around the driving pulley.
10. Remove the wooden block, reassemble beltcase, install covers and louvers.
11. Turn the handwheel so the driving (upper) pulleys close and the belt is properly seated. When readjusting rotate pulleys and belt by hand. When properly seated, the unit can be started-up under power.

WARNING

NEVER ATTEMPT TO DISASSEMBLE A DRIVEN PULLEY ASSEMBLY. THE SPRING IN THE ASSEMBLY CAN ONLY BE REMOVED BY AUTHORIZED FACTORY PERSONNEL WITH SPECIAL TOOLS. A SUDDEN RELEASE OF THE SPRING CAN CAUSE SEVERE BODILY HARM. WHEN THE EF OPTION IS SUPPLIED, MAKE SURE THE MOTOR IS ADJUSTED TO ITS' MINIMUM SPEED SETTING BEFORE MOUNTING THE MOUNTING BRACKET. WHEN A UNIT IS EQUIPPED WITH THE OPTIONS H, H, HS OR EF FOLLOW THE SAME BELTCHANGE PROCEDURE.

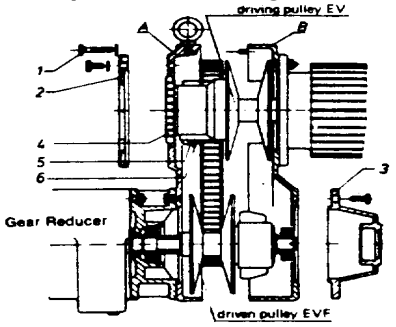
CAUTION: DO NOT ATTEMPT TO CHANGE SPEED WHEN THE BELT IS NOT ROTATING.

FOR LONG BELT LIFE OPERATE THE UNITS IN THE TEMPERATURE RANGE (-20 degrees F to 105 degrees F)

KEEP THE VENT OPENINGS CLEAN!

IF THE HANDWHEEL ROTATES DUE TO VIBRATION, TIGHTEN UP THE LOCKSCREW #6

Std. Supplied Varigear®
Variable Speed Units Varigear® VZ1-VZ4

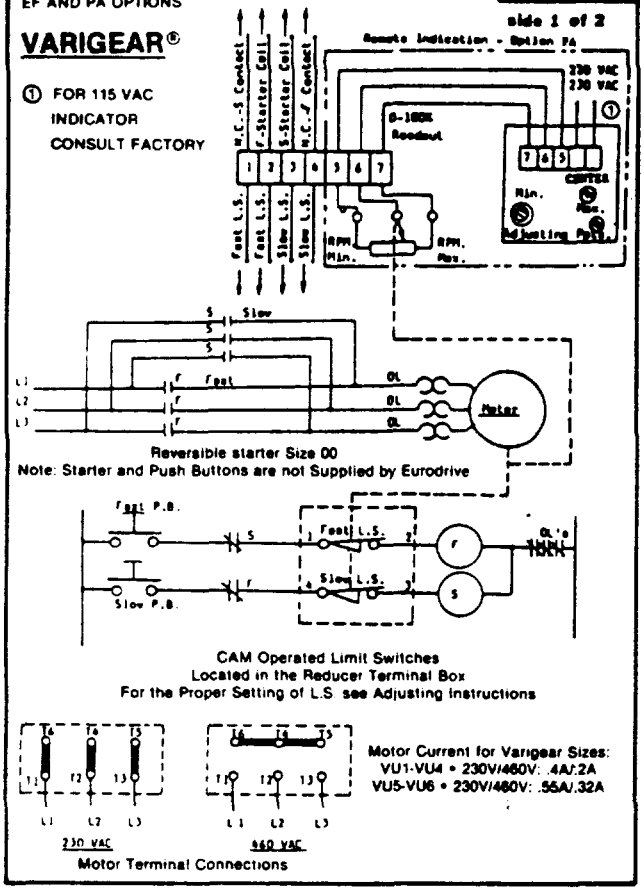


WIRING DIAGRAM FOR 3 PHASE REMOTE SPEED CONTROL MOTORS
EF AND PA OPTIONS

VARIGEAR®

slide 1 of 2

① FOR 115 VAC INDICATOR CONSULT FACTORY



Reversible starter Size 00
Note: Starter and Push Buttons are not Supplied by Eurodrive

CAM Operated Limit Switches
Located in the Reducer Terminal Box
For the Proper Setting of L.S. see Adjusting Instructions

Motor Terminal Connections

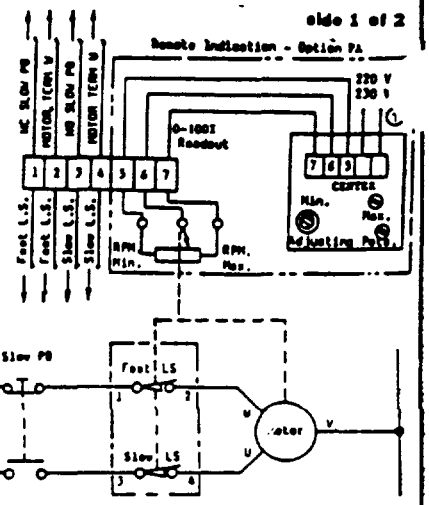
Motor Current for Varigear Sizes:
VU1-VU4 • 230V/460V: .4A/.2A
VU5-VU6 • 230V/460V: .55A/.32A

WIRING DIAGRAM FOR SINGLE PHASE REMOTE SPEED CONTROL MOTORS
EF AND PA OPTIONS

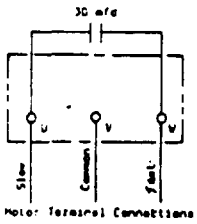
VARIGEAR®

slide 1 of 2

① FOR 115 VAC INDICATOR CONSULT FACTORY



NOTE: FUSE & PUSHBUTTONS ARE NOT SUPPLIED BY EURODRIVE



CAM Operated Limit Switches Located in the Reducer Terminal Box

For the proper setting of LS see Adjusting Instructions.

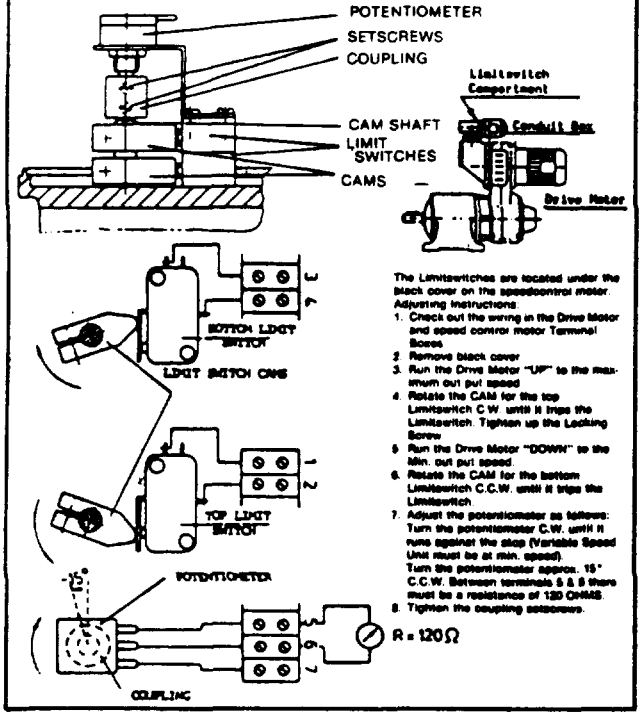
Motor Current for all Varigear Sizes
115V:2.1 Amps.

ADJUSTMENT INSTRUCTIONS FOR THE REMOTE SPEED INDICATOR "PA"

The indicator shows the RPM in percentage of maximum speed (from 0% up to 100%)
Procedure:

1. Adjust the potentiometers: minimum center and maximum to their midrange setting.
   This is done as follows - Turn each potentiometer CW (note the position), then CCW (note the position), and turn the potentiometer CW again but only ½ the rotational distance.
2. Run the ERC motor until the variable speed unit rotates at maximum speed.
   • Adjust the maximum speed potentiometer for 100% speed indication.
3. Run the ERC motor until the variable speed unit rotates at minimum speed.
   • Adjust the minimum speed potentiometer for 0% speed indication.
4. Run the ERC motor until the variable speed unit operates at 50% of the difference in speed between maximum and minimum speed (measured at the output shaft with a tachometer).
   • Adjust the center speed potentiometer for 50% speed indication.

VARIGEAR® Setting of the Speed Range Limits
OPTION: EFPA



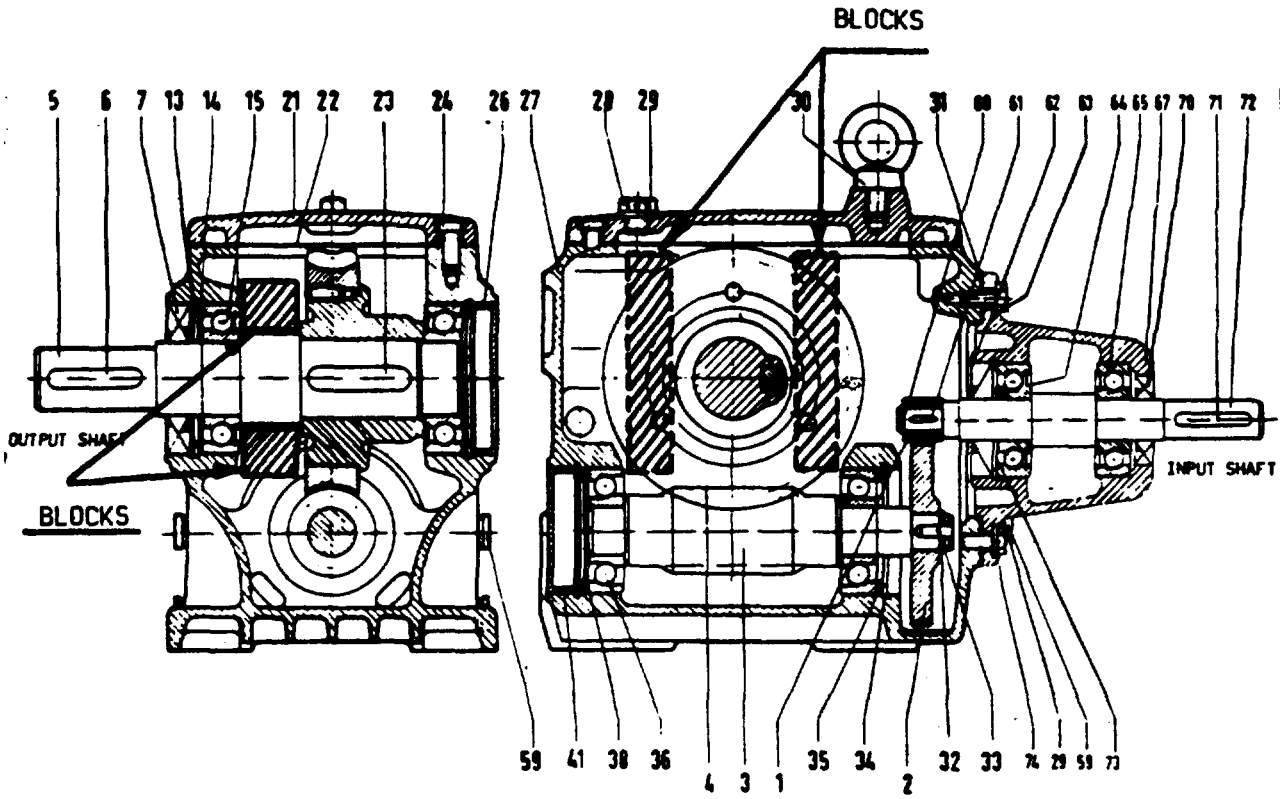
The Limitswitches are located under the black cover on the speedcontrol motor.
Adjusting Instructions
1. Check out the wiring in the Drive Motor and speed control motor Terminal Boxes.
2. Remove black cover
3. Run the Drive Motor "UP" to the maximum out put speed
4. Rotate the CAM for the top Limitswitch C.W. until it trips the Limitswitch. Tighten up the Locking Screw
5. Run the Drive Motor "DOWN" to the Min. out put speed.
6. Rotate the CAM for the bottom Limitswitch C.C.W. until it trips the Limitswitch
7. Adjust the potentiometer as follows: Turn the potentiometer C.W. until it runs against the stop (Variable Speed Unit must be at min. speed). Turn the potentiometer approx. 15° C.C.W. Between terminals 5 & 8 there must be a resistance of 120 OHMS
8. Tighten the coupling setscrews.

BELT SIZES USED ON VARIGEAR® UNITS

VARIGEAR FRAME SIZE	SPEED RANGE	PART BELT SIZE	NUMBER
VUO/VZO	1:5	17x8x570mm	010 961 4
	1:4	25x8x680mm	010 885 5
VU1/VZ1	1:6	25x8x655mm	010 878 2
	1:8	25x8x655mm	010 878 2
	1:4	32x10x820mm	010 908 8
VU2/VZ2	1:6	32x10x790mm	010 901 0
	1:8	32x10x790mm	010 901 0
	1:4	40x12x1040mm	010 928 2
VU3/VZ3	1:6	40x13x1000mm	010 922 3
	1:8	40x13x1000mm	010 922 3
	1:4	52x16x1180mm	010 940 1
VUA/VZ4	1:6	52x16x1180mm	010 940 1
	1:4	70x21x1445mm	010 963 0
VU5	1:6	70x21x1445mm	010 963 0
	1:4	75x23x1900mm	012 211 4
VU6	1:3	75x18x1980mm	012 212 2

CHANGE OF OUTPUT SHAFTS

S40 - S70
Combination Right Angle (Helical-Worm) Reducer

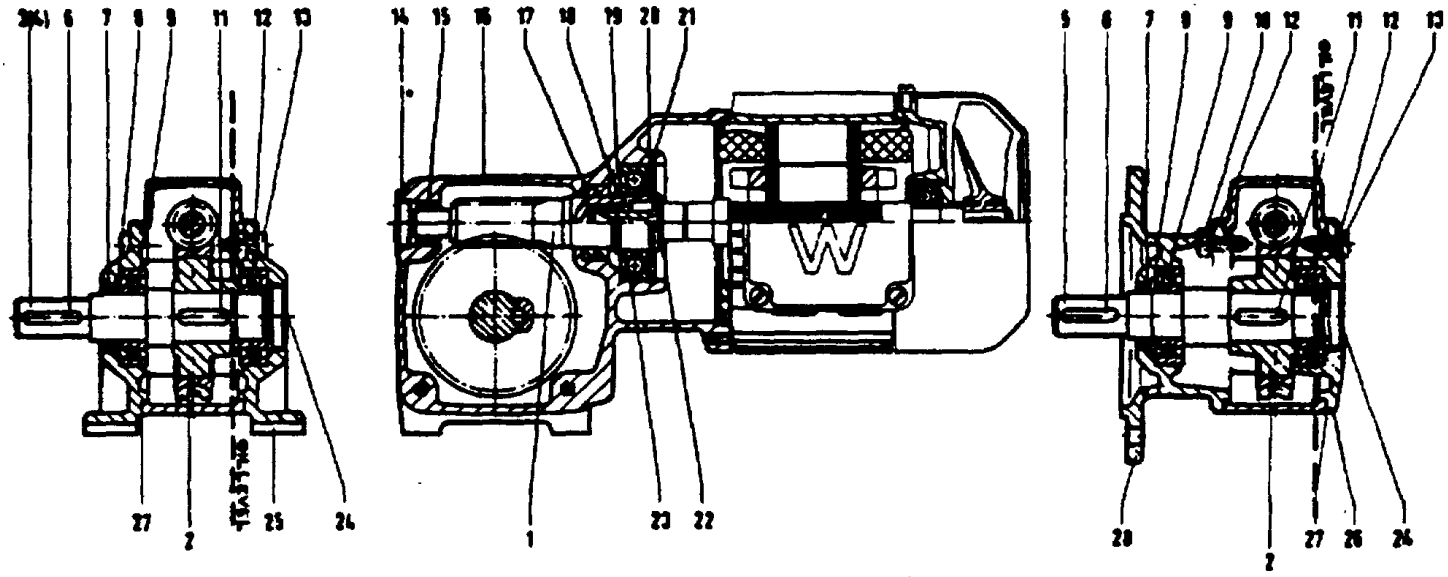


The following are instructions for changing an output shaft on S40-S70 helical worm gear reducers from B3A to B3B mounting or from B3B to B3A.

1. Remove oil drain plug and drain oil.
2. Remove 6 lid bolts #24 and lid #21.
3. Remove oil seal #7 and bearing cap #26. These items will be destroyed when removed. Be careful not to damage the shaft. Scratches on the seal surface causes oil leaks.
4. Remove snapring #13 from both ends of the shaft.
5. Turn the gearbox on its side so the output shaft is pointing downwards.
6. Support the bronze gear with blocks between the steel hub of the bronze gear and the gear housing. This is to make sure the bronze gear will not move from its position from the center of the worm. Not blocking the gear can result in breaking the gear housing.
7. Press out the shaft.
8. The shaft and the lower bearing will now come out. Remove the bronze wormwheel.
9. Take the top bearing out, install the bearing on the opposite side and secure the bearing with snapring #13. Make sure the shims are installed in front of the snapring (same as before).
10. Turn the bronze gear around 180°.
11. Press the shaft and bearing "in" from the top side of the gearbox. When the shaft is pressed "in" we have to make sure that the bronze gear is centered properly. Centering can be accomplished by shimming the shaft. Use the existing shims #14 to center the gear. A bronze gear is properly centered when the worm and wormgear can be rotated relatively easy.
12. Install snapring #13.
13. Install new oil seal #7 and bearing cap #26.
14. Install lid #21 and 6 bolts #24.
15. Install drain plug.
16. Fill gear unit with 140W oil and install breather plug.

NOTE: Item #7 and item #26 must be replaced because they will be damaged at disassembly!

OIL FILL INSTRUCTIONS
S30 DT71DT80
Right Angle (Worm) Gearmotor



Right Angle (Worm) Gearmotor

The S30 and SF30 gearmotors are filled by Eurodrive with a synthetic oil, Mobil Oil SHC 634.
The synthetic oil has an extremely long life at high and low temperatures (temp. range 170° to -5° F).
The oil does not have to be changed during the life of the gear reducer, unless the gear reducer components wear severely or the oil gets contaminated. The unit, therefore, does not have an oil fill plug or drain plug.
Oil Filling The units are filled by removing the indicated side of the reducer. Procedure:

1. Remove Bolt #13. (4 on one side)
2. Remove the section #25 or #26.

Note
The oil is filled to the level shown below (see dotted line).

When the unit has to be taken apart, drain the oil so it can be used again if necessary.
Under one (1) of the bolts #13, a copper washer can be found. It is important to install the washer again, in the proper place, to prevent oil leaks around the bolt.
When a synthetic oil cannot be obtained, a 140W gear oil can be used temporarily. The temperature range of the 140W gear oil is 104° F to 32° F.

C-FACE MOTOR ADAPTERS - TYPE "LP"

C-Face adapters are designed for standard AC motors and DC motors with similar weight. If a large DC motor has to be Installed on a C-face adapter the motor base must be adequately supported to remove the stress from the housing. Excessive stress can cause housing failure.
For additional information about the frame sizes recommended please refer to the Eurodrive Constant Speed Catalog.

SCOOP MOUNTS

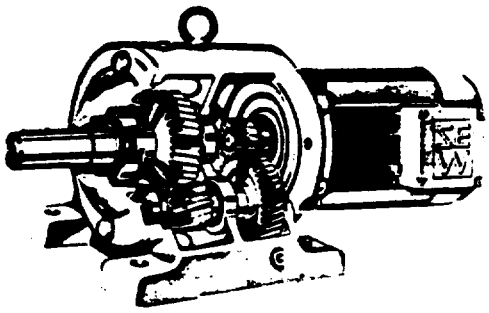
Maximum motor frame sizes recommended for scoops are listed in the Eurodrive Constant Speed Catalog. If a motor larger than recommended has to be Installed, support the scoop, this will prevent misalignments and premature failure of components.

SHAFT MOUNTED REDUCERS

MODELS KA, KAF, SA, SAF, FA, FAF.
For the above listed shaft mounted reducers, Eurodrive recommends:
The use of a light coating of NEVER-SEEZ (or equivalent) on the output shaft.
The NEVER-SEEZ lubricant may prevent a rusting and fretting corrosion between the hollow reducer shaft and the shaft of the driven machine. The lubricant will allow the shafts to be disassembled when necessary.

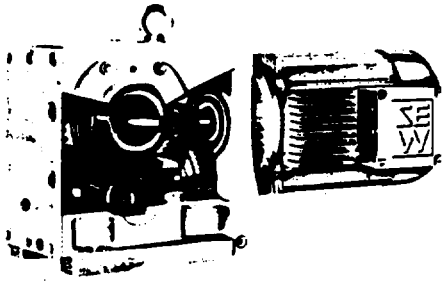
Parallel Gearmotors—(Helical)

Ratings	0.2 to 150 hp;
Speeds	0.5 to 860 rpm;
Torque	to 130,000 lb. in.,
Mtg.	Foot or flange
Service:	AGMA class III;
Features:	cast iron gearcase, ground helical gearing (60Rc);
Specialties:	Brake, agitator extensions, various motor enclosures, various electrical specifications.



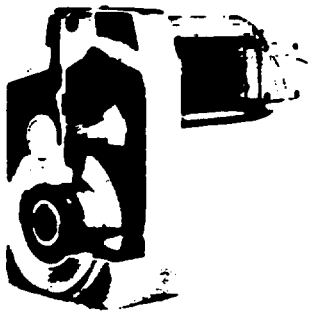
Helical—Bevel Gearmotors—

Ratings	0.75 to 350 hp;
Speeds	0.1 to 150 rpm;
Torque	3500 to 354 000 lb. in.,
Mtg.	Foot, flange, shaft mount;
Service:	AGMA class III;
Features:	cast iron gearcase, ground gearing (AGMA class 12);
Specialties:	Brake, various motor enclosures, various electrical specifications.



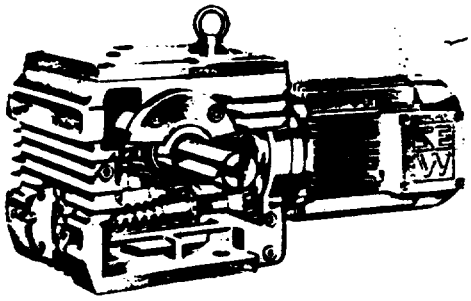
Shaft Mounted Helical Gearmotors
The Snuggler®

Ratings	0.2 to 60 hp
Speeds	0.1 to 150 rpm
Torque	to 53,100 lb. in.
Mtg.	Shaft type
Service	AGMA class III
Features	Smooth cast iron gearcase, ground gearing (AGMA class 12)
Specialties	Brake, various motor enclosures, various electrical specialties.



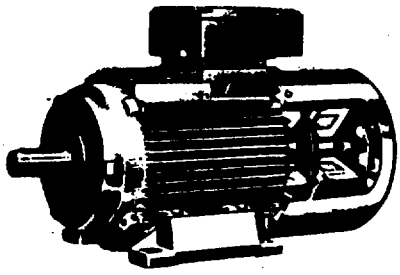
Combination Gearmotors—
(Right Angle-Helical)

Ratings	0.2 to 40 hp;
Speeds	0.1 to 145 rpm;
Torque	to 57000 lb. in.,
Mtg.	Foot, flange or shaft mount;
Service:	AGMA class III;
Features:	cast iron gearcase, ground worm gears (1 to 6 leads)
Specialties:	Brake, various motor enclosures, various electrical specifications.



Brake Motors / Brake Gearmotors

Ratings	0.2 to 60 hp;
Brake size	3.6 to 300 ft. lb;
Mounting	integral with motor;
Features:	enclosed housings. DC epoxy impregnated brake coil, adjustable retarding torque, automatic release.



DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.: 29-A

Quantity Required: 300 inches

Description: Levelwind chain

Manufacturer: Browning

Part Number: No. 60 (3/4 inch Pitch ANSI chain)

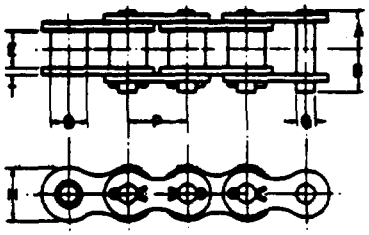
Source: Browning Manufacturing Division
Emerson Electric Co.
Maysville, Kentucky 41056

Tele #: 1-606-56402011
TELEX #: 21-8498

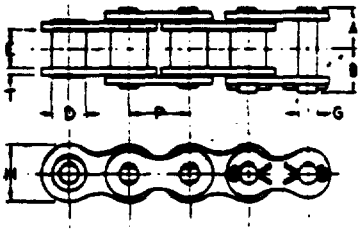
Browning Roller Chain

Single Strand—Riveted

Single Strand—Cottered



Roller Chain



LL Chain

Table No. 1

SINGLE STRAND CHAIN

Chain Pitch P	Chain No.	CHAIN: Average Tensile Strength Lbs.	CHAIN: Average Weight per Ft. Lbs.	DIMENSIONS: Connecting Links A	Connecting Links B	Rollers D	Rollers E	Pins G	Side Plates H	Side Plates T	STOCK PACKAGING: Standard Length†	Riveted Chain also available in Lengths Marked "R", Cottered Marked "C": 25'	50'	100'	250'	500'
								STANDARD								
• ¼"	25	925	.09	.150"	.150"	.130"	¼"	.0905"	.230"	.030"	10'	—	—	R	—	—
• ⅜	35	2,100	.23	.228	.296	.200	5/16	.141	.344	.050	10	—	R	R	—	R
• ½	41	2,000	.28	.260	.370	.306	¼	.141	.390	.060	10	—	R	R	R	R
• ½	40	3,700	.41	.314	.373	.312	5/16	.156	.468	.060	10	—	R	R	R	—
• ⅝	52	5,100	.66	.327	.408	.400	¼	.200	.571	.080	10	—	—	—	—	—
• ⅝	50	6,100	.69	.352	.445	.400	⅜	.200	.571	.080	10	—	R	R	—	—
• ¾	60	8,500	1.04	.493	.567	.468	½	.234	.679	.094	10	—	R, C	R, C	—	—
01	80	14,500	1.77	.843	.762	.625	½	.312	.908	.125	10	—	R, C	R	—	—
01 1¼	100	24,000	2.99	.770	.810	.750	⅝	.375	1.125	.156	10	—	R	—	—	R
01 1½	76	26,000	2.73	.820	.968	.750	¾	.375	1.094	.187	10	—	—	—	—	—
01 1½	120	34,000	4.06	.870	1.111	.875	1	.437	1.344	.187	10	—	R	—	—	—
01 1¾	140	46,000	5.10	1.046	1.204	1.000	1	.500	1.625	.219	10.2	—	—	—	—	—
02	160	58,000	6.85	1.246	1.422	1.125	1¼	.562	1.875	.250	10	—	—	—	—	—
02 1¼	180	80,000	9.40	1.391	1.687	1.406	1 13/32	.687	2.125	.281	10.125	—	—	—	—	—
02 1½	200	96,000	10.20	1.533	1.860	1.562	1⅜	.781	2.250	.312	10	—	—	—	—	—
03	240	130,000	16.80	1.886	2.187	1.875	1⅞	.937	2.800	.375	—	—	—	—	—	—

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

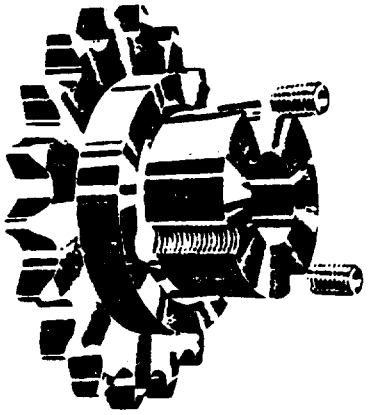
Reference Item No.:	29-B
Quantity Required:	One
Description:	Levelwind Drive Sprocket
Manufacturer:	Martin Sprocket & Gear
Part Number:	Sprocket.....60BTL28 Bushing.....2012 X 1 5/8
Source:	Martin Sprocket & Gear, Inc P. O. Box 888 Arlington, Texas 76010

Tele #: 1-(817)-467-5181

ALL STEEL STOCK SPROCKETS

3/4-INCH PITCH SINGLE WIDTH CHAIN

FOR A.S.A. No. 60

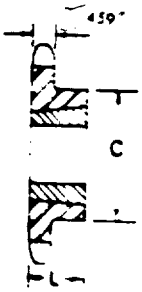


CHAIN TECHNICAL DATA

Pitch	¾"
Roller Width	½"
Roller Diameter	.469"
Inside Linkplate Height	.679"
Linkplate Thickness	.094"
Av. Tensile Strength, lbs.	8500

TAPER-LOCK® — SINGLE — STEEL

No. Teeth	Catalog Number	List Price Rim Only	List Price *Bushing Only	Bushing	Diameters Outside Diameter	Diameters Pitch Diameter	Max. Bore	Dimensions L	Dimensions C	Type	Weight (App.) Rim Only	Weight (App.) Bushing Only
11	60BTL11	SEE LPS-1	SEE LPS-1	1008	3.004	2.662	1	⅞	ϕ1 13/16	B	.7	.3
12	60BTL12			1008	3.249	2.898	1	⅞	1 15/16	B	.6	.3
13	60BTL13			1210	3.493	3.134	1¼	1	ϕ2 1/32	B	.9	.6
14	60BTL14			1210	3.736	3.371	1¼	1	2 1/32	B	1.0	.6
15	60BTL15			1610	3.979	3.607	1⅜	1	2 5/32	B	1.2	.9
16	60BTL16			1610	4.221	3.844	1⅜	1	3	B	1.6	.9
17	60BTL17			1610	4.462	4.082	1⅜	1	3¼	B	1.8	.9
18	60BTL18			1610	4.704	4.319	1⅜	1	3¼	B	2.0	.9
19	60BTL19			1610	4.945	4.557	1⅜	1	3¼	B	2.2	.9
20	60BTL20			2012	5.185	4.794	2	1¼	3 5/16	B	2.2	1.7
21	60BTL21			2012	5.426	5.032	2	1¼	3 5/16	B	2.3	1.7
22	60BTL22			2012	5.666	5.270	2	1¼	3 5/16	B	2.6	1.7
23	60BTL23			2012	5.907	5.508	2	1¼	3 5/16	B	2.8	1.7
24	60BTL24			2012	6.147	5.746	2	1¼	3 5/16	B	2.8	1.7
25	60BTL25			2012	6.387	5.984	2	1¼	3 5/16	B	3.0	1.7
26	60BTL26			2012	6.627	6.222	2	1¼	3 5/16	B	4.2	1.7
28	60BTL28			2012	7.107	6.699	2	1¼	3 5/16	B	4.5	1.7
30	60BTL30			2012	7.586	7.175	2	1¼	3 5/16	B	5.1	1.7
32	60BTL32			2012	8.065	7.652	2	1¼	3 5/16	B	5.6	1.7
35	60BTL35			2012	8.783	8.367	2	1¼	3 5/16	B	6.5	1.7
36	60BTL36			2012	9.022	8.605	2	1¼	3 5/16	B	6.6	1.7
40	60BTL40			2012	9.980	9.559	2	1¼	3 5/16	B	8.1	1.7
42	60BTL42			2012	10.458	10.036	2	1¼	3 5/16	B	10.0	1.7
45	60BTL45			2012	11.175	10.752	2	1¼	3 5/16	B	11.5	1.7
48	60BTL48			2012	11.893	11.467	2	1¼	3 5/16	B	13.3	1.7



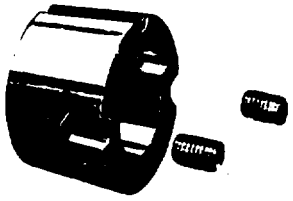
TYPE B

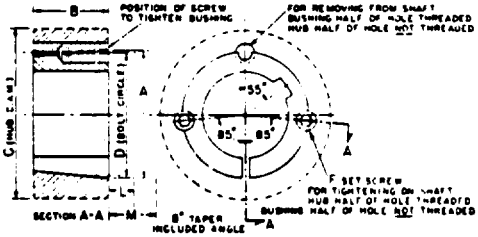
TAPER-LOCK® BUSHINGS

DIMENSIONS & PRICES

NO. 1008 TO 3030 TAPER-LOCK® BUSHINGS

Bush. No.	Bore	Price	Wt.	Bushing Keyseat	Shaft Keyseat
1008	½ to 9/16 5/8 to 7/8 15/16 to 1	SEE LPS-1	.27 .21 .16	1/8 x 1/16 3/16 x 3/32 1/4 x 1/16Δ	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8
1108	½ to 9/16 5/8 to 7/8 15/16 to 1 1 1/16 to 1 1/8		.33 .27 .22 .17	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 1/4 x 1/16Δ	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 1/4 x 1/8
1210	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4		.61 .55 .49	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8
1215	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4		.8 .7 .6	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8
1310	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4 1 5/16 to 1 3/8		.7 .7 .6 .6	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32
1610	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4 1 5/16 to 1 3/8 1 7/16 to 1 1/2 1 9/16 to 1 5/8		.9 .8 .7 .7 .6 .5	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 3/8 x 1/8Δ	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 3/8 x 3/16
1615	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4 1 5/16 to 1 3/8 1 7/16 to 1 1/2 1 9/16 to 1 5/8		1.2 1.1 1.0 .8 .7 .6	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 3/8 x 1/8Δ	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 3/8 x 3/16
2012	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4 1 5/16 to 1 3/8 1 7/16 to 1 3/4 1 15/16 to 1 7/8 1 15/16 to 2		1.7 1.6 1.5 1.4 1.2 1.0 1.0	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8Δ 5/16 x 5/32 3/8 x 3/16 1/2 x 1/4 1/2 x 3/16Δ	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 1/2 x 1/4 1/2 x 1/4
2517	½ to 9/16 5/8 to 7/8 15/16 to 1 1/4 1 5/16 to 1 3/8 1 7/16 to 1 3/4 1 15/16 to 2 1/4 2 5/16 to 2 1/2		3.5 3.4 3.3 3.2 3.0 2.4 1.9	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 1/2 x 1/4 5/8 x 3/16Δ	1/8 x 1/16 3/16 x 3/32 1/4 x 1/8 5/16 x 5/32 3/8 x 3/16 1/2 x 1/4 5/8 x 5/16





DIMENSIONS

Bushing No.	A	B	C Ø Class 20 Gray Iron	C Ø Class 30 Gray Iron	C Ø Steel	D	F †	L° Std. Hex. Key	L° Short Key ‡	M°° Std. Hex. Key	M°° Short Key ‡
1008	1.386	7/8	2 3/8	2 3/16	1 15/16	1 27/64	1/8 x 1/2	1 1/8	5/8	1 1/4	3/4
1108	1.511	7/8	2 1/2	2 5/16	2 1/16	1 29/64	1/4 x 1/2	1 1/8	5/8	1 1/4	3/4
1210	1 7/8	1	3 5/8	3 1/4	2 7/8	1 3/4	3/8 x 5/8	1 3/8	13/16	1 5/8	1 5/16
1215	1 7/8	1 1/2	3 1/8	2 7/8	2 5/8	1 3/4	3/8 x 5/8	1 3/8	13/16	1 5/8	1 5/16
1310	2	1	3 3/4	3 3/8	3	1 7/8	3/8 x 5/8	1 3/8	13/16	1 5/8	1 5/16
1610	2 1/8	1	4	3 5/8	3 1/4	2 1/8	3/8 x 5/8	1 3/8	13/16	1 5/8	1 5/16
1615	2 1/4	1 1/2	3 1/2	3 1/4	3	2 1/8	3/8 x 5/8	1 3/8	13/16	1 5/8	1 5/16
2012	2 3/4	1 1/4	4 3/4	4 3/8	3 7/8	2 5/8	7/16 x 7/8	1 9/16	15/16	2	1 3/8
2517	3 3/8	1 3/4	5 1/2	4 7/8	4 3/8	3 1/4	1/2 x 1	1 5/8	1	2 1/4	1 5/8
2525	3 3/8	2 1/2	4 3/4	4 1/2	4 1/4	3 1/4	1/2 x 1	1 5/8	1	2 1/4	1 5/8
3020	4 1/4	2	7	6 1/4	5 5/8	4	5/8 x 1 1/4	1 13/16	1 3/16	2 11/16	2 1/16
3030	4 1/4	3	6 1/4	5 3/4	5 3/8	4	5/8 x 1 1/4	1 13/16	1 3/16	2 11/16	2 1/16

Bushings cannot be bored larger than largest bore listed.

For detail dimensions required for machining hubs consult Martin.

Δ Key furnished for these sizes only.

Ø For general reference. Severe conditions may require larger hub. Heavy well located web may permit smaller hub. Hub diameter required depends on the particular application. Consult Martin giving full information on the proposed design. Hub diameters shown are based on 20,000, 30,000 and 50,000 P.S.I. minimum ultimate tensile strength respectively for Class 20 gray iron, Class 30 gray iron and steel hubs.

† 2 screws required. Use in positions shown for tightening bushing on shaft. In removing bushing from shaft remove screws and use one of them in other hole. Bushing price includes screws.

° Space required to tighten bushing. Also space required to loosen screws to permit removal of hub by puller.

°° Space required to loosen bushing using one screw as jackscrew—no puller required.

‡ Standard hex key cut to minimum usable length.

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

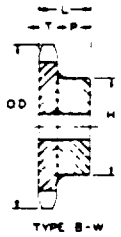
COMPONENT DESCRIPTION

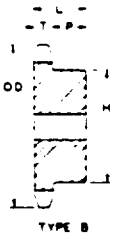
Reference Item No.:	29-C
Quantity Required:	One
Description:	Levelwind Idler Sprocket
Manufacturer:	Browning
Part Number:	60 B17 x 1
Source:	Browning Manufacturing Division Emerson Electric Co. Maysville, Kentucky 41056

Tele # : 1-606-564-2011
TELEX # : 21-8498

DECKMASTER

Browning Roller Chain Sprockets 60





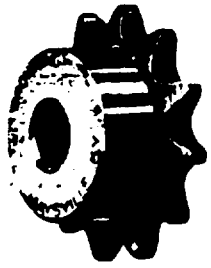


Table No. 1 **Steel Single Type "B" Minimum Bore Sprockets**

Part No.	DIAMETERS Outside	DIAMETERS Pitch	No. Teeth	Type	BORE Stock	BORE Max.*	DIMENSIONS T	DIMENSIONS L Max.	DIMENSIONS P	DIMENSIONS H	Wt. Lbs.
60B8	2.26"	1.960"	8	B	⅝"	1 3/16"	.459"	1¼"	2 5/32"	1 11/32"†	.5
60B9	2.50	2.193	9	B	⅜	1	.459	1¼	2 5/32	1 11/16†	.6
60B10	2.76	2.427	10	B	⅜	1¼	.459	1¼	2 5/32	1 11/16†	.9
60B11	2.96	2.662	11	B	⅜	1¼	.459	1¼	2 5/32	2†	1.0
60B12	3.25	2.898	12	B	⅜	1 5/16	.459	1¼	2 5/32	2⅛	1.3
60B13	3.45	3.134	13	B	⅜	1½	.459	1¼	2 5/32	2⅜	1.7
60B14	3.74	3.371	14	B	⅜	1⅝	.459	1¼	2 5/32	2½	2.0
60B15	3.98	3.607	15	B	⅜	1 11/16	.459	1¼	2 5/32	2¾	2.4
60B16	4.22	3.844	16	B	⅜	1⅞	.459	1¼	2 5/32	2 11/32	2.8
60B17	4.46	4.082	17	B	⅜	2⅛	.459	1¼	1 5/16	3 3/32	3.2
60B18	4.70	4.319	18	B-W	⅜	2¼	.459	1¼	1 5/16	3	3.9
60B19	4.95	4.557	19	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	4.2
60B20	5.19	4.794	20	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	4.6
60B21	5.43	5.032	21	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	4.7
60B22	5.67	5.270	22	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	4.9
60B23	5.91	5.508	23	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	5.1
60B24	6.15	5.746	24	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	5.4
60B25	6.39	5.984	25	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	5.6
60B26	6.63	6.222	26	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	6.0
60B27	6.87	6.460	27	B-W	⅜	2¼	.459	1¼	1 5/16	3¼	6.3
60B28	7.11	6.699	28	B-W	⅜	2¼	.459	1½	1 5/16	3½	7.1
60B29	7.35	6.937	29	B-W	⅜	2¼	.459	1½	1 5/16	3½	7.2
60B30	7.59	7.175	30	B-W	⅜	2¼	.459	1½	1 5/16	3½	7.8
60B31	7.83	7.413	31	B-W	⅜	2¼	.459	1½	1 5/16	3½	8.0
60B32	8.07	7.652	32	B-W	1	2¼	.459	1½	1 5/16	3¾	8.6
60B33	8.30	7.890	33	B-W	1	2¼	.459	1½	1 5/16	3¾	9.1
60B34	8.54	8.129	34	B-W	1	2¼	.459	1½	1 5/16	3¾	9.6
60B35	8.78	8.367	35	B-W	1	2¼	.459	1½	1 5/16	3¾	9.9
60B36	9.02	8.605	36	B-W	1	2¼	.459	1½	1 5/16	3¾	10.2
60B37a	9.26	8.844	37	B-W	1	2¼	.459	1½	1 5/16	3¾	10.8
60B38	9.50	9.082	38	B-W	1	2¼	.459	1½	1 5/16	4	11.2
60B39a	9.74	9.321	39	B-W	1	2¼	.459	1½	1 5/16	4	12.0
60B40	9.98	9.559	40	B-W	1	2¼	.459	1½	1 5/16	4	12.1
60B41a	10.22	9.798	41	B-W	1	2¼	.459	1½	1 5/16	4	12.3
60B42	10.46	10.036	42	B-W	1	2¼	.459	1½	1 5/16	4	13.7
60B43a	10.70	10.275	43	B-W	1	2¼	.459	1½	1 5/16	4	14.1
60B44	10.94	10.513	44	B-W	1	2¼	.459	1½	1 5/16	4	14.4
60B45	11.18	10.752	45	B-W	1	2¼	.459	1½	1 5/16	4	14.5
60B46a	11.42	10.990	46	B-W	1	2¼	.459	1½	1 5/16	4	15.8
60B47a	11.65	11.229	47	B-W	1	2¼	.459	1½	1 5/16	4	15.8
60B48	11.89	11.467	48	B-W	1	2¼	.459	1½	1 5/16	4	16.1
60B49a	12.13	11.706	49	B-W	1	2¼	.459	1½	1 5/16	4	17.4
60B50	12.37	11.945	50	B-W	1	2¼	.459	1½	1 5/16	4	17.5
60B51a	12.61	12.183	51	B-W	1	2¼	.459	1½	1 5/16	4	18.6
60B52a	12.85	12.422	52	B-W	1	2¼	.459	1½	1 5/16	4	19.2
60B53a	13.09	12.660	53	B-W	1	2¼	.459	1½	1 5/16	4	19.8
60B54	13.33	12.899	54	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	22.0
60B55a	13.57	13.137	55	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	23.5
60B56a	13.81	13.376	56	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	23.6
60B57a	14.04	13.615	57	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	24.8
60B58a	14.28	13.385	58	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	25.4
60B59a	14.52	14.092	59	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	26.1
60B60	14.76	14.331	60	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	26.3
60B62a	15.24	14.808	62	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	28.2
60B63a	15.48	15.046	63	B-W	1	2⅜	.459	1¾	1 5/16	4⅜	28.9
60B64	15.72	15.285	64	B-W	1	2⅜	.459	1¾	1 5/32	4⅜	29.0
60B65	15.96	15.524	65	B-W	1	2⅜	.459	1¾	1 5/32	4⅜	29.1
60B67a	16.43	16.001	67	B-W	1	2⅜	.459	1¾	1 5/32	4⅜	31.9
60B68	16.67	16.240	68	B-W	1	2⅜	.459	1¾	1 5/32	4⅜	32.1
60B70	17.15	16.717	70	B-W	1	2⅜	.459	1⅞	1 11/32	4⅜	32.7
60B72	17.63	17.194	72	B-W	1	2⅜	.459	1⅞	1 11/32	4⅜	36.5
60B76	18.58	18.149	76	B-W	1	2¾	.459	1⅞	1 11/32	4¾	39.0
60B80	19.54	19.103	80	B-W	1	2¾	.459	1⅞	1 11/32	4¾	43.0
60B84	20.49	20.058	84	B-W	1	2¾	.459	2⅛	1 21/32	4¾	47.5
60B90	21.93	21.490	90	B-W	1	2¾	.459	2⅛	1 21/32	6	53.5
60B95a	23.12	22.683	95	B-W	1	2¾	.459	2⅛	1 21/32	6	66.4
60B96	23.36	22.922	96	B-W	1	2¾	.459	2⅛	1 21/32	6	69.0
60B102a	24.79	24.354	102	B-W	1	2¾	.459	2⅛	1 21/32	6	73.4
60B112	27.18	26.742	112	B-W	1	2¾	.459	2⅛	1 21/32	6	79.0
60B120a	29.09	28.651	120	B-W	1	2¾	.459	2⅛	1 21/32	6	96.8

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

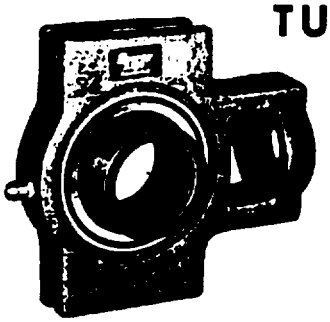
COMPONENT DESCRIPTION

Reference Item No.:	29-D
Quantity Required:	Two
Description:	Levelwind Drive Tightener
Manufacturer:	Hub City
Part Number:	3T200BC, TU250X1
Source:	Hub City P. O. Box 1089 Aberdeen, South Dakota 57401

Tele # : (605) 225-0360
TELEX # : 29-2236

DECKMASTER

TU250—RELUBE TYPE UNITS



Malleable Housings

Self-Aligning Bearings with Setscrew Locking

¼"-28 N.F. Fitting

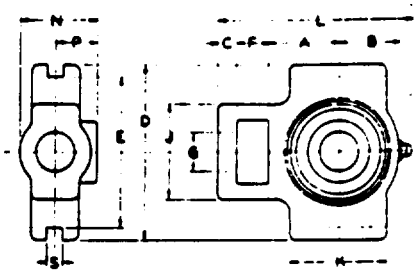
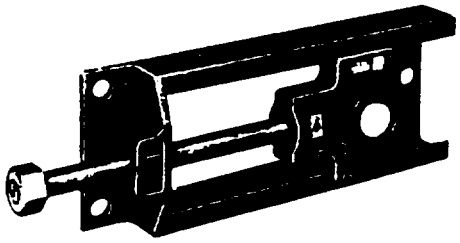


Table No. 1 — **Specifications**

STOCK BORES Basic	STOCK BORES Other	Use with Frame No. ★	DIMENSIONS A	B	C	D	E	F	G	J	K	L	N	P	Se	Wt. Lbs.
½"	5/8"	1T200A	1 1/16"	1 3/64"	3/8"	3"	2 1/2"	1/2"	3/8"	1 3/16"	1 1/2"	2 3/8"	1 5/16"	.625"	5/16"	1.1
¾	—	3— 9T200BC	1 5/16	1 1/8	3/8	3 1/2	3	5/8	3/4	1 7/8	1 3/4	3 13/16	1 11/32	.717	5/16	1.6
1	13/16", 7/8", 15/16"	3— 9T200BC	1 3/8	1 1/4	3/8	3 1/2	3	5/8	3/4	1 7/8	1 15/16	4	1 25/64	.779	5/16	1.8
1 1/16	1 1/16, 1 1/8	3—12T200DE	1 1/2	1 19/32	1/2	4	3 1/2	3/4	1/8	2 1/8	2 5/16	4 19/32	1 13/32	.873	5/16	2.5
1 1/16	1 1/4, 1 5/16, 1 3/8	3—12T200DE	1 11/16	1 21/32	1/2	4	3 1/2	3/4	1/8	2 1/8	2 1/8	5	1 29/32	.998	5/16	2.9
1 1/2	1 9/16	3—18T200FH	1 7/8	1 7/8	5/8	4 1/2	4	3/4	1 1/8	2 5/8	2 13/16	5 1/2	2 3/32	1.186	5/16	4.3
1 11/16	1 5/8, 1 3/4	3—18T200FH	2 1/16	2	5/8	4 1/2	4	3/4	1 1/8	2 5/8	3 1/16	5 13/16	2 3/32	1.186	5/16	4.6
1 15/16	1 7/8	3—18T200FH	2 1/16	2 1/8	5/8	4 1/2	4	3/4	1 1/8	2 5/8	3 5/16	6 1/16	2 5/16	1.278	5/16	4.6
2 1/16	2, 2 1/8	9—18T200JK	2 5/8	2 11/32	3/4	5 1/8	5 1/8	1	1 3/8	3 1/4	4 1/16	7 13/32	2 5/8	1.310	5/16	8.1
2 1/16	2 1/4, 2 3/8	9—18T200JK	2 11/16	2 19/32	3/4	5 1/8	5 1/8	1	1 3/8	3 1/4	4 1/16	7 13/32	2 5/8	1.360	5/16	8.9

Part Numbers are specified by "TU250" and bore size. Example: "TU250—1½".
★Take-Up Frames shown in Table No. 2, below.
▲Take-Up Units with wider slots are shown on Page H-19.
For Load Ratings, See Page H-24.

T200 SIDE MOUNTING FRAMES



Welded Steel Construction with Cadmium Plated Adjusting Screws

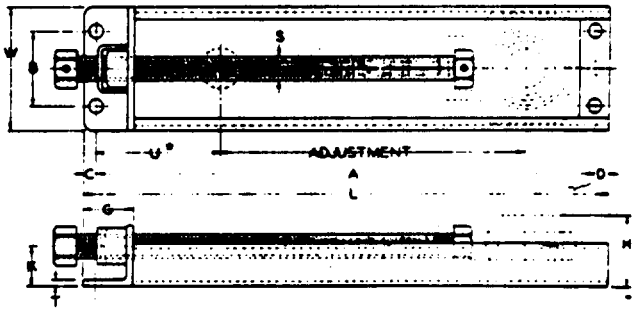


Table No. 2 — **Specifications**

Part Number	BORE RANGE For "200" Series Unit	BORE RANGE For "300" Series Unit	Adjustment	DIMENSIONS L	W	A	B	C	D	G	H Max.	K	S	T	Bolt Holes No.	Bolt Holes Size	Wt. Lbs.
1T200A	½"— 15/16"	—	1½"	6 3/16"	3 1/16"	5 3/16"	2 1/16"	½"	½"	1½"	2 15/64"	1 3/16"	½"	¼"	3	9/16"	2.2
3T200BC	¾ —1	—	3	8½	4 3/16	7½	3 5/16	½	½	1½	2 15/64	1 3/16	5/8	½	3	9/16	3.6
6T200BC	¾ —1	—	6	11½	4 3/16	10½	3 5/16	½	½	1½	2 15/64	1 3/16	5/8	½	3	9/16	4.4
9T200BC	¾ —1	—	9	14½	4 3/16	13½	3 5/16	½	½	1½	2 15/64	1 3/16	5/8	¼	3	9/16	5.3
3T200DE	1 1/16—1 7/16	—	3	9 3/16	4 11/16	8 3/16	3 11/16	½	½	1½	2 17/32	1 3/16	3/4	½	3	9/16	4.3
6T200DE	1 1/16—1 7/16	—	6	12 3/16	4 11/16	11 3/16	3 11/16	½	½	1½	2 17/32	1 3/16	3/4	½	3	9/16	5.3
9T200DE	1 1/16—1 7/16	—	9	15 3/16	4 11/16	14 3/16	3 11/16	½	½	1½	2 17/32	1 3/16	3/4	½	3	9/16	6.3
12T200DE	1 1/16—1 7/16	—	12	18 3/16	4 11/16	17 3/16	3 11/16	½	½	1½	2 17/32	1 3/16	3/4	¼	3	9/16	7.4
3T200FH	1½ —1 15/16	1 7/16"—1 3/4"	3	11	5 1/16	9 3/16	3 1/16	½	1/16	2	2 15/16	1 3/16	1	½	4	9/16	6.3
6T200FH	1½ —1 15/16	1 7/16 —1 3/4	6	14	5 1/16	12 3/16	3 1/16	½	3/16	2	2 15/16	1 3/16	1	½	4	9/16	7.5
9T200FH	1½ —1 15/16	1 7/16 —1 3/4	9	17	5 1/16	15 3/16	3 1/16	½	3/16	2	2 15/16	1 3/16	1	½	4	9/16	9.1
12T200FH	1½ —1 15/16	1 7/16 —1 3/4	12	20	5 1/16	18 3/16	3 1/16	½	3/16	2	2 15/16	1 3/16	1	½	4	9/16	10.5
18T200FH	1½ —1 15/16	1 7/16 —1 3/4	18	26	5 1/16	24 3/16	3 1/16	½	3/16	2	2 15/16	1 3/16	1	¼	4	9/16	13.2
9T200JK	2 —2 7/16	1 15/16—2 5/16	9	18 1/4	6 3/16	16 3/16	4 1/16	3/16	3/16	2	3 3/16	1 3/16	1 1/4	5/16	4	11/16	13.9
12T200JK	2 —2 7/16	1 15/16—2 5/16	12	21 1/4	6 3/16	19 3/16	4 1/16	3/16	3/16	2	3 3/16	1 3/16	1 1/4	5/16	4	11/16	15.8
18T200JK	2 —2 7/16	1 15/16—2 5/16	18	27 1/4	6 3/16	25 3/16	4 1/16	3/16	3/16	2	3 3/16	1 3/16	1 1/4	5/16	4	11/16	19.8

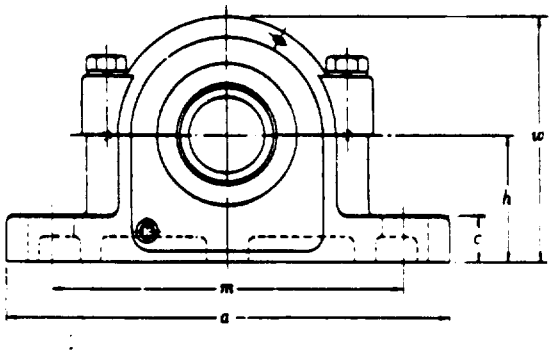
These Take-Up Frames are used with TU200, TU220 and TU250 Take-Up Units shown on pages H-20 and H-21 and with TU350 Take-Up Units shown on page H-28.
*NOTE—"U" may have more than one value, depending on the take-up unit and frame combination used, therefore determine "U" from frame dimensions "G" minus "C" plus take-up unit dimensions "A", "C" and "F".

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	30-A
Quantity Required:	One
Description:	Winch Drum / Small Shaft Bearing
Manufacturer:	NTN
Part Number:	SAF 22528
Source:	NTN Bearing Corp. of America 31E Oakton Street Des Plaines, Illinois 60018

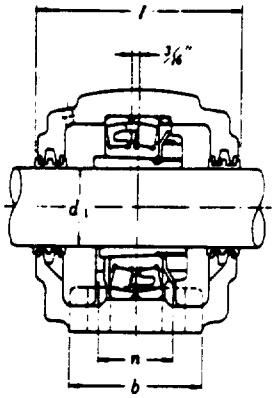
Tele # : 1-312-298-7500
TELEX # : 282-586



SAFS PILLOW BLOCKS

Shaft Diameter d_1 in.	Complete Pillow Block No.	Pillow Block Components No.					
		Pillow Block Housing No.	Bearing		Adapter Locknut and Lockwasher	Triple Seal Ring (2 required)	Stabilizing Ring (1 required)
			Bearing No.	Basic Dynamic Load Rating C lbs.			
1 7/16	SAFS22509	SAFS509	22209CKD1	16100	SNW09	LER17	SR 85X6
1 1/2	SAFS22510	SAFS510	22210CKD1	16800	SNW10	LER20	SR 90X6.5
1 15/16	SAFS22511	SAFS511	22211BKD1	18300	SNW11	LER24	SR100X6
2 3/16	SAFS22513	SAFS513	22213BKD1	28000	SNW13	LER29	SR120X8
2 7/16	SAFS22515	SAFS515	22215BKD1	32500	SNW15	LER37	SR130X10
2 1/2	SAFS22516	SAFS516	22216BKD1	35000	SNW16	LER44	SR140X10
2 15/16	SAFS22517	SAFS517	22217BKD1	42000	SNW17	LER53	SR150X10
3 3/16	SAFS22518	SAFS518	22218BKD1	50000	SNW18	LER69	SR160X10
3 7/16	SAFS22520	SAFS520	22220BKD1	62500	SNW20	LER75	SR180X10
3 15/16	SAFS22522	SAFS522	22222BKD1	80500	SNW22	LER93	SR200X10
4 3/16	SAFS22524	SAFS524	22224BKD1	95000	SNW24	LER113	SR215X10
4 7/16	SAFS22526	SAFS526	22226BKD1	111000	SNW26	LER117	SR230X10
4 15/16	SAFS22528	SAFS528	22228BKD1	133000	SNW28	LER122	SR250X10
5 3/16	SAFS22530	SAFS530	22230BKD1	151000	SNW30	LER125	SR270X10
5 7/16	SAFS22532	SAFS532	22232BKD1	170000	SNW32	LER130	SR290X10
5 15/16	SAFS22534	SAFS534	22234BKD1	196000	SNW34	LER140	SR310X10
6 3/16	SAFS22536	SAFS536	22236BK	203000	SNW36	LER148	SR320X10
6 15/16	SAFS22538	SAFS538	22238BK	226000	SNW38	LER224	SR340X10
7 3/16	SAFS22540	SAFS540	22240BK	256000	SNW40	LER228	SR360X10
7 15/16	SAFS22544	SAFS544	22244BK	305000	SNW44	LER236	SR400X10

DECKMASTER



SAFS22500

HOW TO ORDER

Example: No.1: When you order one SAFS22520, you will receive a package containing one SAFS520 Pillow Block Housing, One No.22220BKD1 Bearing and one SNW 20 Adapter.

Example No.2: When you order one SAFS22220, you will receive a package containing one SAFS220 Pillow Block Housing, one No.22220BKD1 Bearing, one No.AN20A Locknut and one No.W20 Lockwasher.

For both of the above examples:

All units are supplied with two Triple Seal Rings and a Stabilizing Ring. If you specify SAFS22520M3, the required end cover will be included. Always specify shaft size.

1) A pillow block housing number includes one housing and two triple seal rings automatically. Suffix G on a pillow block housing number means one stabilizing ring is included additionally.

NTN

SERIES
SAFS225
SAFS222

SAFS PILLOW BLOCKS

Complete Pillow Block No.	Nominal Dimensions (Inch)									Set Bolts		Approx. Wt. in lbs. Comp.
					Max.	Min.						
	h	a	b	c	m	m	n	u	l	Size	Number	
SAFS22509	2 1/4	8 1/4	2 3/8	7/8	7	6 1/4	—	4 1/16	3 5/8	1/2	2	11.6
SAFS22510	2 1/2	8 1/4	2 3/8	1	7	6 1/2	—	4 13/16	4	1/2	2	12.7
SAFS22511	2 3/4	9 5/8	2 3/4	1	7 7/8	7 3/8	—	5 5/16	4 1/4	5/8	2	14.9
SAFS22513	3	11	3 1/8	1	9 1/2	8 1/8	—	5 15/16	5	5/8	2	23
SAFS22515	3 1/4	11 1/4	3 1/8	1 3/16	9 5/8	8 5/8	—	6 3/8	5 1/4	5/8	2	26
SAFS22516	3 1/2	13	3 1/4	1 1/4	11	9 5/8	—	6 15/16	5 3/8	3/4	2	41
SAFS22517	3 3/4	13	3 1/4	1 1/4	11	9 7/8	—	7 3/8	5 3/8	3/4	2	44
SAFS22518	4	13 3/4	3 1/4	1 5/16	11 5/8	10 3/4	—	7 13/16	6 1/4	3/4	2	54
SAFS22520	4 1/2	15 1/4	4 3/8	1 1/2	13 1/8	11 1/4	—	8 1/4	6 3/4	7/8	2	72
SAFS22522	4 15/16	16 1/2	4 3/4	1 5/8	14 1/2	12 5/8	2 3/4	9 11/16	7 1/4	3/4	4	89
SAFS22524	5 1/4	16 1/2	4 3/4	1 3/4	14 1/2	13 1/4	2 3/4	10 1/4	7 3/8	3/4	4	103
SAFS22526	6	18 3/8	5 1/4	1 7/8	16	14 5/8	3 1/4	11 5/16	8	7/8	4	151
SAFS22528	6	20 1/8	5 7/8	1 15/16	17 1/8	16	3 3/8	12	7 5/8	1	4	175
SAFS22530	6 9/16	21 1/4	6 1/4	2	18 1/4	17	3 3/4	12 11/16	8 3/8	1	4	208
SAFS22532	6 11/16	22	6 1/4	2	19 1/4	17 7/8	3 3/4	13 5/16	8 3/4	1	4	248
SAFS22534	7 1/16	24 3/4	6 3/4	2 1/8	21 1/8	19 3/8	4 1/4	14 5/16	9 1/4	1	4	330
SAFS22536	7 1/4	26 3/4	7 1/4	2 1/4	23 5/8	20 7/8	4 5/8	15 5/16	10	1	4	383
SAFS22538	7 7/8	28	7 1/4	2 3/4	24 3/8	21 1/4	4 1/4	16 3/16	10 5/8	1 1/4	4	413
SAFS22540	8 1/4	29 1/4	8	2 3/8	25	22 1/8	5	17 3/16	11 1/8	1 1/4	4	490
SAFS22544	9 1/4	32 3/4	8 3/4	2 3/4	27 7/8	24 3/4	5 1/4	19 1/16	11 7/8	1 1/2	4	

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	30-B
Quantity Required:	One
Description:	Winch Drum / Large Shaft Bearing
Manufacturer:	Miether
Part Number:	23048K/W33
Source:	Miether Machine Works, Inc. Bearing Products Division 8700 West County Road Odessa, Texas 79762

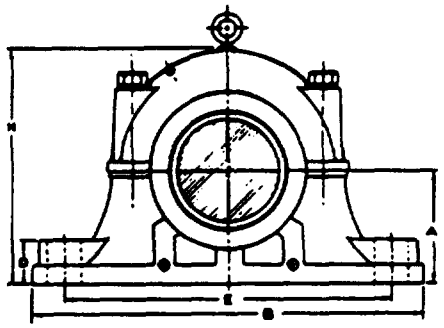
Tele #: 1-915-366-8811

DECKMASTER

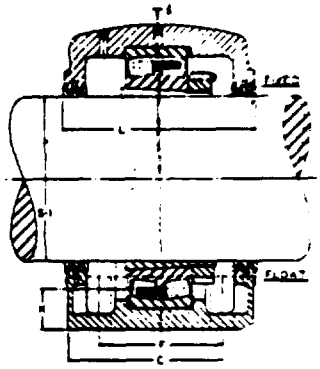
MIETHER

SAF 230-K
SDAF 230-K

Spherical Roller bearing pillow block ● adapter mounting



Note: Fixed bearing is offset 3/16" in relation to Housing centerline.



SAF 230 K

PILLOW BLOCK PART NUMBERS

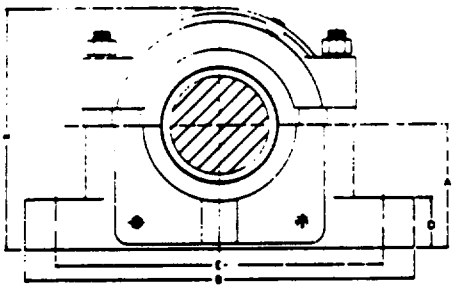
Shaft Diameter	Complete Pillow Block Number	Pillow Block Housing Only	Bearing Number	Adapter Locknut and Lockwasher or Lockplate	Triple Seal Ring (2 Req.)	Stabilizing Ring (No. Req.)
*4	SAF 23024 K/4	SAF 024 K/4	23024 K	SNW 3024/4	LER 113	(1) SR-20-17
*4	SAF 23026 K/4	SAF 026 K/4	23026 K	SNW 3026/4	LER 117	(1) SR-22-19
*4	SAF 23028 K/4	SAF 028 K/4	23028 K	SNW 3028/4	LER 122	(1) SR- 0-20
*5	SAF 23030 K/5	SAF 030 K/5	23030 K	SNW 3030/5	LER 125	(1) SR- 0-21
5	SAF 23032 K/5	SAF 032 K/5	23032 K	SNW 3032/5	LER 130	(1) SR- 0-22
5	SAF 23034 K/5	SAF 034 K/5	23034 K	SNW 3034/5	LER 140	(1) SR- 0-24
6	SAF 23036 K/6	SAF 036 K/6	23036 K	SNW 3036/6	LER 148	(1) SR- 0-26
6	SAF 23038 K/6	SAF 038 K/6	23038 K	SNW 3038/6	LER 155	(1) SR-32- 0
7	SAF 23040 K/7	SAF 040 K/7	23040 K	SNW 3040/7	LER 159	(1) SR-34- 0
7	SAF 23044 K/7	SAF 044 K/7	23044 K	SNW 3044/7	LER 167	(1) SR-38-32
8	SAF 23048 K/8	SAF 048 K/8	23048 K	SNP 3048/8	LER 526	(2) A 8697
8½	SAF 23048 K/8½	SAF 048 K/8½	23048 K	SNP 3048/8½	LER 527	(2) A 8697
8	SAF 23048 K/8	SAF 048 K/8	23048 K	SNP 3048	LER 529	(2) A 8697
➤9	SAF 23048 K/9	SAF 048 K/9	23048 K	SNP 3048/9	LER 530	(2) A 8697
9	SAF 23052 K/9	SAF 052 K/9	23052 K	SNP 3052	LER 178-1	(2) A 8698
9½	SAF 23052 K/9½	SAF 052 K/9½	23052 K	SNP 3052/9½	LER 178	(2) A 8698
9	SAF 23056 K/9	SAF 056 K/9	23056 K	SNP 3056/9	ER 751	(2) A 8819
10	SAF 23056 K/10	SAF 056 K/10	23056 K	SNP 3056/10	ER 705	(2) A 8819
10	SAF 23056 K/10	SAF 056 K/10	23056 K	SNP 3056	ER 745	(2) A 8819
10½	SAF 23056 K/10½	SAF 056 K/10½	23056 K	SNP 3056/10½	ER 710	(2) A 88'

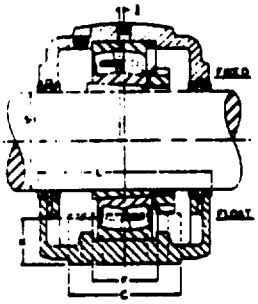
DECKMASTER

MIETHER

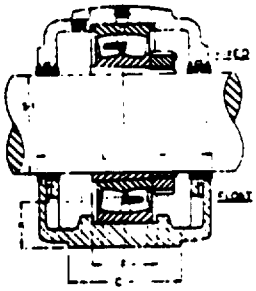
Spherical Roller bearing pillow block ● adapter mounting

SAF 230-K
SDAF 230-K





SAF 23024-K — 23044-K
NOTE: Fixed bearing is offset 3/16" in relation to housing centerline.

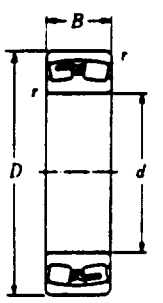


SAF 23048-K — 23064-K
NOTE: Fixed bearing is centered in housing; two stabilizing rings required.

SAF 230 K

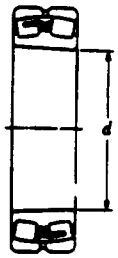
PILLOW BLOCK DIMENSIONS

A in.	B in.	C in.	D in.	F Max. in.	F Min. in.	P in.	R in.	S Bolt Clearance in.	L in.	Bolts (No. Req'd) Size in.	Approx. Weight Lbs. Complete	Complete Pillow Block Number
4½	15¼	4¼	1¾	13¼	11⅝	2¾	8¾	1¾	6	(4)— ¾	60	SAF 23024 K 4
4¾	16½	4¾	2	14½	12⅝	2¾	9⅝	1⅞	6½	(4)— ¾	76	SAF 23026 K 4
5¼	16½	4¾	2⅛	14½	13¼	2¾	10¼	1⅞	7⅜	(4)— ¾	90	SAF 23028 K 4
6	18⅜	5⅛	2⅜	16	14⅝	3⅛	11⅝	2⅛	8	(4)— ⅞	125	SAF 23030 K/5
6	18⅜	5⅛	2⅜	16	14⅝	3¼	11⅝	2¼	8	(4)— ⅞	132	SAF 23032 K/5
6	20⅛	5⅞	2⅝	17⅛	16	3⅜	11¾	2⅛	7⅝	(4)—1	154	SAF 23034 K/5
6½	22	6¼	2⅝	19¼	17⅜	3⅜	13½	2⅜	8⅜	(4)—1	212	SAF 23036 K/6
6½	22	6¼	2⅝	19¼	17⅜	3¾	13½	2⅜	8⅜	(4)—1	220	SAF 23038 K/6
7½	24¾	6¾	2¾	21⅛	19⅛	4¼	14⅜	2⅜	9⅜	(4)—1	295	SAF 23040 K/7
7⅛	28	7½	3⅛	24⅜	21⅝	4½	15⅞	2⅝	10⅜	(4)—1¼	370	SAF 23044 K/7
8¼	29½	8	3⅜	25	22½	5	16½	2¼	11⅛	(4)—1¼	430	SAF 23048 K/8
8¼	29½	8	3⅜	25	22½	5	16½	2¼	11⅛	(4)—1¼	428	SAF 23048 K/8½
8¼	29½	8	3⅜	25	22½	5	16½	2¼	11⅛	(4)—1¼	422	SAF 23048 K/8
➤8¼	29½	8	3⅜	25	22½	5	16½	2¼	11⅛	(4)—1¼	420	SAF 23048 K/9
9½	32¾	8¾	3¾	27⅛	24¾	5¼	18½	2½	11⅞	(4)—1½	587	SAF 23052 K/9
9½	32¾	8¾	3¾	27⅛	24¾	5¼	18½	2½	11⅞	(4)—1½	585	SAF 23052 K/9½
9⅞	34¼	9	4	29½	26¼	5½	20⅛	2½	12⅛	(4)—1½	640	SAF 23056 K/9
9⅞	34¼	9	4	29½	26¼	5½	20⅛	2½	12⅛	(4)—1½	635	SAF 23056 K/10
9⅞	34¼	9	4	29½	26¼	5½	20⅛	2½	12⅛	(4)—1½	625	SAF 23056 K/10
9⅞	34¼	9	4	29½	26¼	5½	20⅛	2½	12⅛	(4)—1½	620	SAF 23056 K/10½



Cylindrical bore
230
Bore No. = 22

Cylindrical bore
230
Bore No. ≥ 24



Tapered bore
230K
Taper 1:12

NTN
SERIES
230

In this series the machined brass cages are also available. When placing an order for them, put the suffix L1 on the bearing number.
Example: 23024BL1D1

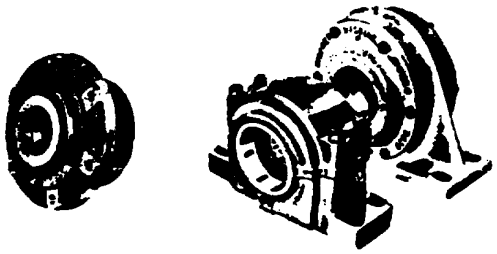
SPHERICAL ROLLER BEARINGS

Bearing 1) No.		d		D		B		G 2)		Basic Load Ratings lbs.	
230	230K	mm	in.	mm	in.	mm	in.	mm	in.	Dynamic C	Static C_0
23022B	—	110	4.3307	170	6.6929	45	1.7717	3	.118	— —	55000	63500
23024BD1	23024BKD1	120	4.7244	180	7.0866	46	1.8110	3	.118	8 .31	58000	68500
23026BD1	23026BKD1	130	5.1181	200	7.8740	52	2.0472	3	.118	8 .31	73500	86000
23028BD1	23028BKD1	140	5.5118	210	8.2677	53	2.0866	3	.118	8 .31	78500	96000
23030BD1	23030BKD1	150	5.9055	225	8.8583	56	2.2047	3.5	.138	8 .31	87000	107000
23032BD1	23032BKD1	160	6.2992	240	9.4488	60	2.3622	3.5	.138	8 .31	99000	122000
23034BD1	23034BKD1	170	6.6929	260	10.2362	67	2.6378	3.5	.138	10 .39	123000	150000
23036BD1	23036BKD1	180	7.0866	280	11.0236	74	2.9134	3.5	.138	10 .39	144000	180000
23038BD1	23038BKD1	190	7.4803	290	11.4173	75	2.9528	3.5	.138	10 .39	148000	187000
23040BD1	23040BKD1	200	7.8740	310	12.2047	82	3.2283	3.5	.138	10 .39	176000	225000
23044B	23044BK	220	8.6614	340	12.3858	90	3.5433	4	.157	12 .47	207000	266000
23048B	23048BK	240	9.4488	360	14.1732	92	3.6220	4	.157	12 .47	222000	297000
23052B	23052BK	260	10.2362	400	15.7480	104	4.0945	5	.197	12 .47	277000	365000
23056B	23056BK	280	11.0236	420	16.5354	106	4.1732	5	.197	12 .47	296000	405000
23060B	23060BK	300	11.8110	460	18.1102	118	4.6457	5	.197	12 .47	370000	495000

MM

MIETHER

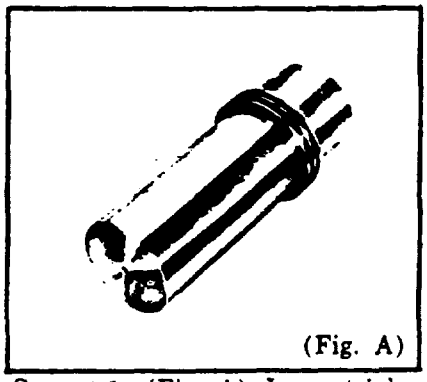
ASSEMBLY, LUBRICATION & MAINTENANCE



PILLOW BLOCKS
FLANGE CARTRIDGES

ASSEMBLY INSTRUCTIONS FOR SPHERICAL ROLLER BEARING (ADAPTER MOUNTING)

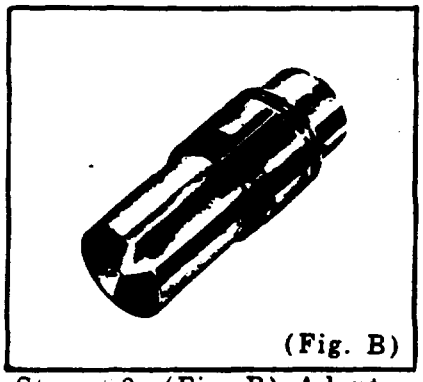
Note: Leave bearing in protective wrapping until you are ready to install it on the shaft . . . do not remove slushing compound, it protects the bearing and will mix with any lubricant you choose.



(Fig. A)

Step #1. (Fig. A) Inner triple seal

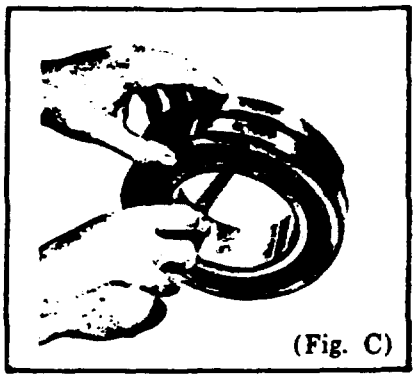
Slide inner triple seal onto shaft. This seal slides freely into position.



(Fig. B)

Step #2. (Fig. B) Adapter Sleeve

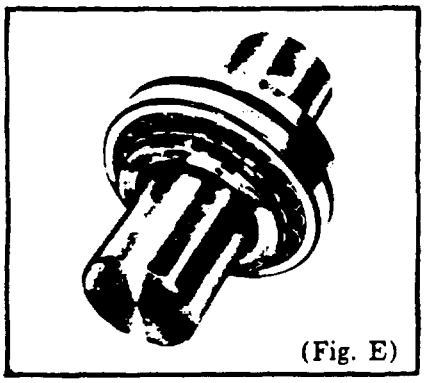
Slide adapter sleeve onto shaft with threads to outside. Locate sleeve where bearing centerline will be. Bearing will be easier to mount and remove if you put micronized or powdered (not flaked) graphite on outer diameter of sleeve.



(Fig. C)

Step #3. (Fig. C) Unmounted clearance

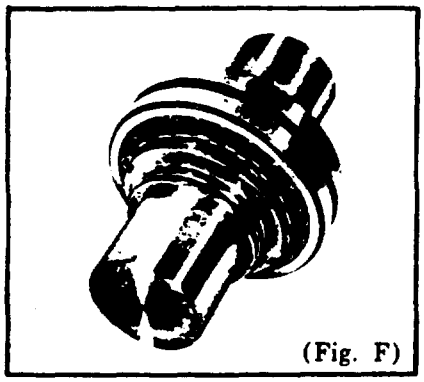
Before you put bearing on shaft determine unmounted internal clearance. Insert progressively larger feeler blades full length of roller between most vertical unloaded roller and outer bearing ring. Slide feeler blade through . . . . do not roll it. Record measurement of largest size blade that slides through. This is the unmounted internal clearance.



(Fig. E)

Step #6. (Fig. E) Locknut and Lockwasher

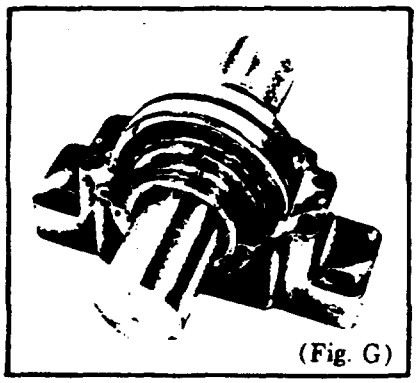
Remove locknut. Mount lockwasher on adapter sleeve with inner prong of lockwasher toward face of bearing and in slot of adapter sleeve. Re-apply locknut until tight. Do not drive bearing farther up adapter sleeve . . . . check to see that clearance has not changed (Refer to Table 1, page 5). Find lockwasher tang nearest a locknut slot. If slot is slightly past tang, don't loosen nut, tighten to meet a washer tang.



(Fig. F)

Step #7. (Fig. F) Outer triple seal

Slide outer triple seal onto shaft. Locate both inner triple seal and outer triple seal to match labyrinths in base section of housing.

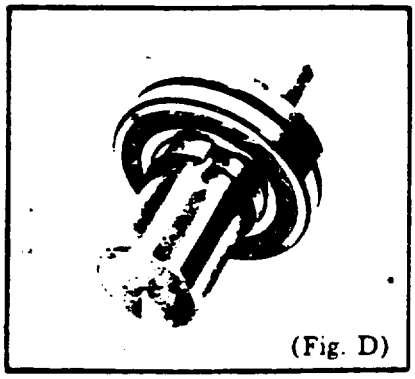


(Fig. G)

Step #8. (Fig. G) Lower half of housing

Remove any paint or burrs from the mating surfaces at the split and thoroughly clean housing. The vertical hole in the lower part of each enclosure groove must be free of any foreign matter for proper lubrication. Set lower half of housing in place and oil bearing seat. Place shaft with bearing into lower half of housing while carefully guiding triple seal rings on the shaft into enclosure grooves. Bolt fixed housing in place.

ASSEMBLY INSTRUCTIONS FOR SPHERICAL ROLLER BEARING (ADAPTER MOUNTING)

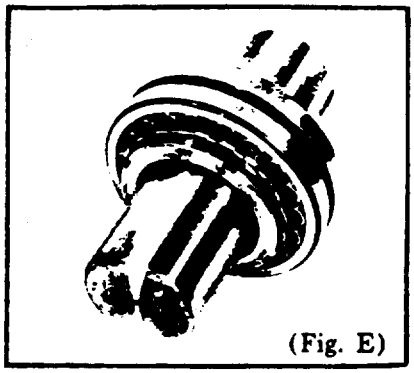


(Fig. D)

Step #4. (Fig. D) Bearing

Mount bearing on adapter sleeve, starting with large bore of inner ring to match taper of adapter. With bearing hand-tight on adapter, locate bearing to proper axial position on the shaft.

Leave lockwasher off until you have finished the next step.



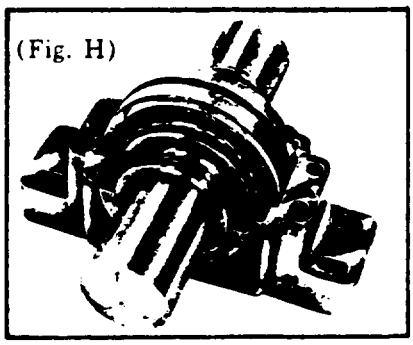
(Fig. E)

Step #5. (Fig. E) Locknut

Put locknut on with chamfered face toward bearing. A coating of graphite on face of locknut where it contacts bearing will make mounting easier.

Large size bearings will require a heavy-duty spanner wrench and extension to obtain required reduction in internal clearance.

Do not attempt to tighten locknut with hammer and drift . . . locknut will be damaged and chips can enter bearing. Tighten locknut and measure internal clearance with feeler blades between most vertical unloaded roller and outer ring until clearance is less than the figure measured in Step #3 above. Refer to tabulation on page 5 Table 1 to determine proper amount of reduction in internal clearance.



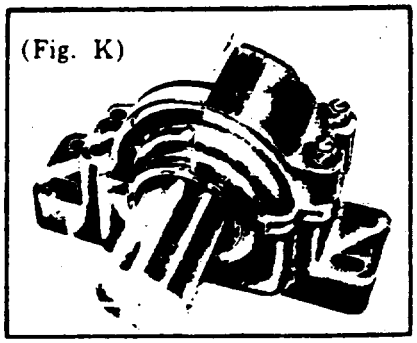
(Fig. H)

Step #9. (Fig. H) Stabilizing Ring

Move shaft axially so that stabilizing ring may be inserted between "Fixed" Bearing outer ring and housing shoulder on locknut side of bearing. Center all other bearings on one shaft in their housing seats.

Please note: There must be only one "Fixed" bearing per shaft. Other bearing(s) must be free to permit shaft expansion.

If the pillow block is to have one closed end, an end plug is supplied which fits snugly into triple seal groove. It is inserted in lower half of housing before upper half is bolted to base. If grease is used as a lubricant it should be applied to the bearing (See Lubrication notes . . . Page 6 & 7).



(Fig. K)

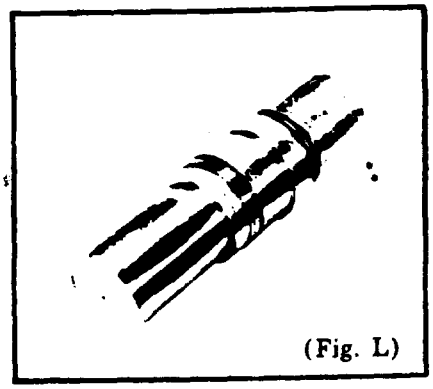
Step #10. (Fig. K) Cutaway illustration

Here a section of the housing has been removed to show you the position of all the parts . . . check before you put on cap to see that all parts are in their correct positions.

The bearing seat in the upper half of the housing (cap) should be deburred, thoroughly cleaned, oiled and placed over bearing. A sealing compound such as Permatex 2 may be used between the mating surfaces of the cap and base to eliminate lubricant leakage. The two dowel pins will align upper half of housing.

Please note: Caps and bases of pillow blocks are not interchangeable . . . each cap and base must be assembled with its mating part.

Lockwashers and capbolts are then applied and tightened to complete the assembly.



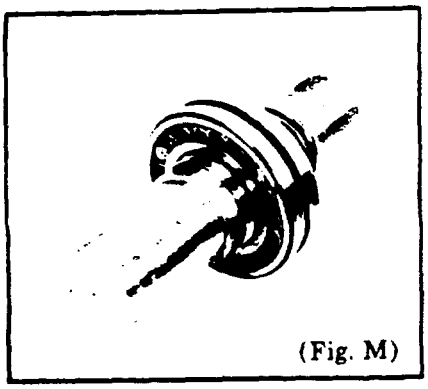
(Fig. L)

Step #1. (Fig. L) Inner triple seal—Cylindrical bore

Slide inner triple seal onto shaft. This seal slides freely into position.

Step #2. Press small bearing onto shaft.

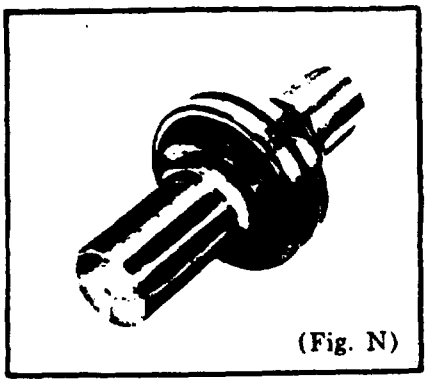
To press small bearings onto a shaft, fit clean pipe over shaft and rest it on inner bearing race. Before pressure is applied to bearing apply a coat of light oil or micronized graphite to the shaft and bearing bore. Be sure bearing is square on shaft and then apply pressure with an arbor press.



(Fig. M)

Step #3. (Fig. M) Bearing with cylindrical bore

To mount larger bearings that are not easily pressed onto a shaft, heat bearing in clean oil to a maximum of 200° F for approximately 15 minutes. Be sure to place supports under bearing to isolate it from bottom of container and prevent overheating the bearing. Mount bearing on shaft firmly against shaft shoulder. Quickly follow through with steps #4 and #5 to prevent bearing's drawing away from its proper position against shaft shoulder.



(Fig. N)

Step #4. (Fig. N) Lockwasher

Mount lockwasher over threads on shaft with inner prong of lockwasher toward face of bearing and in slot in shaft.

Step #5. (Fig. N) Locknut on shaft

Apply locknut with the chamfered face toward the bearing. Tighten with spanner wrench until bearing firmly seated against shaft shoulder. Bend one of the lockwasher tangs into a slot in locknut. If slot is slightly past tang, don't loosen nut, tighten to meet a tang.

To complete the mounting proceed with Steps 7 through 10 as for Adapter mountings.

ASSEMBLY INSTRUCTIONS FOR ONE-PIECE BLOCKS WITH SELF-ALIGNING SPHERICAL ROLLER BEARINGS

Note: Leave bearing in package until ready to assemble. Gather all necessary parts and tools before starting. Clean all parts except bearing. Leave slushing compound on bearing (it will mix with any lubricant you choose). Remove shipping plugs and install lubrication fittings in pillow block.

Step #1: Check shaft for nicks and burrs, correct if necessary and apply a light coat of machine oil. Clean threads of adapter and locknut with stiff brush and apply light coat of lubricant.

Step #2: Bench check unmounted internal clearance of bearing (See Page 5, Table 1).

Step #3: Slide inboard end cap and housing body on shaft if space permits; if not, slide inboard end cap on shaft. Mount bearing on adapter with small bore end next to adapter thread. Place lockwasher (used with small bearings only) against bearing with inner prong of lockwasher toward bearing and slot of adapter.

Step #4: Screw locknut on adapter until it contacts the bearing. Do not tighten beyond contact. Slide adapter and bearing, with locknut outboard, onto shaft and locate to correct position on shaft. Tighten locknut on adapter. For large locknuts use a heavy duty spanner wrench and extension. Check bearing internal clearance at intervals during tightening until correct amount of clearance remains (see Engineering section, page 5, Table 1). Peen one tang of lockwasher into one slot of the locknut. On larger bearings: bolt lockplate with tab in adapter slot to face of locknut. Lockwire heads of capscrews.

Step #5: Slide housing body over bearing assembly. Slide outboard end cap onto shaft. Bolt inboard and outboard end caps to housing body.

On closed end pillow blocks the shaft should not extend more than 1/8" beyond bearing locknut to avoid rubbing against end cap.

Use only one fixed bearing per shaft.

Bearing may be lubricated with either grease or oil bath. Bearing cavity should be approximately one-half full of grease or filled to the center line of the lowest rollers when oil bath is used. Pillow blocks can also be supplied for air-oil mist or circulating oil. Cylindrical Mount. Follow same procedures as for adapter mount.

FEATURES OF THE SOLID HOUSING PILLOW BLOCKS

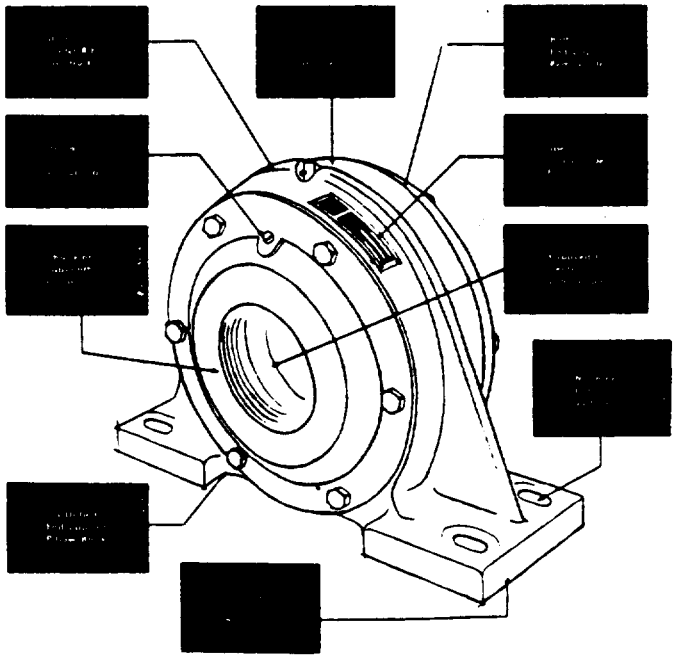


TABLE 1. Recommendation for Driving a Spherical Roller Bearing on a Tapered Seat

Bearing Bore mm		Decrease in Internal Clearance Inches	Bearing Bore mm		Decrease in Internal Clearance Inches
Over	Incl		Over	Incl	
40	65	.0010	250	315	.005
65	100	.0015	315	355	.006
100	120	.0020	355	400	.007
120	140	.0025	400	500	.008
140	180	.0030	500	560	.009
180	200	.0035	560	630	.010
200	225	.0040	630	710	.012
225	250	.0045	710	800	.013
			800	900	.014

Note: The axial displacement of the bearing is approximately 15 times the clearance decrease.

TABLE 2.
Shaft Tolerance Limits for Pillow Block Mountings

Nominal Diameter Inches		Diameter Tolerance Limits Inches	
Over	Including	S-1	S-2 & S-3
½	1	+.000 —.002	+.000 —.002
1	2	+.000 —.003	+.000 —.003
2	4	+.000 —.004	+.000 —.004
4	6	+.000 —.005	+.000 —.005
6	10	+.000 —.006	−.000 —.006
10	15	+.000 —.006	−.000 —.006
15 UP		+.000 —.006	+.000 —.006

LUBRICATION DATA

The selection of the proper type of lubricant and lubrication system for spherical roller bearing pillow blocks is based on a combination of several factors depending on operating temperature, speed and design conveniences.

GREASE LUBRICATION

Since the simplest design that will accomplish the job is usually the best design, thought should first be given to the possibility of grease lubrication. Here the factors to be considered are:

1. Operating temperature should be below 200°F.
2. Load and speed should be within the limits shown in the "Load-Capacity" tables.
3. Correct type and grade of grease should be used.
4. Correct quantity of grease should be applied.

Excess grease in a pillow block may result in high induced temperatures; therefore the quantity of grease should be kept at approximately 1/3 to 1/2 of the free air space. A regreasing schedule based on operating conditions should be drawn up and adhered to. For general purpose applications a grade #2 sodium or lithium soap grease, will provide good service. Because of the variety of oils, bases and additives used in present day greases, it is not good practice to mix greases of different types and makes Where contamination or other operating conditions are severe the Miether Engineering Department should be consulted.

OIL LUBRICATION

Although oil lubrication will allow roller bearings to run at speeds and temperatures higher than those permissible with grease, is is essential that the following points be observed:

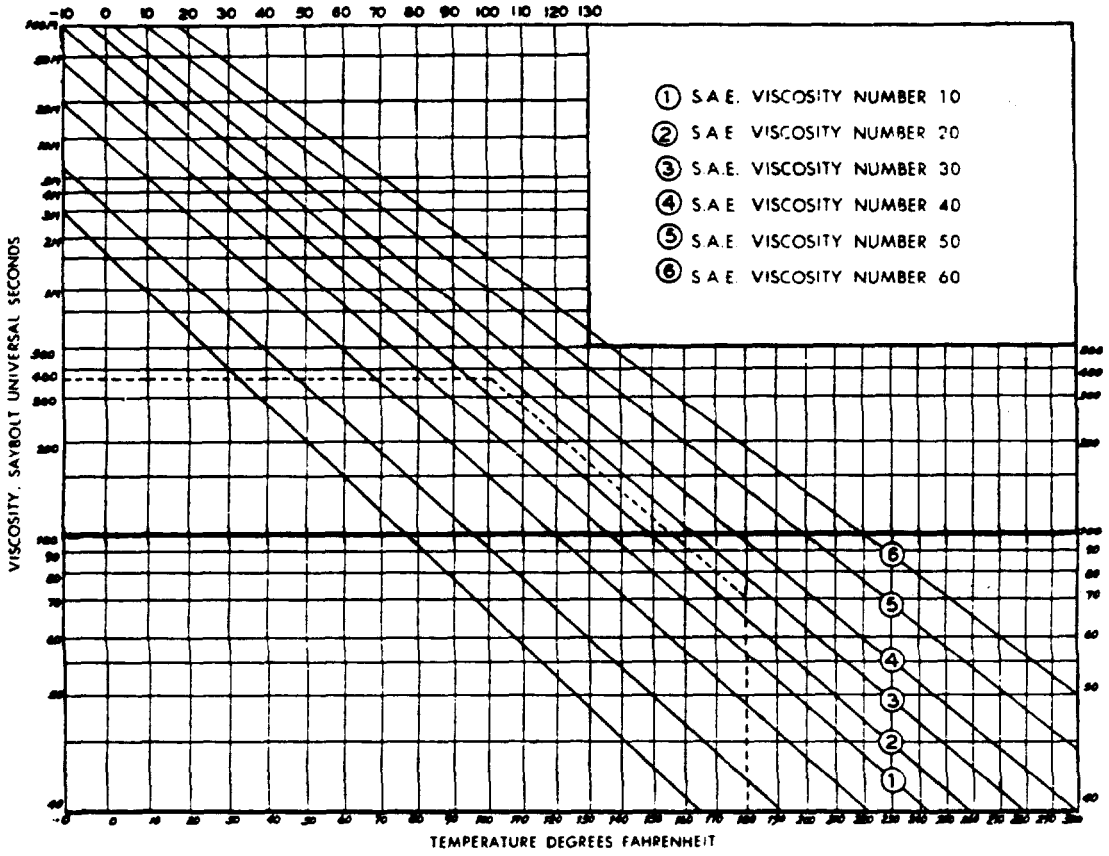
1. Only high quality petroleum oil should be used.
2. The oil should have a minimum viscosity of 100 SUS at the operating temperature.
3. The correct quantity must be applied.

Petroleum oils of poor quality. animal oils and vegetal)!e oils tend to oxidize easily and form sludge deposits on the hearing parts. In order to provide an oil film of the correct shear strength an oil with a minimum viscosity of 100 SUS at the operating temperature should be used. As the viscosity falls below this level the bearing life will be reduced. For example, a bearing running in a fluid with a viscosity of 25 SUS may be expected to have a life equal to 1 % of calculated life.

The quantity of oil used in roller bearings is quite critical. Too much oil will result in churning and excess heat. Too little oil will not coat the load surfaces adequately and will result in early failures. Where a splash system is used the oil level should be maintained at the mid-point of the lowest roller when the bearing is stationary. Drop feed systems and mist systems should be adjusted on a flow versus operating temperature basis.

The Oil Selection chart on back page may be used as a guide in selecting the proper oil viscosity. Find the operating temperature on the bottom scale then go up vertically to or past the gray line until it intersects one of the slanted lines. For example, at 170° F we would have to go past the heavy gray line to find the first intersecting slanted line to be number "4". Number "4" is SAE 40 oil.

The limiting speed for grease and splash oil are shown in the "Load Rating and Limiting Speed" charts. If a circulating oil system is used, a limiting speed of 150% of the grease limits is used. These limiting speeds are conservative and can be increased with experience on the specific application.



CLEANING DATA

You may have to clean bearings when they have been removed from their positions, during overhaul of equipment or to remove accumulated dirt of deteriorated lubricants.

To clean unmounted bearings use a clean petroleum solvent or kerosene. You may soak the bearings in a hot light oil (200° F max) or if you have extremely oxidized greases you may boil in an emulsifying cleaner. If compressed air is used be sure it is clean . . . do not allow the bearing to spin : during blowing. After all solvents have been removed coat bearing with petroleum and reinstall in the pillow block or wrap in clean oil-proof paper while awaiting reassembly.

To clean mounted hearings flush a hot, light oil (180 to 200°) through the housing while rotating the shaft slowly. A hot aqueous emulsion may be used as a flush. When the bearing is clean remove all solvents and flush housing and bearing with a hot light oil. Relubricate with the recommended lubricant.

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

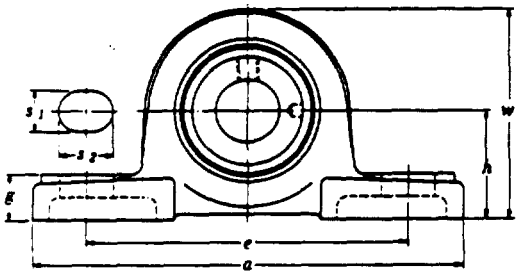
COMPONENT DESCRIPTION

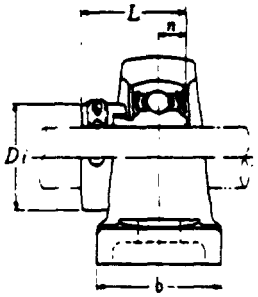
Reference Item No.:	30-D
Quantity Required:	ten
Description:	Levelwind roller bearings
Manufacturer:	NTN
Part Number:	AELPL-205-100
Source:	NTN Bearing Corp. of America 31E Oakton Street Des Plaines, Illinois 60018

Tele # : 1-312-298-7500
TELEX # : 282-586

NTN
SERIES
AELPL

ECCENTRIC LOCKING COLLAR TYPE





PILLOW BLOCKS CAST HOUSING (LOW CENTER HEIGHT)

Shaft Dia. in.	Complete [1] Pillow Block No.	Nominal Dimensions (Inch) h	a	e	b	s_1	s_2	g	w	Di	L	n	Bearing No.	Basic Load Rating lbs. Dynamic C	Housing No.
1/4	AELPL 201-008	1 1/16	4 3/4	3 1/2	1 3/4	7/16	9/16	1/4	2 1/4	1.14	1.126	.256	AEL 201-008	1660	PL201
9/16 5/8	AELPL 202-009 AELPL 202-010	1 1/16	4 3/4	3 1/2	1 3/4	7/16	9/16	1/4	2 1/4	1.14	1.126	.256	AEL 202-009 AEL 202-010	1660	PL201
11/16	AELPL 203-011	1 1/16	4 3/4	3 1/2	1 3/4	7/16	9/16	1/4	2 1/4	1.14	1.126	.256	AEL 203-011	1660	
3/4	AELPL 204-012	1 1/4	5	3 3/4	1 1/2	1/4	5/8	9/16	2 17/32	1.31	1.219	.295	AEL 204-012	2220	
13/16 7/8 15/16 ➤1	AELPL 205-013 AELPL 205-014 AELPL 205-015 AELPL 205-100	1 5/16	5 1/4	4 1/4	1 1/4	1/4	5/8	15/32	2 11/16	1.50	1.219	.295	AEL 205-013 AEL 205-014 AEL 205-015 AEL 205-100	2430	PL205
1 1/16 1 1/4 1 5/16 1 3/8	AELPL 206-101 AELPL 206-102 AELPL 206-103 AELPL 206-104	1 5/16	6 1/4	4 3/4	1 1/4	21/32	25/32	21/32	3 5/32	1.75	1.406	.354	AEL 206-101 AEL 206-102 AEL 206-103 AEL 206-104	3350	PL206

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

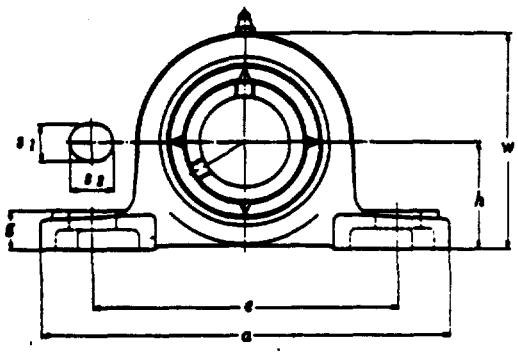
COMPONENT DESCRIPTION

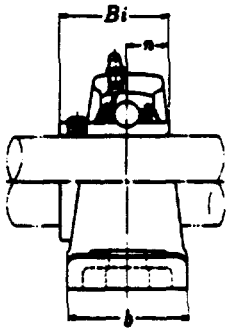
Reference Item No.:	30-L
Quantity Required:	Two
Description:	Winch Roller Shaft Bearing
Manufacturer:	NTN
Part Number:	UCP 207-107T
Source:	NTN Bearing Corp. of America 31E Oakton Street Des Plaines, Illinois 60018

Tele # : 1-312-298-7500
TELEX # : 282-586

NTN
SERIES
UCP2

SET SCREW TYPE





PILLOW BLOCKS CAST HOUSING

Shaft Dia. in.	Complete Pillow Block No.	Nominal Dimensions (inch)										Bearing No.	Basic Load Rating lbs. Dynamic C	Housing No.
		h	a	e	b	s_1	s_2	g	w	Bi	n			
1/2	UCP 201-008T	1 3/16	5	3 3/4	1 1/4	1/4	5/8	5/16	2 1/16	1.220	.500	UC 201-008D1	2220	P203T
9/16 5/8	UCP 202-009T UCP 202-010T	1 3/16	5	3 3/4	1 1/4	1/4	5/8	5/16	2 1/16	1.220	.500	UC 202-009D1 UC 202-010D1	2220	P203T
11/16	UCP 203-011T	1 3/16	5	3 3/4	1 1/4	1/4	5/8	5/16	2 1/16	1.220	.500	UC 203-011D1	2220	P203T
3/4	UCP 204-012T	1 3/16	5	3 3/4	1 1/4	1/4	5/8	5/16	2 1/16	1.220	.500	UC 204-012D1	2220	P204T
13/16 7/8 15/16 1	UCP 205-013T UCP 205-014T UCP 205-015T UCP 205-100T	1 7/16	5 1/4	4 1/4	1 1/4	1/4	3/4	13/32	2 11/32	1.339	.563	UC 205-013D1 UC 205-014D1 UC 205-015D1 UC 205-100D1	2430	P205T
1 1/16 1 1/8 1 3/16 1 1/4	UCP 206-101T UCP 206-012T UCP 206-103T ☆UCP 206-104T	1 11/16	6 1/4	4 3/4	1 1/4	21/32	25/32	21/32	3 5/32	1.500	.626	UC 206-101D1 UC 206-102D1 UC 206-103D1 UC 206-104D1	3350	P206T
1 1/4 1 5/16 1 3/8 1 7/16	UCP 207-104T UCP 207-105T UCP 207-106T ☆UCP 207-107T	1 7/8	6 5/16	5	1 1/4	21/32	25/32	25/32	3 11/32	1.689	.689	UC 207-104D1 UC 207-105D1 UC 207-106D1 UC 207-107D1	4450	P207T

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	31-A
Quantity Required:	One
Description:	Swivel Joint
Manufacturer:	Parker Hannifin Corporation
Part Number:	4 inch Style 20 - Flg x Flg Swivel
Source:	Parker Hannifin Corporation Hose Accessories Division 35 Cotters Lane East Brunswick, New Jersey 08816

Tele # : 1-201-238-4450
TELEX # : 844451

ANDREWS FABRICATED SWIVEL JOINTS

The Andrews' 2100 Series Swivel Joints are designed to give the maximum in swivel joint service. All bodies and sleeves are manufactured from a special grade of carbon steel with flame-hardened dual raceways. Each swivel joint is packed with three "V"-Rings which are spring loaded, affording a leak-proof gland at either high or low pressure. If the swivels are to be used for vacuum service, please specify direction to insure proper installation of packing assembly. All Andrews' Swivels are fabricated with short radius forged elbows. Flanges conform to 150# A.S.A. standard drilling. This series is also supplied with female threads, or beveled for welding. Any combination of the above fitting may be specified to meet customer requirements. An "O"-Ring dust seal is used to protect ball races and seal chamber from all outside elements. The precision machined design assures perfect alignment and years of trouble-free service.

The Andrews' 2300 Series Swivel Joints offer the above features in type 316 stainless steel.

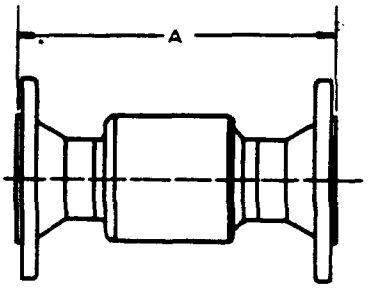
Lubrication should be performed periodically, depending on service and operating conditions. Twice yearly is normally sufficient.

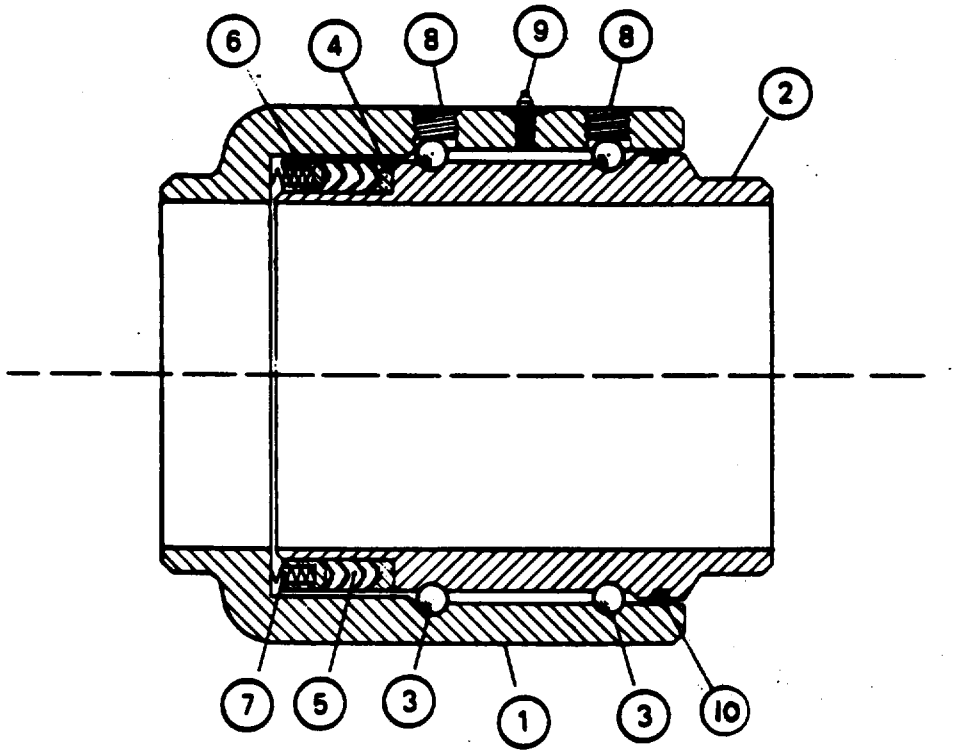
Compounds — Buna-N Seals standard. Viton, Teflon or special compounds available.

Style 20-Flg x Flg

STRAIGHT SWING JOINT.
FLANGED BODY, FLANGED SLEEVE.

	STYLE 20-FxFlg	STYLE 20-Flg x Flg
SIZE	A	A
2	9-7/16	10-5/16
3	10-3/8	11-1/4
4	12	13
6	13-7/8	15-3/8
8	14-3/4	16-5/8





FLAME-HARDENED RACEWAYS —
COLD WORKING PRESSURE — 1000 P.S.I.
WITH SPRING-LOADED "V" RINGS

PARTS LIST

1) Body
2) Sleeve
3) Ball Bearing
4) Seal Retainer
5) V-Ring Seals
6) Spring Retainer
7) Spring
8) Ball Retainer Screw
9) Grease Fitting
10) Dust Seal

ASSEMBLY INSTRUCTIONS
SWING JOINTS

Note that the last coil of the springs (7) has been upset (o.d. slightly larger). When the upset end is inserted into the holes provided in the spring retainer (6) the springs remain secure. Place the assembled unit (spring end first) into the body (I) bore. Place the set of three 'V' rings (5) onto spring retainer in body. The 'V' rings must be installed with the sealing lips facing toward the direction of pressure.

Set dust seal (10) into 'O' ring groove on sleeve (2). On the opposite end place the seal retainer (4) over diameter on sleeve with chamfered end facing the 'V' rings.

Insert sleeve unit into body bore, compressing swing joint together until ball races of both body and sleeve are in line. (DO NOT ROTATE EITHER UNIT WHILE COI1IPRESSING.) Care should be taken to avoid pinching or tearing 'V' rings. Drop balls (3) into raceways through loading holes, rotating sleeve as you load. After a complete set of balls have been installed, assemble ball retaining screws (8).

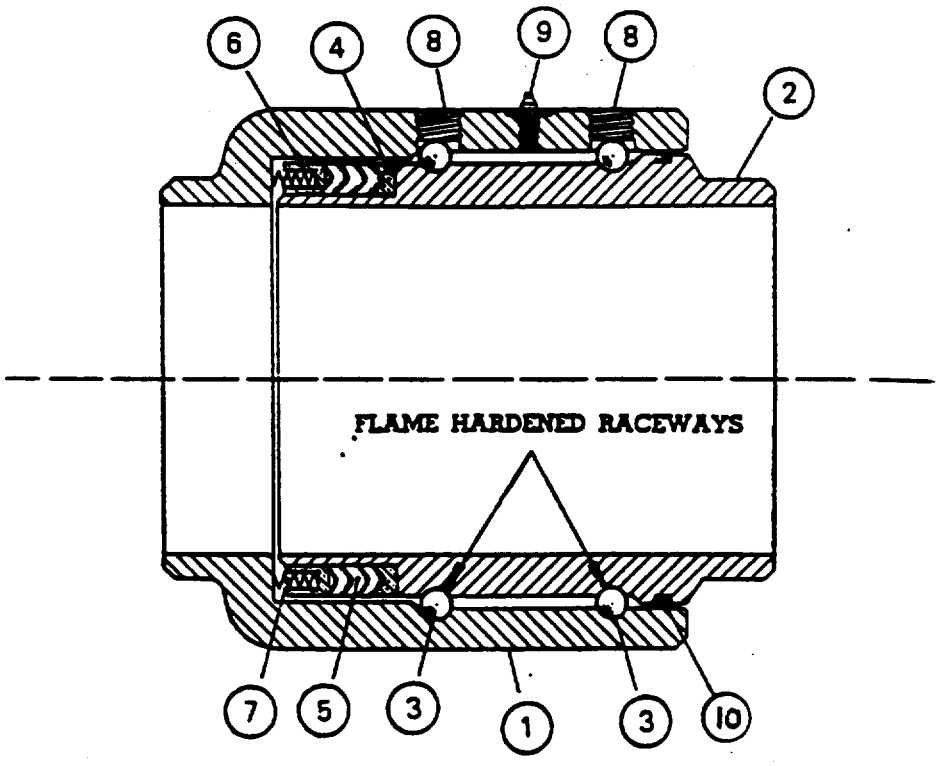
Grease Swing Joint as required through grease fitting (9). If grease fitting does not have a pressure relief feature, do not over-grease as you might create a pressure lock and the Swing Joint will not rotate.

All seals and their contact surfaces should be lubricated for ease of assembly.

The Swing Joints are shipped completely assembled and ready for service. However, if you need to disassemble the unit, reverse the procedure described. After fabricating end styles re-assemble per instructions.

PARTS LIST

1. Body
2. Sleeve
3. Ball
4. Seal Retainer
5. 'V' Ring
6. Spring Retainer
7. Spring
8. Retaining Screw
9. Grease Fitting
10. Dust Seal



WITH SPRING-LOADED "V" RINGS

ANDREWS IDUSTRIES INC.

DAYTON, N.J.

4" Swing Joint
Style 20
Model 2372 S
2300 Series

PARTS LIST

PART NO.	ITEM	DESCRIPTION	MATERIAL	REQ	DWG. SIZE
2086	1	Body	Stn. Stl. 316	1	C
2087	2	Sleeve	Stn. Stl. 316	1	C
1677	3	Ball 3/8"	Steel	84	A
2096	4	Ring Seal Retainer	Teflon or Stn. Stl. 316	1	B
2130	5	V-Ring Packing (-50)	Teflon	3	A
2095	6	Ring Spring Retainer	Teflon or Stn. Stl. 316	1	B
1966	7	Spring	Stn. Stl.	8	A
2008	8	Screw, Set	Stl. (5/8-18 x 5/16)	2	A
2006	9	Plug, Grease	Stl. (1/4 - 28)	1	A
1700-181	10	"O" Ring (-250)	Buna-N (-250)	1	A

TITLE: 4" Swing Joint, MODEL 2372

BY RI DATE 11/7/72

SHEET 1 OF 1

PART NO A-5038 DWG SIZE C

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	31-B
Quantity Required:	See Attachment
Description:	Fasteners (Nuts, bolts, washers)
Manufacturer:	N/A
Part Number:	N/A
Source:	Any

DECKMASTER

FASTENER LIST

SYSTEM	COMPONENT	SIZE	TYPE	FASTENERS - QTY BOLTS QTY	BOLTS Lg	NUT	WASHERS LOCK	WASHERS FLAT
LEVELWIND	Chain Tie-Down	10-24	HEX-SS	12	3/4	0	12	0
LEVELWIND	Chain Block	3/8-16	HEX-SS	4	2	4	4	0
LEVELWIND	Second Reduction	1/2-13	HEX-SS	4	1-3/4	0	4	4
LEVELWIND	Primary Reduction	1/2-13	HEX-SS	4	1-1/4	0	4	0
LEVELWIND	Hyd. Mtr.	1/2-13	HEX-SS	2	1-5/8	2	2	0
LEVELWIND	Spacers	3/8-16	HEX-SS	28	1-1/4	0	28	0
LEVELWIND	Brg. Block	7/16-14	HEX-SS	12	1-1/2	0	12	0
LEVELWIND	Brg. Block	7/16-14	HEX-SS	4	2-1/2	0	4	0
LEVELWIND	Fnd. Bracket	3/4-10	HEX-SS	8	2-1/2	8	8	0
LEVELWIND	Sprocket	3/8-16	HEX-SS	4	1-7/8	0	4	0
Mn. Fnd.	Bracket	3/4-10	Hex-Fe	32	2-1/2	32	32	0
Conn. Clamp	down	1/2-13	Hex-SS	4	1-5/8	4	4	0
Conn. Clamp	together	1/2-13	Hex-SS	2	2	2	2	0
Hub	Cushion	1/4-20	Hex-SS	375	2	375	375	0
Gear Set	Spur	3/4-10	Hex-Gr8	16	4	0	16	0
Gear Set	Pinion	1/2-20	Hex-SS	2	2	0	2	0
Water line	Flange	3/4-10	Hex-SS	16	3-1/2	16	16	0
Water line	Bushing	1/4-20	Allen-SS	8	1	0	0	0
Bearing-Winch	large	1-1/4-7	Hex-Gr8	4	lb-1/2	4	4	0
Bearing-Winch	small	1-8	Hex-Gr8	4	13-1/2	4	4	0
Pwr. Drive	Red. Gear	3/4-10	Hex-Gr8	10	3	10	10	0
Pwr. Drive	Brake	1/2-13	Hex-SS	2	4-1/2	0	2	0
Pwr. Drive	Mtr.	1/2-13	HEX-SS	4	1-1/4	0	4	0
Pwr. Drive	Bracket	3/4-10	HEX-Gr8	9	1-5/8	0	9	9
Pwr. Drive	Bracket	3/4-10	HEX-Gr8	3	2	3	3	3
Pwr. Drive	Adj.	3/4-10	HEX-SS	2	6	4	2	0
Band Brake	Adj.	1-1/2-6	HEX-Gr8	1	12	2	2	0
Band Brake	Shaft	1/4-20	Allen-SS	4	1	0	0	0
Band Brake	handwheel	1-8	HEX-SS	0	0	1	1	0
Band Brake	Bracket	1/2-13	HEX-SS	4	1-1/2	4	4	0
Band Brake	Det. # 11	3/8-16	HEX-SS	4	1-1/2	0	4	0
Water	Swivel	1/2-13	HEX-SS	4	1-1/2	4	4	0

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	31-C
Quantity Required:	As Listed
Description:	Hose List
Manufacturer:	Aeroquip or Equivalent
Part Number:	See List
Source:	Brancart Development Corporation 17150 Butte Creek #219 Houston, Texas 77090 or Local Distributor

Tele # : 1-713-440-4661

DECKMASTER

SYSTEM	FUNCTION	QTY	HOSE	LENGTH	FITTING # 1	FITTING # 2
Winch	Bulkhead to Ball Value	2	2781-12	48 in.	191112H12-12S	191112H12-12S
Winch	Bulkhead to Joystick (supply/drain)	2	2556-6	*	4741-6B	4741-6B
Winch	Joystick to Bulkhead (pump control)	2	2556-4	*	4797-4B	4797-4B
Winch	Cushion Value to Motor	2	2781-10	54 in.	191100H10-10S	191100H10-10S
Winch	Shuttle Value to Pressure 6auge	1	2781-4	96 in.	191100H4-4S	191100H4-4S
Winch	Joystick to Disc Brake	1	2556-4	*	4797-48	4738-4B
Winch	Joystick Drain to Hand Pump	1	2556-6	*	4741-68	4741-6B
Winch	Hand Pump to Disc Brake	1	2781-4	30 in.	191100H4-4S	191101-4-4S
Winch	Hand Pump to Band Brake Cylinder	2	2781-4	30 in.	191100H4-4S	191100H4-4S
Levelwind	Valve to Motor	2	2556-8	*	4797-8B	4797-8B
Levelwind	Motor	2	2556-8	*	4797-8B	4797-8B
Levelwind	Value to Pressure Gauge	1	2556-4	*	4797-4B	4797-48

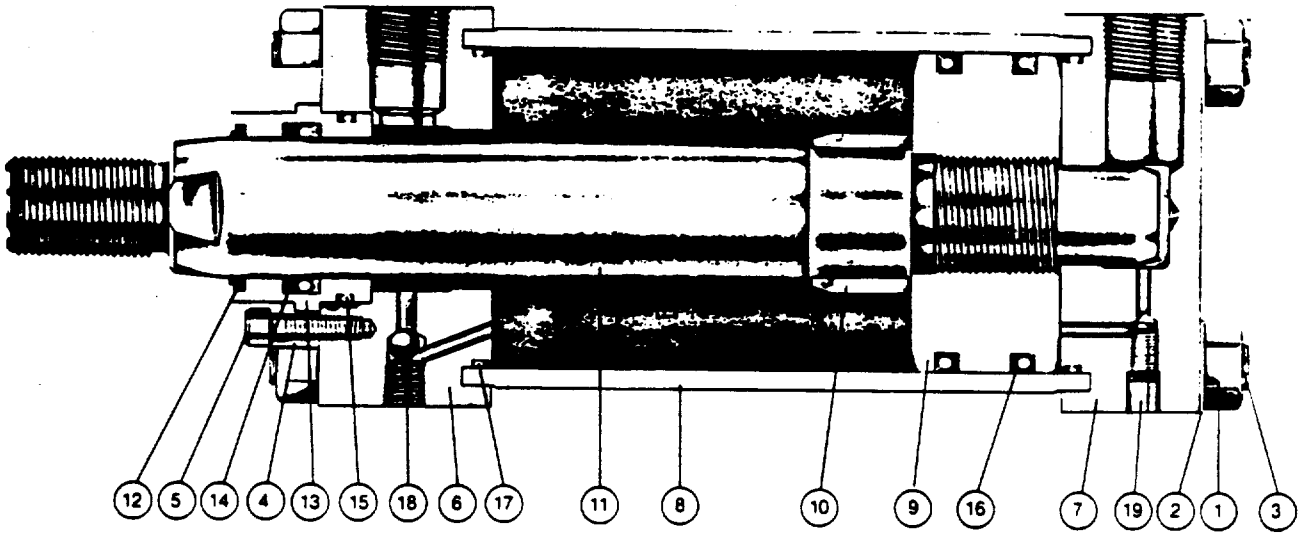
* These hoses have reusable push-on fittings. Cut hose length as required

DECKMASTER
WINCH MODEL NO. WHR-102-12525
and
WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.:	31-D
Quantity Required:	ONE
Description:	Hydraulic Cylinder
Manufacturer:	Atlas Cylinders
Part Number:	H-PB-2, 2" X 1" X 6" NC with JIC-42
Source:	Atlas Cylinder Corporation P.O. Box 2248 Eugene, Oregon 97402

Tele # : 1-(503)-689-9111



PARTS LIST

1. Tie Rod Nut
2. Hardened Washer
3. Tie Rod
4. Retainer Plate
5. Retainer Plate Capscrews
6. Rod Head
7. Blank Head
8. Cylinder Barrel (Honed Steel)
9. Piston
10. Rod End Cushion Sleeve
11. Piston Rod
12. Rod Wiper
13. Rod Bearing Cartridge
14. Rod Seal
15. Cartridge O.D. Seal ('O' Ring & Back-up)
16. Piston O.D. Seal
17. Barrel Seal ('O' Ring)
18. Cushion Check Assembly
19. Adjustable Cushion Assembly

Cylinder Repair Kit Contents

ITEMS
12-13-14-15-16-17

IMPORTANT

When ordering parts or repair kits, it will speed the handling if you will please specify:

1. **Cylinder serial number.**
2. **Cylinder diameter.**
3. **Stroke.**
4. **Piston rod diameter.**
5. **Air, oil, water, or etc.**

WARRANTY

Our products are warranted for one year to be free from defects in workmanship and material. We will replace or repair, at our election, including lowest transportation cost but excluding installation or any other charges, any product that our inspection shows to be defective. Immediately upon receipt of the product covered by this warranty, buyer shall inspect same. Any claim under this warranty must be made in writing to us at our most recent address within ten days after Buyer's receipt of the product shipped or, in the event the defect is incapable of discovery until in use or in processing in the manufacture of other products, within ten days after Buyer learns of the alleged defect giving rise to the claim. In any event, any such claim must be made within the one year period covered by this warranty. Buyer shall return the product in question to our plant for inspection immediately upon written request by us. No product may be returned to us under this warranty without our written consent or request. This warranty is in lieu of all other warranties, express or implied, including merchantability and fitness for a partic purpose, and constitutes the only warr made by seller. We assume no liability fo consequential damages of any kind, or for damages arising from a claim of negligence. Our liability under this warranty is limited to replacement of or repair of the defective part. No agent or purported agent of ours has authority to expand the terms and warranties herein described.

ENGINEERING DATA

FEATURES

The main objective in this square head design is to provide a cylinder to fit minimum space requirements, coupled with maximum strength and wear characteristic. The only parts subject to wear are the piston cups, rod packing and bearing, The life of these part's greatly increased because of the mechanical stability inherent in the extra-long piston rod bearing. This reduces maintenance worries and costly downtime.

The standard cylinder has a wide versatility of population since all mountings are interchangeable with all NFPA/JIC cylinders. Cylinders may be mounted in any position. The piston stroke is made to your specification, even to the fraction of an inch.

PRESSURES

Series 'H' cylinders are rated at 3,000 P.S.I. operating pressure. Certain mounting styles may be used in higher pressure non-shock applications. Please consult your distributor.

TEMPERATURE RANGE

Sees 'H' cylinders are designed to perform well in continuous operation at temperatures ranging from -30° F. to +200° F. If your needs should extend into other operating temperatures, consult our distributor for specific recommendations, giving temperature range, medium, and cycle time.

LUBRICATION

Series 'H' cylinders are designed for oil operation, lubricated with mineral or petroleum-base oils. For special acetic or gaseous fluids or where synthetic lubricants are used, consult our distributor, giving full details and information.

MOUNTING

Standard NFPA/JIC mounting styles are shown in this catalog. For special mountings or combination mountings, contact our distributor.

PORTING

Standard cylinders will be furnished with NPTF ports.
SAE straight thread 'O' ring ports, in comparable size to pipe port can be had optionally at no extra cost. Where mounting clearances permit, the ports can be had in any of four positions in either head, Indicate both port locations by position number 1, 2, 3, or 4. Unless otherwise specified, the ports will be furnished in position number 1 (Port position numbers can be located on each mounting specification diagram.)

CUSHIONS

Cushioning is achieved by trapping oil between the piston and cylinder head, then allowing the oil to escape at a predetermined rate. This is accomplished by closing off the normal oil passage a the piston nears the cylinder head, trapping and bleeding oil through an adjustable needle valve.

Cylinder may be furnished cushioned at both ends or at either end. If only one end of the stroke is to be cushioned, in designating the end of the cylinder at which this cushion action is to take place, the ends of the cylinder should be referred to as the 'Head" or 'Rod" end, and the other end as the "Cap" or 'Blind" end. This will avoid confusion and delay.

Cushioning is designed to properly cushion the cylinder and is NOT intended to cushion large-inertia loads. Cushions are not a substitute for speed controls, or deceleration valves.

ADJUSTABLE CUSHION VALVE

The needle valve provided on cushioned cylinders permits infinite adjustment of the cushioning effect to any degree desired. The cushion adjust valve is supplied at position #2 standard unless otherwise specified. A cushion ball Check is at position #4 standard.

NOTE: Some cylinder and rod combinations will have a fixed cushion on the rod end and not have a needle valve adjustment.

PISTON ROD

The standard piston rod is cold drawn carbon steel with an induction hardened case of 50 Rc. It is hard chrome plated and finished to 16 microinches, providing a smooth, hard. dent and abrasion resistant surface. These features extend seal and bearing life and reduce maintenance cost.

ROD PACKING CARTRIDGE

Our rod packing cartridge is designed as a unitized assembly, made of SAE 660 bearing bronze. The unitize rod cartridge is easily removable without disturbing the torque on the tie rods and by using a standard Allen wrench. The piston rod bearing is exceptionally long, providing excellent piston rod alignment, and contributing to the very long life of the cylinder.

ROD SEAL

A polyflex seal is employed to seal the piston rod, providing a virtually zero leak seal with long life and with friction held to a minimum. The highly resilient lip is pressure-actuated and wear compensating, giving complete reliability after millions of cycles.

ROD WIPER

The rod wiper is urethane, of the projecting lip type. The recess in the cartridge will accept any MS28776 (or AN6231) standard rod wiper. Alternate materials include teflon or brass.

PISTON

A special close grained nodular iron casting is used for a one-.a piston. The piston is piloted and torqued onto the piston rod with thread size adjusted to rod diameter.
LOCTITE® is used to chemically lock and S the Ion to the rod permanently.

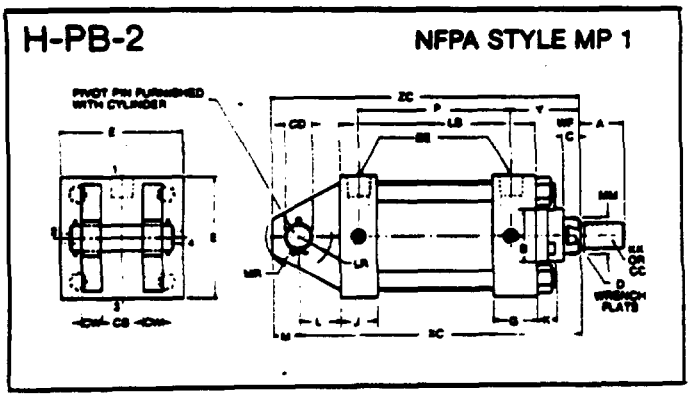
PISTON SEAL

Polyflex seals are furnished as standard. and provide a virtually zero leak seal. These seals are generally accepted by engineers as the most effective seal available.

TOLERANCES

All dimensions are in inches. Stroke length tolerance is ± 1/32, Closerr tolerance can be had at extra cost.

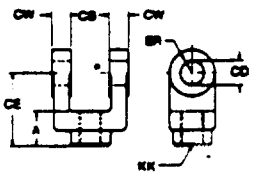
H-PB-2 NFPA STYLE MP 1



Red letters are for zero stroke — add stroke to dimensions identified with red letters.

NOTE: All hydraulic cylinders furnished non-cushioned unless ordered otherwise.

BORE	E	(NPT) EE	(SAE) EE	G	J	K	L	M	LR	MR	CB	CW	CD	CK	LB	MA	P	SL	F	LE
1 1/2	2 1/2	1/2	#8	1 3/4	1 1/2	1/2	3/4	1/2	9/16	11/16	3/4	1/2	.500	7/16	4 5/8	3/4	3	13/16	3/8	9/16
2	3	1/2	#8	1 3/4	1 1/2	5/8	1 1/4	3/4	15/16	15/16	1 1/4	5/8	.750	21/32	4 5/8	1 1/4	3	1 3/16	5/8	7/8
2 1/2	3 1/2	1/2	#8	1 3/4	1 1/2	5/8	1 1/4	3/4	15/16	15/16	1 1/4	5/8	.750	21/32	4 3/4	1 1/4	3 1/8	1 3/16	5/8	7/8



PART	JIC-40	JIC-41	JIC-42	JIC-43
A	5/8	3/4	1 1/8	1 5/8
CB	5/8	3/4	1 1/4	1 1/8
CD	1/2	1/2	3/4	1
CE	1 1/8	1 1/2	2 1/8	3 1/8
CW	1/2	1/2	5/8	3/4
ER	1/2	1/2	3/4	1
KK	7/16-20	1/2-20	5/8-18	3/4-14
LOAD RATING LBS.	2800	4000	8300	12700

PRESSURE TABLE

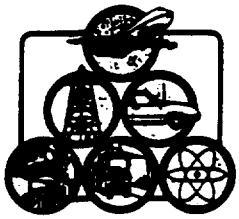
This chart lists theoretical push and pull forces that Atlas "H" Cylinders will exert when supplied with various working pressures.

CYL. BORE DIA.	PRESS. RATINGS Heavy-Duty Service	Non-Shock Service	4:1 Safety Factor	PISTON ROD DIA.	CYL. WORK ACTION	WORK AREA SQ. IN	HYDRAULIC WORKING PRESSURE P S I 350	500	750	1000	1500	2000	3000	FLUID REQUIRED /IN OF STROKE GAL.	CU. FT.
1 1/2	3000	5000	2200	5/8	Push	1.767	618	883	1325	1767	2651	3534	5301	.00765	.00102
				1	Pull	1.460	511	730	1095	1460	2190	2920	4380	.00632	.00084
					Pull	.982	344	491	736	982	1473	1964	2946	.00425	.00057
2	3000	5000	2150		Push	3.141	1099	1571	2356	3141	4711	6283	9423	.01360	.00182
				1	Pull	2.356	825	1178	1767	2356	3534	4712	7068	.01020	.00136
				1 3/8	Pull	1.656	580	828	1242	1656	2484	3312	4968	.00717	.00096

RECOMMENDED TIE ROD TORQUE VALUE FOR CYLINDERS

BORE		1 1/2	2	2 1/2	3 1/4	4	5	6	7	8	10	12
SERIES "H"	TIE ROD THREAD	3/8-24	1/2-20	1/2-20	5/8-18	5/8-18	7/8-14	1-14	1 1/8-12	1 1/8-12	1 3/8-12	2-12
	TORQUE FT. LBS.	22	55	60	95	150	320	465	690	850	*1300	*1700

*When 1" diameter multiple tie rods are used on 10" & 12" bore "H" Series Cylinders, equivalent torque is 400 ft. lbs.



ATLAS CYLINDERS

Dependable POWER For Industry

HIGH PRESSURE HYDRAULIC CYLINDER INTERCHANGEABILITY CHART

MOUNTING DESCRIPTION	NFPA CODE	NFPA/JIC CYLINDER MANUFACTURERS SERIES NUMBERS								
		ATLAS	PARKER	MILLER	HYDRO-LINE	T.J.	SHEFFER	ORTMAN	MILWAUKEE	HANA
PLAIN NO TIE ROD EXTENSION	MX0	H-NM-0	2H-T	H-50	N2K or N5K	SH-9	HH-NX	3TH	H-11	H-MX0
SIDE TAPPED	MS4	H-FS	2H-F	H-74	N2B or N5B	SH-1A	HH-SF	3THH	H-41	H-MS4
SIDE LUGS	MS2	H-SL	2H-C	H-72	N2A or N5A	SH-1	HH-SL	3THJ	H-42	H-MS2
CENTERLINE LUGS	MS3	H-CL	2H-E	H-73	N2H or N5H	SH-7	HH-CL	3THK	H-51	H-MS3
SIDE END LUGS	MS7	H-FM-2	2H-G	H-77	N2E or N5E	—	—	3THCC	H-43	H-MS7
HEAD RECTANGULAR FLANGE	MF1	H-REF2	2HJ	H-61	N2F or N5F	SH-2	HH-FF	3THB	H-31	H-MF1
HEAD RECTANGULAR	ME5	H-ME5	—	—	N2G or N5G	—	HH-FHF	—	H-35	H-ME5
CAP RECTANGULAR FLANGE	MF2	H-BEF2	2H-H	H-62	N2R or N5R	SH-4	HH-RF	3THA	H-32	H-MF2
CAP RECTANGULAR	ME6	H-ME6	—	—	N2P or N5P	—	HH-RHF	—	H-36	H-ME6
HEAD SQUARE FLANGE	MF5	H-REF1	2H-JB	H-65	N2J or N5J	SH-2B	HH-FFX	3THBB	H-21	H-MF5
CAP SQUARE FLANGE	MF6	H-BEF1	2H-HB	H-66	N2S or N5S	SH-4B	HH-RFX	3THAA	H-22	H-MF6
BOTH ENDS TIE RODS EXTENDED	MX1	H-NM1	2H-TD	H-51	N2L or N5L	SH-9BE	HH-BX	3THL	H-10	HMX1
HEAD TIE RODS EXTENDED	MX3	H-NM3	2H-TB	H-53	N2M or N5M	SH-9R	HH-FX	3THM	H-12	HMX3
CAP TIE RODS EXTENDED	MX2	H-NM2	2H-TC	H-52	N2N or N5N	SH-9B	HH-RX	3THN	H-13	H-NM2
HEAD TRUNNION	MT1	H-TM1	2H-D	H-81	N2U or N5U	SH-5R	HH-TF	3THER	H-71	HMT1
CAP TRUNNION	MT2	H-TM2	2H-DB	H-82	N2W or N5W	SH-5B	HH-TR	3THER	H-72	HMT2
INTERMEDIATE FIXED TRUNNION	MT4	H-TM3	2H-DD	—	N2TT or N5TT	—	HH-T Except on 4"	3THE	—	—
CAP FIXED CLEVIS	MP1	H-PB2	2H-BB	H-84	N2C or N5C	SH-3	HH-C	3THG	H-61	HMP1
CAP DETACHABLE	MP2	H-MP2	2H-BC	H-86	N2DC or N5DC	—	—	—	—	—

Main Plant & Corporate Headquarters

Atlas Cylinder Corporation 29289 Airport Road P. O. Box 2248 Eugene, Oregon 97402-0079 (503) 689-9111

Midwest Manufacturing Branch

Atlas Cylinder Corporation 5530 Milton Parkway Rosemont, Illinois 60018-4938 (312) 678-0911

DECKMASTER

WINCH MODEL NO. WHR-102-12525

and

WINCH HYDRAULIC POWER PACKAGE MODEL NO. HPP-30EC-50

COMPONENT DESCRIPTION

Reference Item No.: 31-E

Quantity Required: ONE

Description: Hand Pump

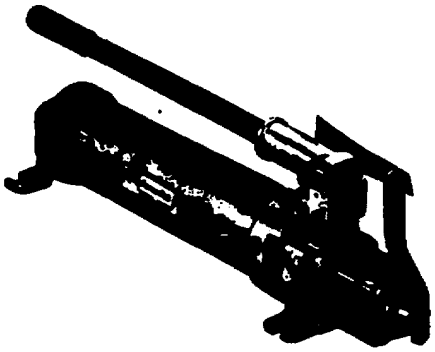
Manufacturer: Templeton, Kenly & Co.

Part Number: RP8CR

Source: Templeton, Kenly & Co.
Gardner Road and 16th Street
Broadview, Illinois 60153

Tele #: 1-(312)-865-1500

TELEX #: 6871027



Model RP6CR, with two-stage, single-piston operating pressures of 250 and 10,000 PSI. Comes with four-way, three-position valve.

Model Number	Item Number	Usable Reservoir Capacity (Cu. In.)	Operating Pressure (PSI)	Piston Dia. (In.)	Stroke (In.)	Vol./Stroke (Cu. In.)	Handle Effort—Lbs. at 250 PSI	Handle Effort—Lbs. at Capacity	Relief Pressure (PSI)	Wt. (Lbs.)
TWO-STAGE PUMPS WITH RESERVOIR AND RELEASE SCREW FOR USE WITH SINGLE-ACTING CYLINDERS										
RP6BR	34004	126	10,000/250	½—$^{13}/_{16}$	1	0.20/0.52	5½	110/3	10,000	29
RP18SR	34009	197.5	10,000/1,500	½—1	1⅜	0.28/1.08	9/35	176/106	10,000	38
RP40SRB	34061	411	10,000/1,500	½—1	1⅜	0.28/1.08	9/35	176/106	10,000	59
TWO-STAGE PUMPS WITH RESERVOIR AND 4-WAY VALVE FOR USE WITH DOUBLE-ACTING CYLINDERS										
➤ RP6CR	34035	126	10,000/250	½—$^{13}/_{16}$	1	0.20/0.52	5½	110/3	10,000	36
RP12DR	34008	130	10,000/1,500	½—1	1⅜	0.28/1.08	9/35	176/106	10,000	42
RP40DR	34017	411	10,000/1,500	½—1	1⅜	0.28/1.08	9/35	176/106	10,000	55
910A-4-8	34041	866	10,000/1,500	½—1	1⅜	0.28/1.08	9/35	176/106	—	77

DECKMASTER

TEMPLETON, KENLY & COMPANY

GARDNER ROAD and 16th STREET • BROADVIEW, ILLINOIS 60153
PHONE 312 - 865-1500 TWX 910 - 226-1955

TWO WAY PUMP

REPAIR PARTS SHEET

RP8CR

OPERATING PROCEDURE

1.0 Remove pump from container and inspect for damage.

1.1 Make necessary connections to advance and retract ports of valve. If hoses are used connect hose half coupler to one end of each hose remove plastic pipe plugs in ports and thread other end of hose into proper ports. Be sure all connections are tight.

1.2 Place pump in horizontal position and remove pipe plug (item No. 25) and check oil level. Oil should be visible at bottom of hole. If necessary fill to bottom of hole with Simplex Hydraulic Oil or equivalent. CAUTION: Do not over fill or add oil if ram being used with pump is in the raised position. Install breather plug in place of pipe plug (item No. 25). The breather plug is in bag attached to pump. CAUTION: Failure to install the breather plug can result in damage to the equipment.

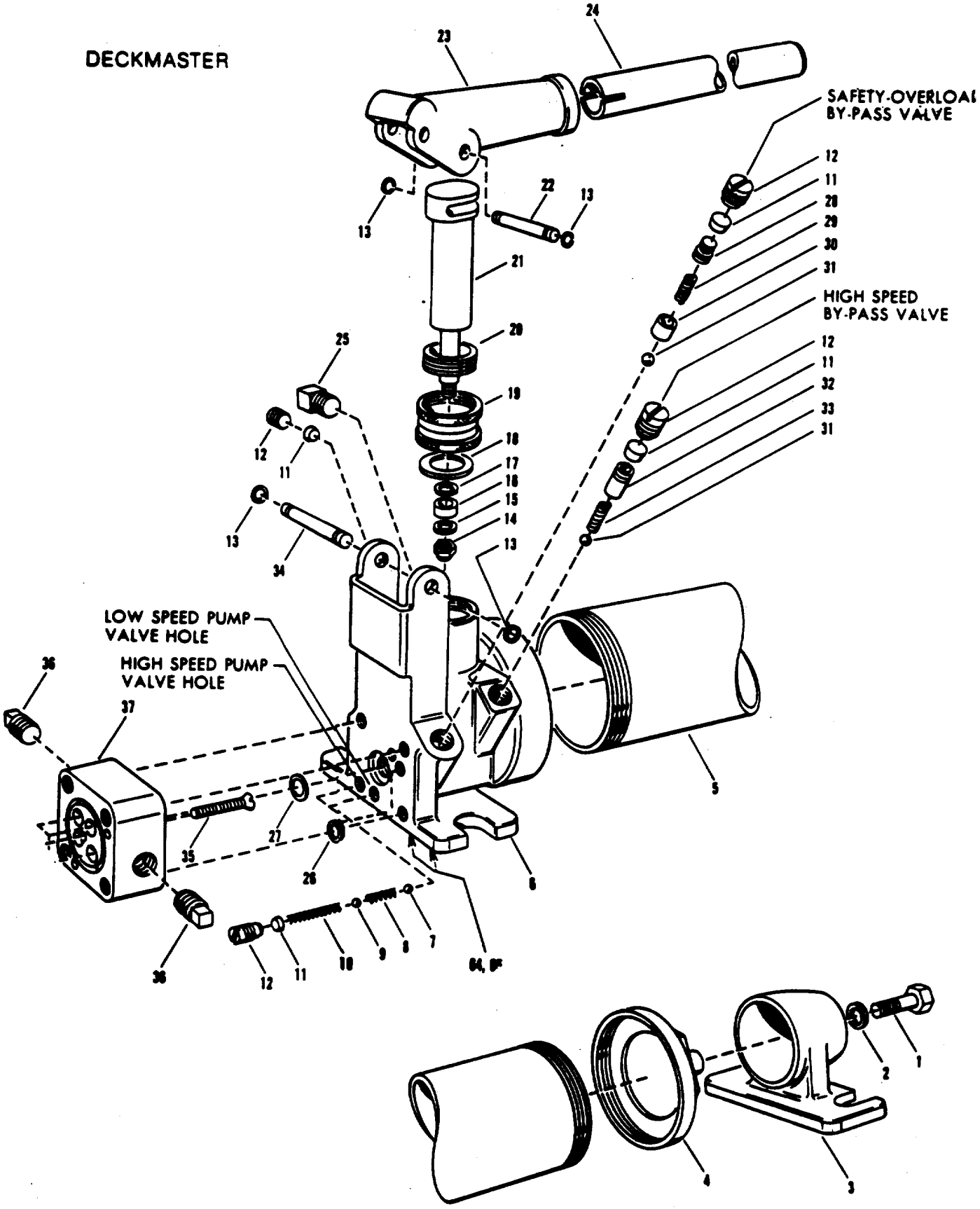
1.3 Connect hose half coupler on end of hose to ram half coupler on ram taking care to assemble hose from advance port of pump to bottom of ram and hose from retract port of pump to top of ram. Be sure knurled nuts on couplers are tight. CAUTION: Failure to have couplers tightly connected can result in injury or damage to the equipment.

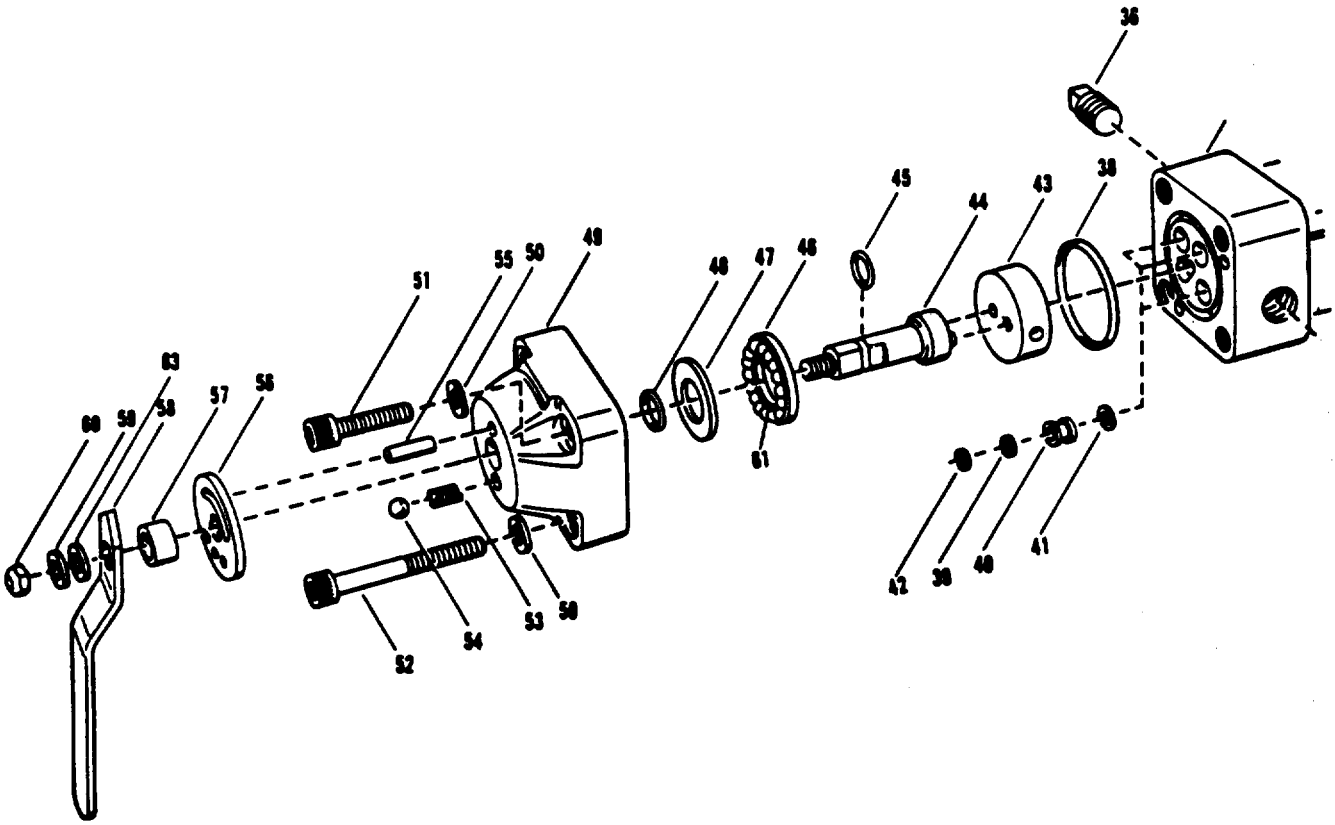
1.4 To extend cylinder, move control handle to advance position and pump on handle. CAUTION: Do not attempt to exceed rated cylinder capacity or plunger stroke.

1.5 To retract cylinder, move control handle to retract position and pump on handle. CAUTION: Do not continue pumping after cylinder has reached its maximum retracted position.

1.6 Extend cylinder plunger several times to purge air from the system. The cylinder should be lower than the pump and there should be no load on the ram.

DECKMASTER


SAFETY-OVERLOAD
BY-PASS VALVE
HIGH SPEED
BY-PASS VALVE
LOW SPEED PUMP
VALVE HOLE
HIGH SPEED PUMP
VALVE HOLE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SIMPLEX DIVISION

GUARANTEE

Templeton, Kenly & Co., Broadview, Ill., guarantees its Products against defects in workmanship and materials for 1 year from date of delivery to the user. When question of warranty arises, the user should send his unit to the nearest simplex Authorized Service Depot for inspection, transportation prepaid and evidence of purchase date furnished.

If the difficulty comes under the terms of our guarantee, the Authorized Service Depot will repair or replace parts affected and return prepaid. Our guarantee does not cover ordinary wear and tear, abuse, misuse, overloading, altered products or use of improper fluid.

TEMPLETON, KENLY & COMPANY

16TH & GARDNER RD., BROADVIEW, ILLINOIS

PARTS LIST

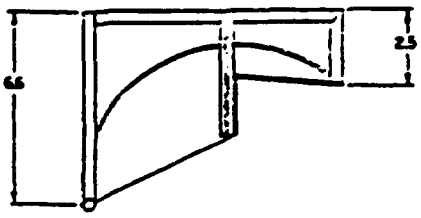
ITEM NO.	QTY.	ORDER NO.	DESCRIPTION
1	1	94333	Hex. Hd. Cap Screw ⅜ x 1" Long
2	1	93947	Lock Washer ⅜
3	1	92288	Foot
4	1	92289	Reservoir End Cap
5	1	92286	Reservoir Tube
6	1	99920	Pump Housing
7	2	92549	¼" Ball
8	2	92273	Spring
9	2	92550	⅜ Ball
10	2	92551	Spring
11	5	92552	Seal
12	5	92543	Pipe Plug
13	4	92540	Locking Rings
14	1	93846	Piston Packing Nut #10-32
15	1	93921	#10 Washer
16	1	92271	Piston Packing
17	1	92272	Back Up Washer
18	1	92267	Male Adapter
19	1	92266	Gland Packing
20	1	92265	Gland Nut
21	1	92269	Piston
22	1	92268	Pin (Short)
23	1	92263	Handle Socket
24	1	55703	Handle
25	1	90534	Pipe Plug
26	1	5602017	"O" Ring
27	1	5602114	"O" Ring
28	1	92217	Safety Valve Screw
29	1	92216	Spring
30	1	92215	Spring Seat
31	2	90548	⅜" Ball
32	1	92279	Spring Cap
33	1	92280	Spring
34	1	92264	Pin (Long)
35	2	85004	Body Screw
36	2	97093	Plastic Pipe Plug
37	1	6011208	Body
38	1	80726	"O" Ring
39	3	80727	Back Up Ring Shear Seal Seat
40	3	85001	Shear Seal Seat
41	3	80719	Washer
42	3	80723	"O" Ring
43	1	80707	Rotor
44	1	6011209	Shaft
45	1	80711	Retainer Ring
46	17	80712	Ball Retainer
47	1	80716	Thrust Washer
48	1	80725	"O" Ring
49	1	80720	Housing
50	4	93943	Lock Washer
51	1	6011214	Soc. Hd. Cap Screw
52	3	99921	Soc. Hd. Cap Screw
53	1	80709	Detent Spring
54	1	80731	Detent Ball
55	1	80729	Stop Pin
56	1	80722	Disc Detent
57	1	80713	Spacer Disc.
58	1	6011210	Handle
59	1	80717	Shaft Washer
60	1	80714	Nut
61	1	80730	Ball Bearing
62	2	6011215	Shear Seal Seat
63	1	6011213	Lockwasher
64	2	92508	Oil Channel Plug
65	1	92756	Oil Channel Seal
		54142	Valve Repair Kit (Incl. #47, #38, #40, #42, #28, #39, #41, #48, #53, #54)
		99824	Pump Packing Kit (Incl. #11, #16, #17, #19, #27, #62, #14, #15)
		54141	Valve Packing Kit (Incl. #48, #38, #39, #42, #26)

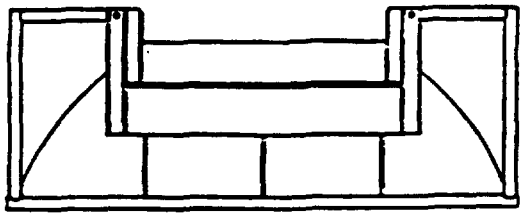
IV. STEEL CHUTE

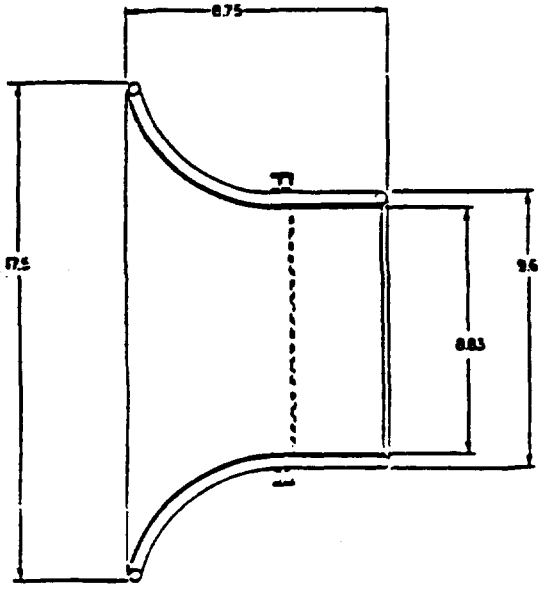
The chute is a steel structure used to protect the flexible pipe from overbending as it leaves the deck of the barge. Size and frame dimensions have been designed to support the forces induced by the system during extreme conditions in the operating mode. See Figure IV-1.

The chute has been carefully ground to avoid any welding burr or slag which might damage the flexible pipe outer jacket. It is important that the upper surface of the chute and both walls in contact with the flexible pipe be kept as smooth as possible. Do not create gouges, cracks, or any other irregularity.

The chute is corrosion protected by a protective coating as defined in Section III-8-5.







STEEL CHUTE

WEIGHT 8000 LBS.

840464-B

FIGURE IV-1

COFLEXIP & services inc

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V. PIGGING SYSTEM

The flexible pipe must be purged from its water content before being retrieved onboard the ROWPU barge. This will reduce the weight of the pipe, minimize the back hauling forces and facilitate retrieval.

The pigging system is comprised of the following components:

- One (1) pig launcher (AISI 316 stainless steel), a stationary part bolted to the drum pipe water inlet. Water supply will be connected to the pig launcher branch inlet, while compressed air is connected to the pig launcher main inlet through a 3/8" nipple.

- Ten (10) flexible pigs 4" OD x 8" length.

- One (1) pig receiver (galvanized steel), a removable part to he connected to the shore flange prior to pigging.

See Figure V-1.

The pigging system requires a 125 psi air supply.

One pig will be launched at a time and then recovered in the pig receiver at the beach end. The pigs can be reused for successive operations if no visual damage is apparent to the pig body.

Instructions for pigging operations are given in Section VI.5.

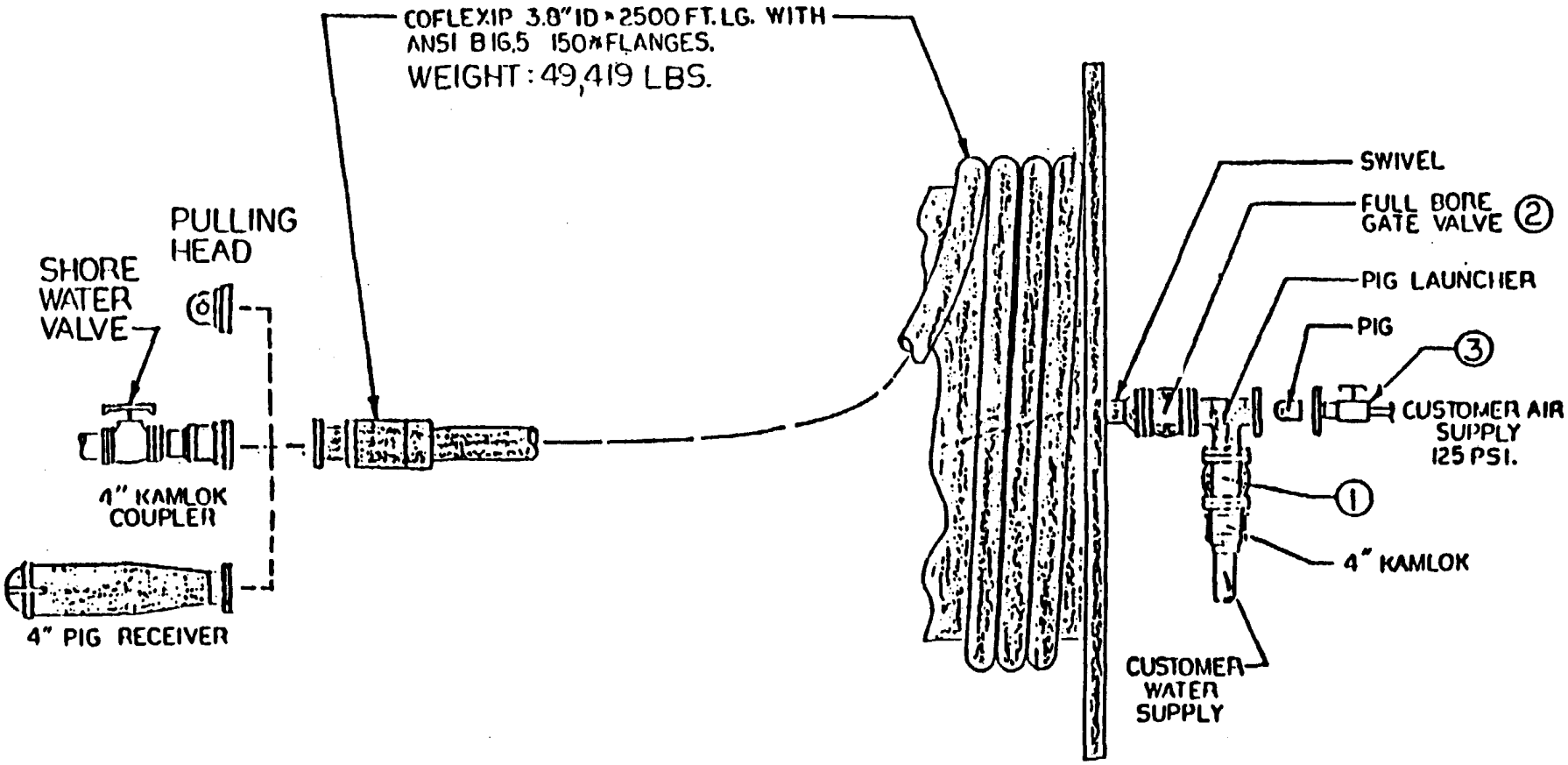

FIGURE V-1

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VI. RECOMMENDATIONS FOR DEPLOYMENT AND RETRIEVAL

The procedure to be followed for the Deployment and Retrieval of the Drinking Water Discharge Line depends to a great extent on the environmental conditions at the site. The following are general guide lines and instructions to be followed. See figures VI-1 and VI-2. It is assumed that the ROWPU barge has been moored off the shore with its stern oriented toward the objective area on the beach. The Coflexip pipe is empty and stored onto the winch drum.

COFLEXIP & services inc

1.0 ROWPU Barge Set-Up

A. Close water gate valves #1 and 2.

B. Close air supply valve 03.

C. Connect barge water supply to Valve #1.

D. Connect air supply to valve #3.

E. Free the end of the discharge line. Check that pulling head is secured to the coupling.

F. Check that the winch band brake is set.

G. Release winch drum tie-downs, if any.

H. Check that winch control lever is in OFF position.

I. Attach towline from shore to pulling head.

J. Attach a 500 lbs. buoyancy float to the pulling head. This will prevent embedment of the end-fitting in the sea-bottom.

2.0 Winch Drive Start-Up

A. Check that the hydraulic hoses are properly connected to the hydraulic power package and to the winch and levelwind, and that the electrical connections are in order. Check the sight gauge on the reservoir to see that it is filled with oil.

B. Place the valve handles in the NEUTRAL position (winch joystick control and manual levelwind control OFF).

C. Push the green START button on the electrical enclosure to start the electric motor and pumps.

D. Check the pump rotation.

E. Check the charge pump pressure on the hydraulic power package. A minimum pressure of 180 psi is required for proper stroke control and make-up flow for the winch circuit.

F. If this is the initial start-up, or if the system has not been operated for a period of several days, allow the pumps to run with the valves in the NEUTRAL position for approximately five minutes. This will allow the oil to circulate at low pressure and remove entrapped air, etc.

G. Check for oil leaks and tighten fittings as necessary

H. Check the bias setting for the piston pump stroke control. With the joystick in NEUTRAL position, compare the readings of the two gauges on the hydraulic power. package indicating the pressures in the two sides of the winch circuit. If the two readings differ, the bias can be zeroed by adjusting the socket-head screw on the end of the stroke control on the piston pump; this will assure that the pump is fully destroked when the joystick is in the neutral position.

I. Make sure that the level wind is engaged over the flexible pipe.

J. Make sure that the steel surfaces are smooth and free from any irregularities.

K. Release band brake.

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3.0 Pipe Deployment

A. The flexible pipe is paid out from the winch drum on demand, and is simultaneously towed to shore by the towline. The operation must be coordinated to avoid excessive slack or tension in the line. The maximum allowable pay-out rate is 30 ft/mn.

B. When the flexible pipe has' reached shore and is connected to the receiving tanks, an additional length of flexible pipe must be deployed on the sea-floor to allow for the excursion of the barge.

C. A sufficient length of line must be deployed to protect the pipe and winch from being subjected to unexpected tensions.

D. At least 70 ft. of pipe should rest on the beach; sand bagging and/or anchoring might be needed, depending on the conditions.

E. When the pipe has been satisfactorily deployed, the band brake of the drum is, engaged, and the hydraulic power unit is stopped.

4.0 Water Discharge

A. Open valve at shore receiving station.

B. Open gate valves #1 and 2.

C. Start pumping.

D. The configuration of the flexible pipe should be regularly verified to ensure that the line is not subjected to excessive stress.

COFLEXIP & services inc

5.0 Pigging

A. Close water valves #1 and 2.

B. Close valve at shore receiving station.

C. Disconnect flexible pipe from shore receiving station.

D. Connect pig receiver to the shore end of the flexible pipe.

E. Open pig launcher flange on the winch and insert one pig.

F. Close pig launcher flange. Check that air supply is properly connected.

G. Open gate valve #2. Gate valve #1 must remain closed.

H. Open air supply valve #3.

I. The pig will then travel through the entire flexible line until it is trapped in the pig receiver, at the shore. Approximately 1,500 gallons of water will be discharged at the shore. Pigging time is approximately 15 minutes.

J. When the pig arrives in the receiver, stop the air flow by closing the air supply valve #3. Close gate valve #2.

K. Open pig receiver and recover pig. The pig can be re-used, unless it presents excessive wear.

L. Disconnect the pig receiver from the flexible pipe, and install the pulling head in its place.

6.0 Pipe Retrieval

A. Start-up the winch system as per subsection 2.0 above.

B. Make sure that all valves #1, 2, and 3 are closed.

C. Make sure that the pulling head is attached watertight to the shore end of the flexible pipe. Attach 500 lbs. buoyancy float to the pulling head.

D. Reel in the flexible pipe. The winch is controlled by its command lever in REEL-IN position.

E. At the end of each pipe layer, when the flexible pipe reaches one of the winch flanges, make sure that the transition to the next layer occurs smoothly, and that the top layer initiates evenly. If necessary, use the level wind manual control to gently form the first coil of the top layer.

F. When the flexible pipe is completely reeled-in, tie down the pulling head into the barge.

G. Stop the hydraulic power unit.

7.0 Rilsan Outer Jacket Repair

The Rilsan outer jacket is a continuously extruded thermoplastic sheath (0.2" thick) which provides extra protection to the flexible pipe during bottom tow on the seafloor. The outer jacket does not participate in the mechanical strength of the flexible pipe, or in its pressure integrity. In fact, even if the Rilsan outer jacket was completely eliminated, the flexible pipe would retain all its properties because of the pressure of High Density Polyethylene Sheath (0.15" thick) right underneath the Rilsan. Because Rilsan and HDPE are of different colors, it is easy to determine when the Rilsan outer jacket has been damaged through its entire thickness.

Minor damages to the Rilsan outer jacket, such as tears, cuts, scratches and wear, do not require any repair action, provided they do not affect the entire thickness of the Rilsan material.

For a larger damage, a repair can be-conducted in order to restore the continuity of the Rilsan outer jacket. It is recommended that Coflexip be contacted for such repair work; however, repairs can also be performed by normally trained technicians. A repair kit is included

in the Scope of Supply of the Coflexip Drinking Water Discharge System, to assure that tools and material will be readily available. The Rilsan outer jacket repair kit is comprised of the following components:

- One hot air gun with air supply unit
- Three (3) air nozzles
- 1/2" Stainless steel bands with clamps and wrench
- Six (6) lbs. of Rilsan wire
- Tool box and consumables

Basically, the repair consists of melting the Rilsan material and applying it firmly, similarly to caulking. Both temperature and pressure are required to make a proper repair.

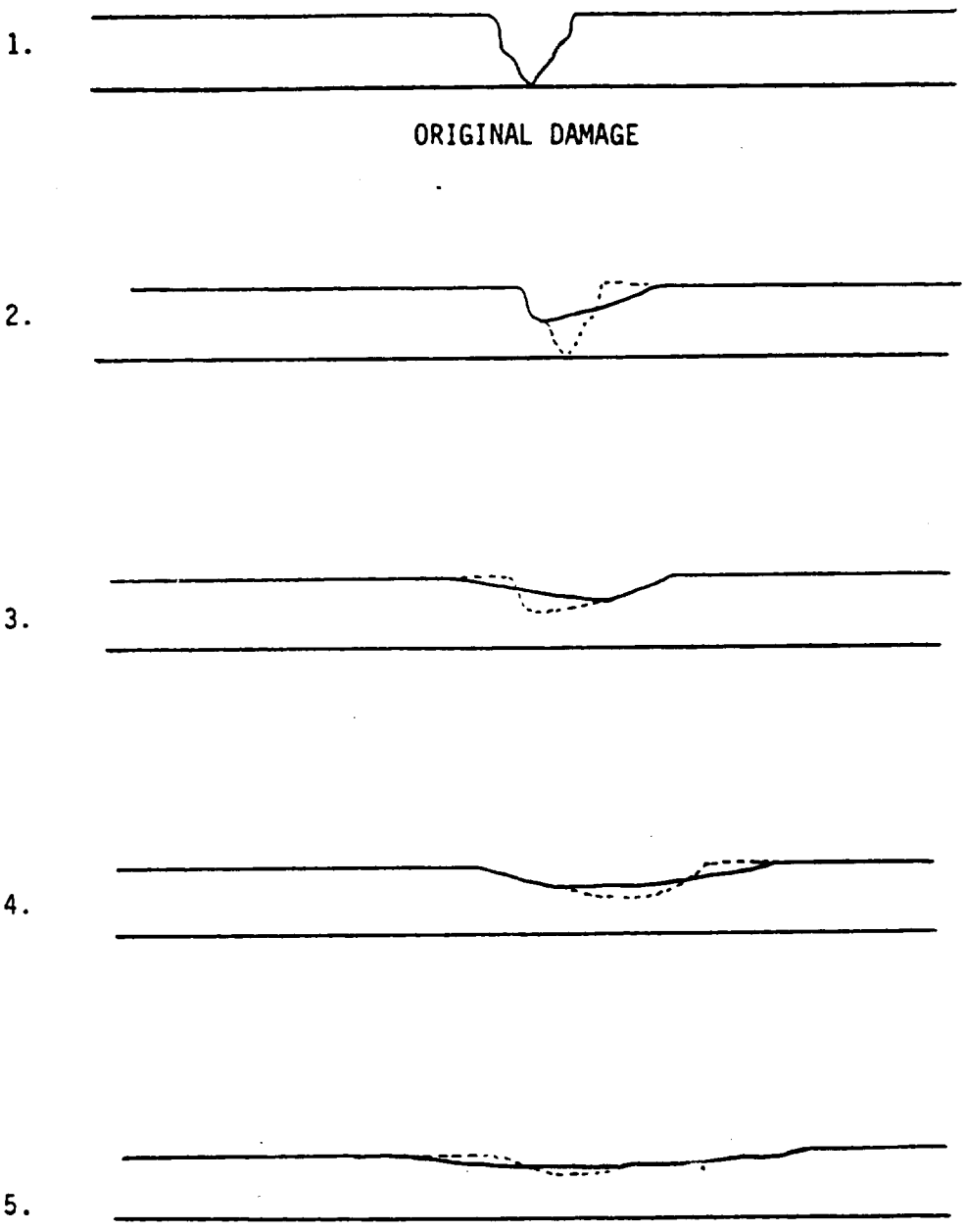
The hot air gun should be set on 3, and held approximately one (1) inch from the repair area.

In most cases, it is not necessary to add Rilsan material; it is usually easier and better to melt Rilsan from around the damage (cut, tear, etc...) and use that base material to fill in the damage.

If necessary, and depending on the size of the damage, stainless steel bands can be used to hold the Rilsan outer jacket during and after the repair.

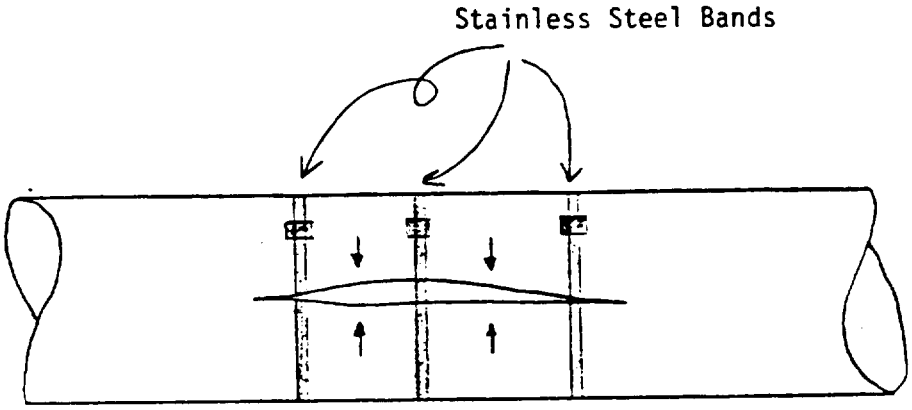
See figure VI-3 and VI-4.

COFLEXIP & services inc



PROGRESSIVE ELIMINATION OF OUTER JACKET DAMAGE

FIGURE VI-3



FASTENING OF LONG CUT

FIGURE VI-4

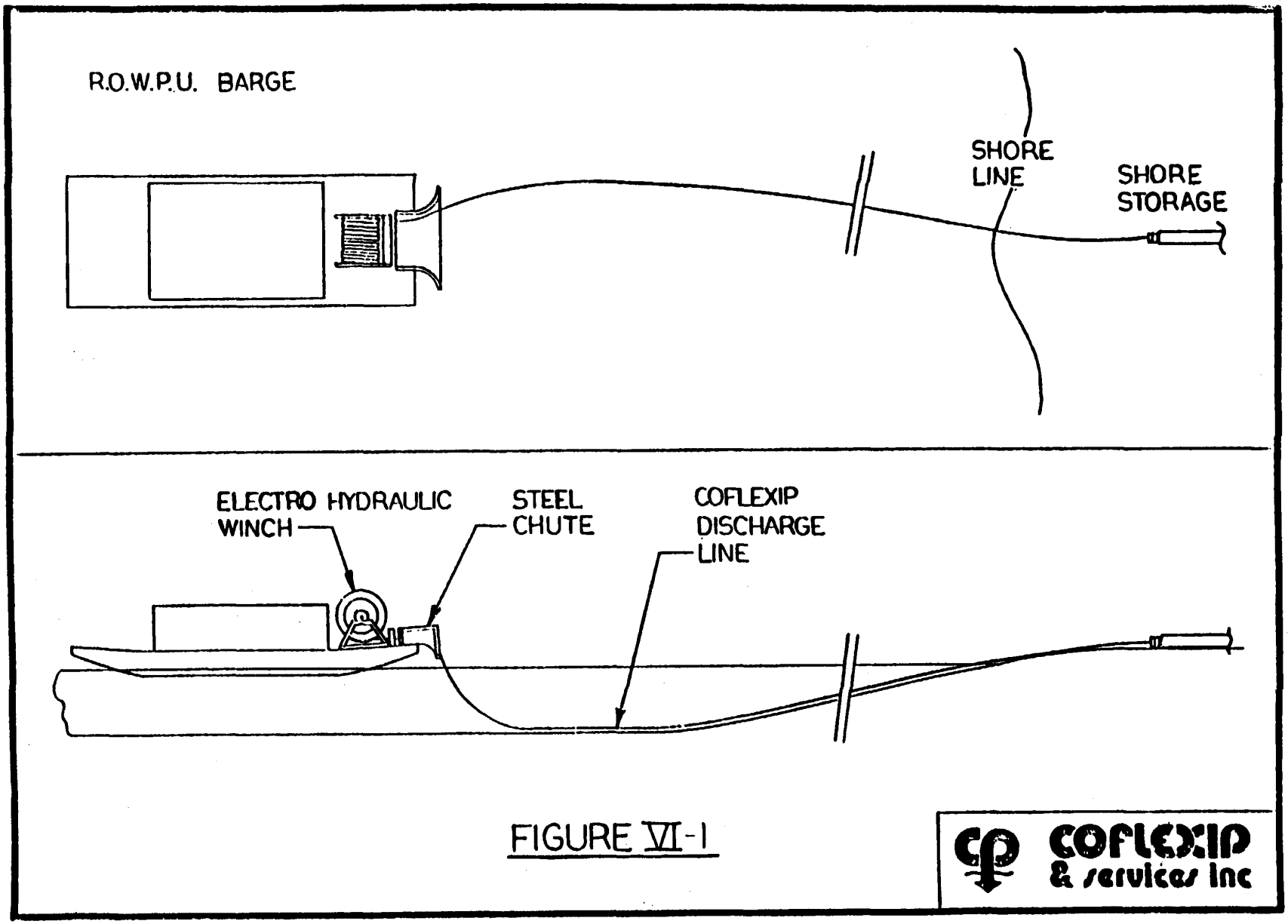


FIGURE VI-1

COFLEXIP & services Inc

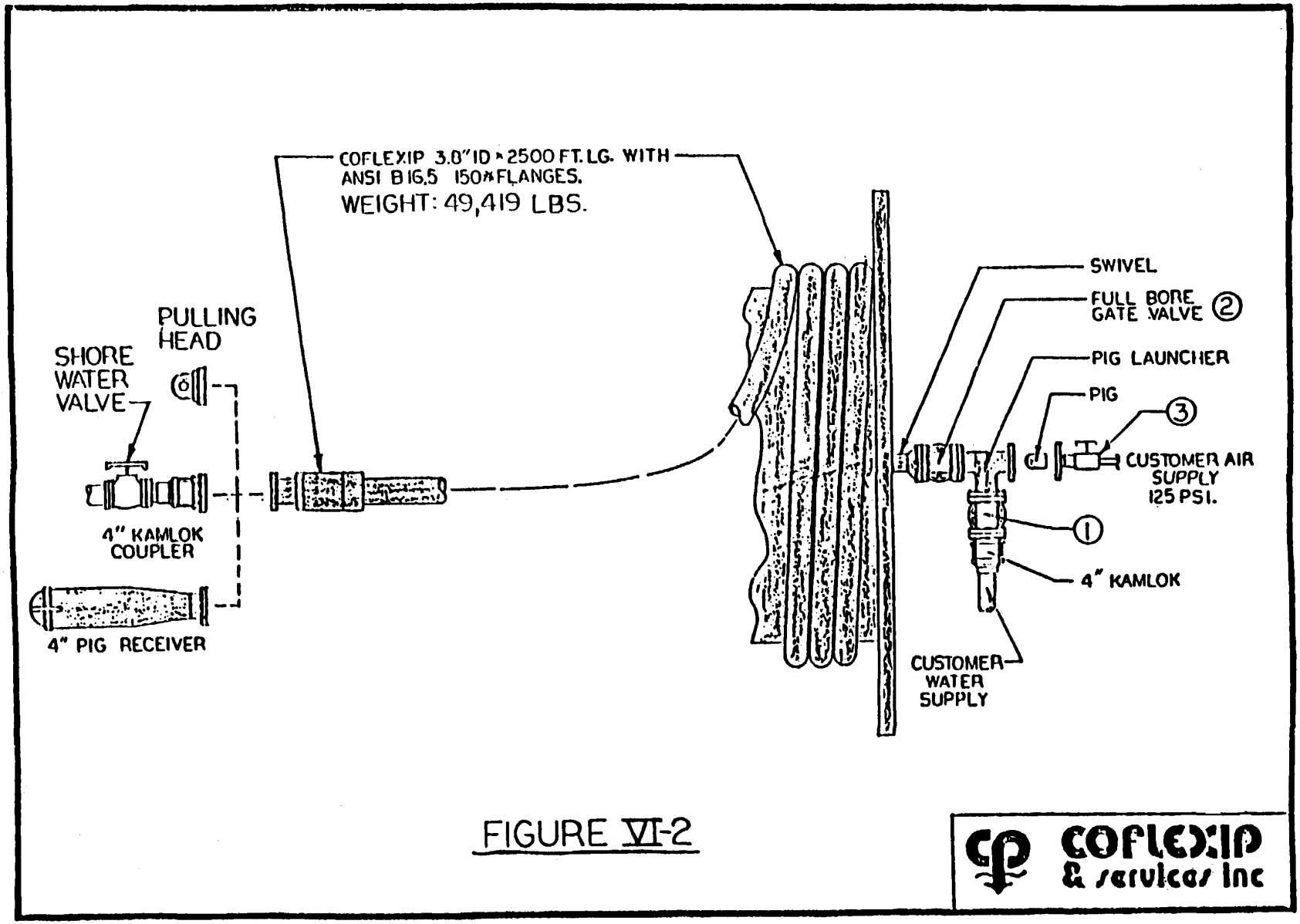
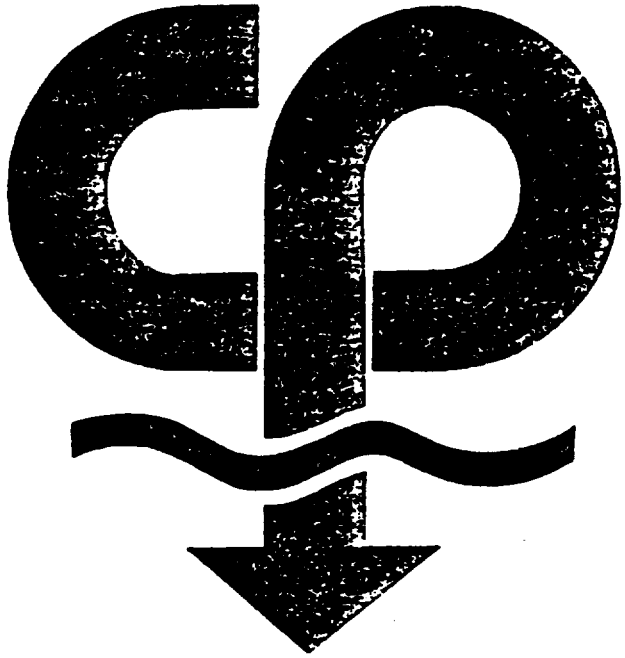


FIGURE VI-2

COFLEXIP & services Inc

COFLEXIP



VSE CORPORATION

DRINKING WATER DISCHARGE SYSTEM

CERTIFICATES AND TEST REPORTS

Coflexip Ref: 840464 B

VSE Ref: P.O. 48098 4/1/85

COFLEXIP & services inc
Phone: 713/627-8540
4242 Southwest Freeway, Suite 600
Houston, Texas
Twx: 910-881

COFLEXIP & services inc

TABLE OF CONTENTS

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H 840464-B

DRINKING WATER DISCHARGE SYSTEM

Certificate of Compliance

Coflexip & Services Inc. hereby certifies that its Drinking Water Discharge System meets the requirements specified in the V.S.E. Corporation Purchase Description Document, Purchase Order 48098 of April 1, 1985, and is both mechanically and functionally in the compliance with all requirements, including successful completion of final manufacturers inspection and all operational tests.

COFLEXIP & SERVICES

Bruno Floris
President

DATE 8-15-85

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H-840464-B

DRINKING WATER DISCHARGE SYSTEM

Hydrostatic Pressure Test Report

The winch/flexible pipe assembly was subjected to 450 psi (i.e. 150% of design pressure) for 1 hour.

The system held the test pressure, the hydrostatic pressure test was accepted.

Signed _____ Date 14 Aug 1985
VSE Representative

Signed _____ Date 14. Aug. 1985
Coflexip Representative

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H-840464-B

DRINKING WATER DISCHARGE SYSTEM

No Load Test Report

Test No. 1

The drum assembly, loaded with the flexible pipe full of water, has been operated under no load at 1.3 rpm.

From 11:45 a.m. to 1:45 p.m. Clockwise

From 1:45 p.m. to 3:45 p.m. Counterclockwise

Following temperatures have been recorded:

Locations	Temperature ° F
Brake side bearing	120
Driven side bearing	120
Gear Box	120
Electrical Motor	120
Hydraulic Motor	120
Hydraulic Pumps	

The no-load test was accepted.

Signed _____ Date 14 AUG 1985
VSE Representative

Signed _____ Date 14 Aug. 1985
Coflexip Representative

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H-840464-B

DRINKING WATER DISCHARGE SYSTEM

Rated Load Test Report

Test No. 2

The drum assembly has been operated:

* Under 10,000 lbs load at mid layer
* With 25 ft/mn speed
* Over a distance of 20 ft. in each direction, and for five complete cycles. The load has been stopped and held for a period of 1 minute at the end of each cycle.

The rated load test was accepted.

Signed _____ Date 14 Aug 1985
VSE Representative

Signed _____ Date 14 Aug. 1985
Coflexip Representative

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H-840464-B

DRINKING WATER DISCHARGE SYSTEM

Overload Test Report

Test No. 3

The drum assembly has been operated under 15,000 lbs. loaded at mid layer (150 percent normal load) at 25 ft/mn. over 20 ft. distance in each direction.

The overload test was accepted.

Signed _____ Date 14 Aug 1985
VSE Representative

Signed _____ Date 14 Aug. 1985
Coflexip Representative

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H-840464-B

DRINKING WATER DISCHARGE SYSTEM

Mechanical Drum Brake Test Report

Test No. 4

The drum assembly has been submitted to 15,000 lbs. pull at mid layer with brake on.

The effort to set the drum brake were noted as less than 60 lbs. on the hand wheel.

No slippage occurred.

The Mechanical drum brake test was accepted.

Signed _____ Date 14 Aug 1985
VSE Representative

Signed _____ Date 14 Aug. 1985
Coflexip Representative

COFLEXIP & services inc

V.S.E. CORPORATION
JOB H-840464-B

DRINKING WATER DISCHARGE SYSTEM

Hydraulic Motor Brake Test Report

Test No. 5

The disk brake was tested under the following conditions:

1. Under 15,000 lbs. static load at mid layer (150 percent of rate load). No slippage occurred.

2. Under 15,000 lbs. dynamic load at 25 ft./mn then suddenly stopped (by simulated power failure conditions). Stopping distance 0.1 ft.

The hydraulic motor brake test was accepted.

Signed _____ Date 14 Aug 1985
VSE Representative

Signed _____ Date 14 Aug. 1985
Coflexip Representative

Drinking Water Discharge

Winch System

Operations

Log

Operations Log

Drinking Water Discharge Winch System

Event No	Exercise and Date(s)	Operating Time				Remarks this Event
		ON Time	OFF Time	Elapse Time	Total Hrs To Date	

Afte
Ent

Drinking Water Discharge

Winch System

Maintenance

Log

Drinking Water Discharge Winch System Maintenance Log

Date	Exercise	Maintenance Tasks Accomplished and Remarks

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official: 

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
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DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 065355-000