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 8 FUEL OIL 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.

***This manual supersedes TM 55-1930-209-14&P-8, 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, controls, 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 gloves 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 settings.
- To avoid flying particles lodging in eyes, do not use compressed air to "dust-off' clothing or workspace.
- Stay dear of anchor cables when operating anchor winches.
- Always wear safety glasses or face shield when using power tools.
- Always wear life vests when on weatherdeck and throughout the barge during storm conditions.
- Life vests 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, shutdown 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 close 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-8

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.

1. SCOPE

TM 55-1930-209-14&P covers the Reverse Osmosis Water Purification Barges, Models 300-WPB-1, 300-WPB-2 and 300WPB-3, NSN 1930-01-234-2165. This manual consists 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 or to 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 55-1930-209-1 4&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 holding/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 consists of searchlights and floodlights for use at night or during reduced visibility. Lights on the weatherdecks 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 CO_2 hose reel units, a smoke detector system, 17 portable CO_2 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 fire 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 each 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 and the Repair Parts and Special Tools List for the winch.

TECHNICAL MANUAL
NO. 55-1930-209-14&P-8

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 8
FUEL OIL 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.

*Supersedes TM 55-1930-209-14&P-8, 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 LIST (ESML)
REPAIR PARTS AND SPECIAL TOOLS LIST (RPSTL)
REPAIR PARTS LIST TO FIGURE NUMBER CROSS-REFERENCE LIST

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)

TABLE OF CONTENTS (Continued)

VOLUME 8

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 fuel oil 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 installed systems is in TM55-1930-209-14 & P-1 thru P-7 and P-9 thru P-17. TM 55-1930-209-14 & P-18 and TM 55-1930-209-14&P-20 contains appendices common to all TM's. Location of major barge components is shown in Figure 1-1.

1-2 Scope. The fuel system onboard (Figure 1-2) provides fuel oil for two 155 kW diesel ship service generators (SSG's), a 20 kW ship auxiliary generator (SAG), two Reverse Osmosis Water Purification Unit (ROWPU) high-pressure (HP) pump diesel engines, and a fueling station for the barge workboat.

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

1-4 Maintenance forms 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. The fuel oil system provides a centralized receiving, storage and distribution system for diesel fuel used for barge operations. This includes diesel engine fuel for three generators, two HP pumps, and the workboat. Major components are listed in Table 1-1 and a block diagram of the fuel oil system is shown In Figure 1-2. System installation is shown in drawings referenced in Appendix A.

1-7.1 System Capabilities. Pump and tank capacities are stated in gallons (gal), pounds per square Inch (psi), and flow capacities in gallons per minute (gpm) or gallons per hour (gph).

1-8 Capabilities. This system provides fuel for about 7 days when barge Is operating 24 hours a day. The system provides fuel for about 21 days when the barge is operating 8 hours a day.

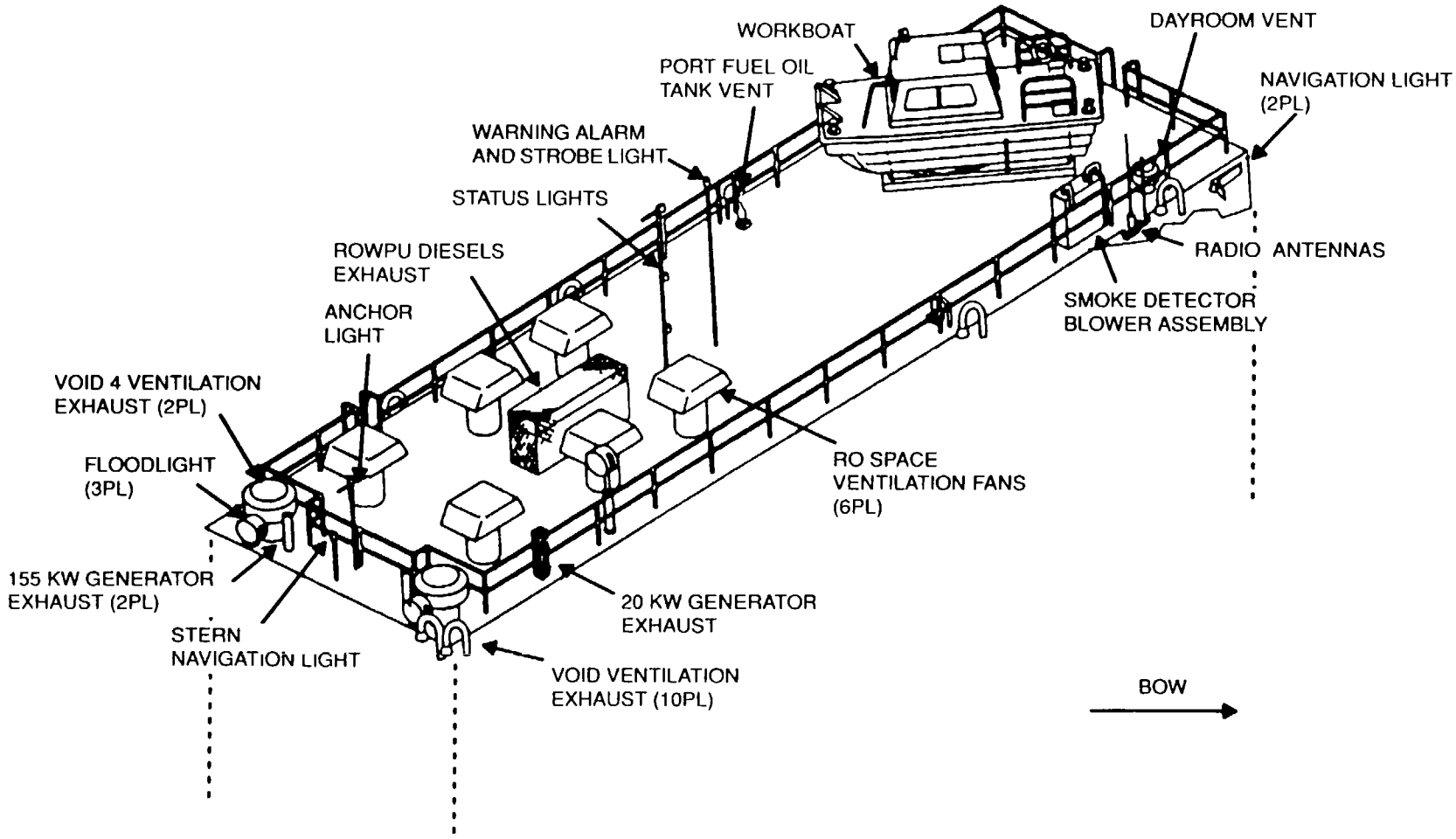


Figure 1-1. Major Components of ROWPU Barge Systems and Equipment - Deckhouse Roof (Sheet 1 of 3)

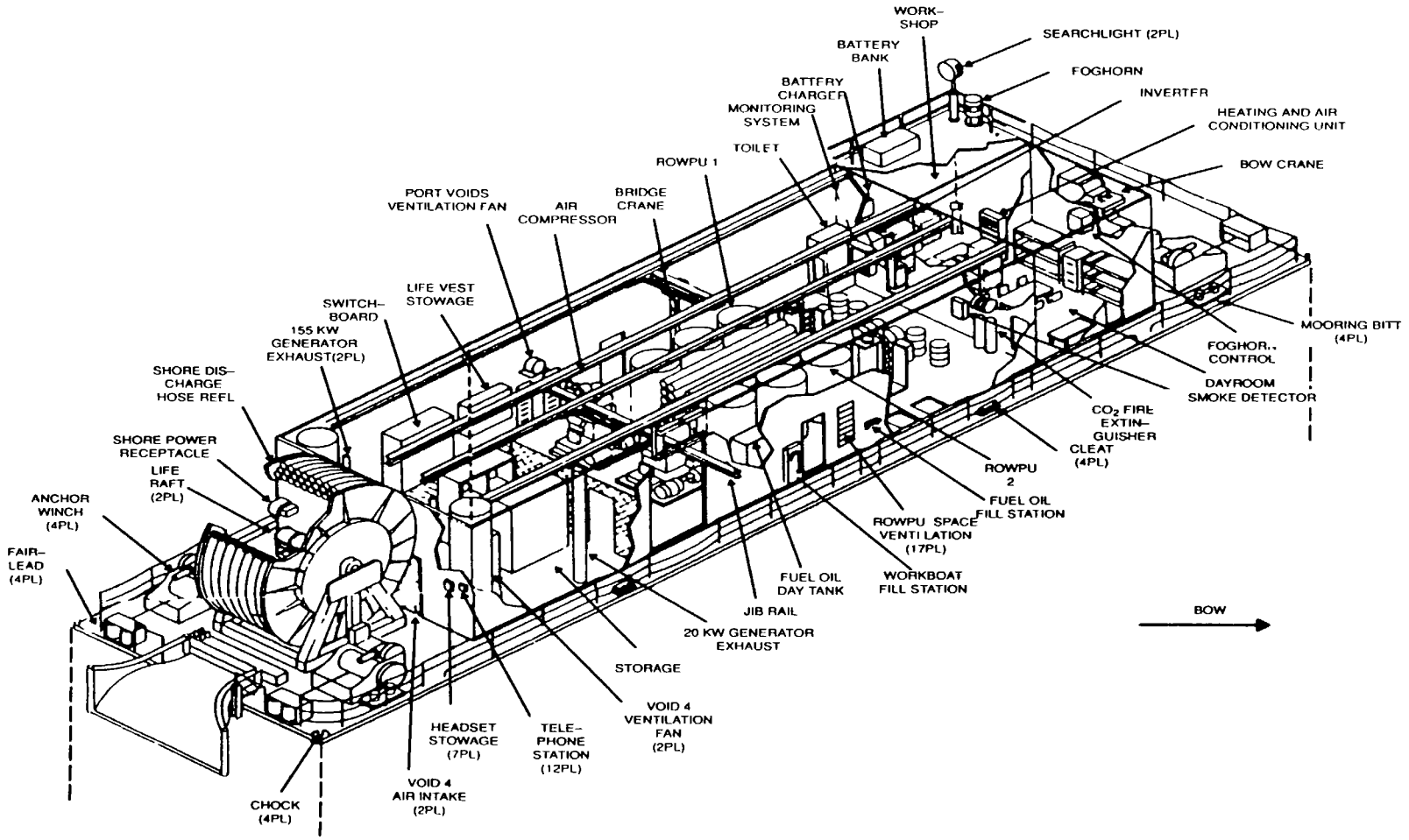


Figure 1-1. Major Components of ROWPU Barge Systems and Equipment - Deckhouse (Sheet 2 of 3)

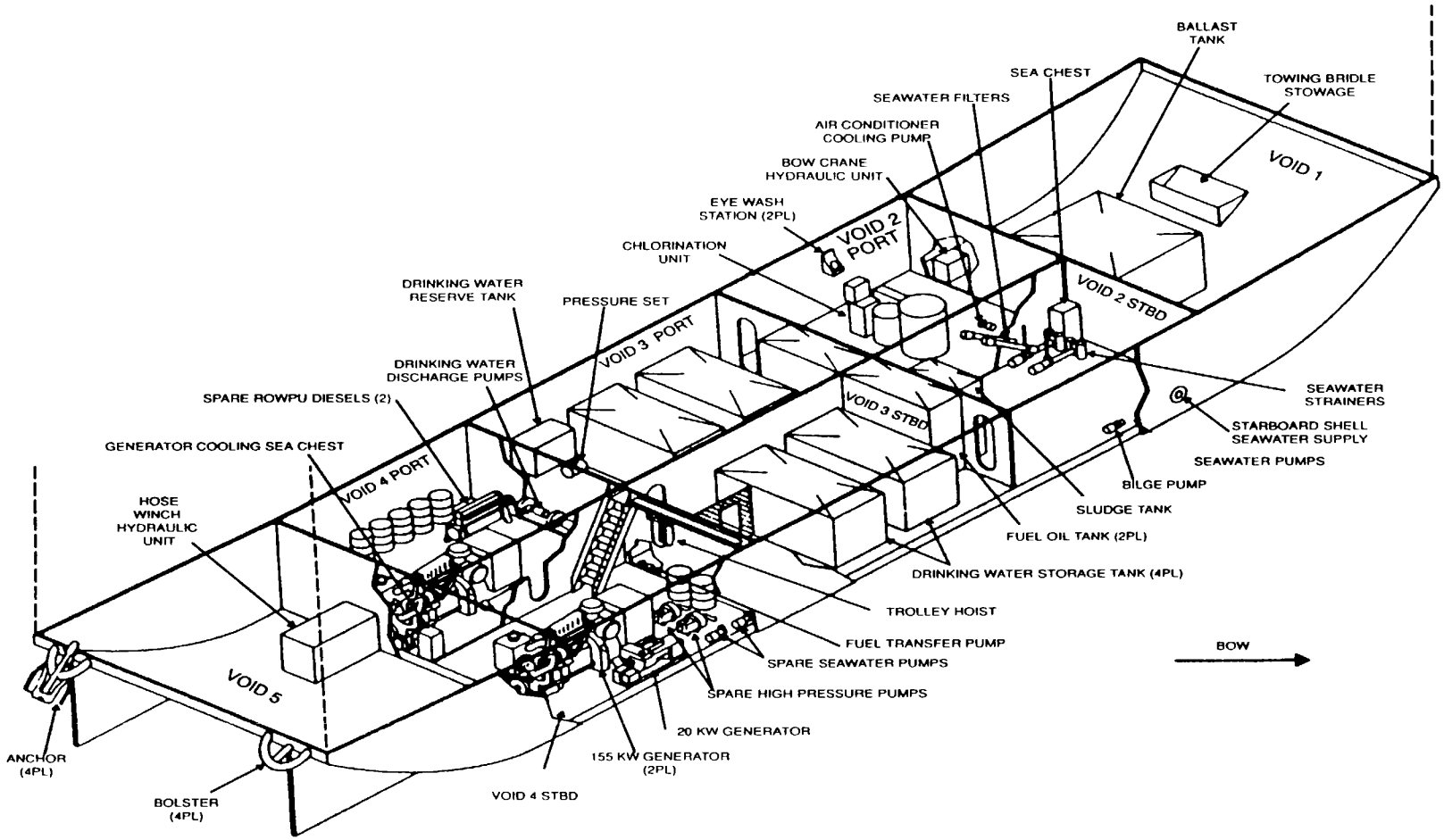


Figure 1-1. Major Components of ROWPU Barge Systems and Equipment - Voids (Sheet 3 of 3)

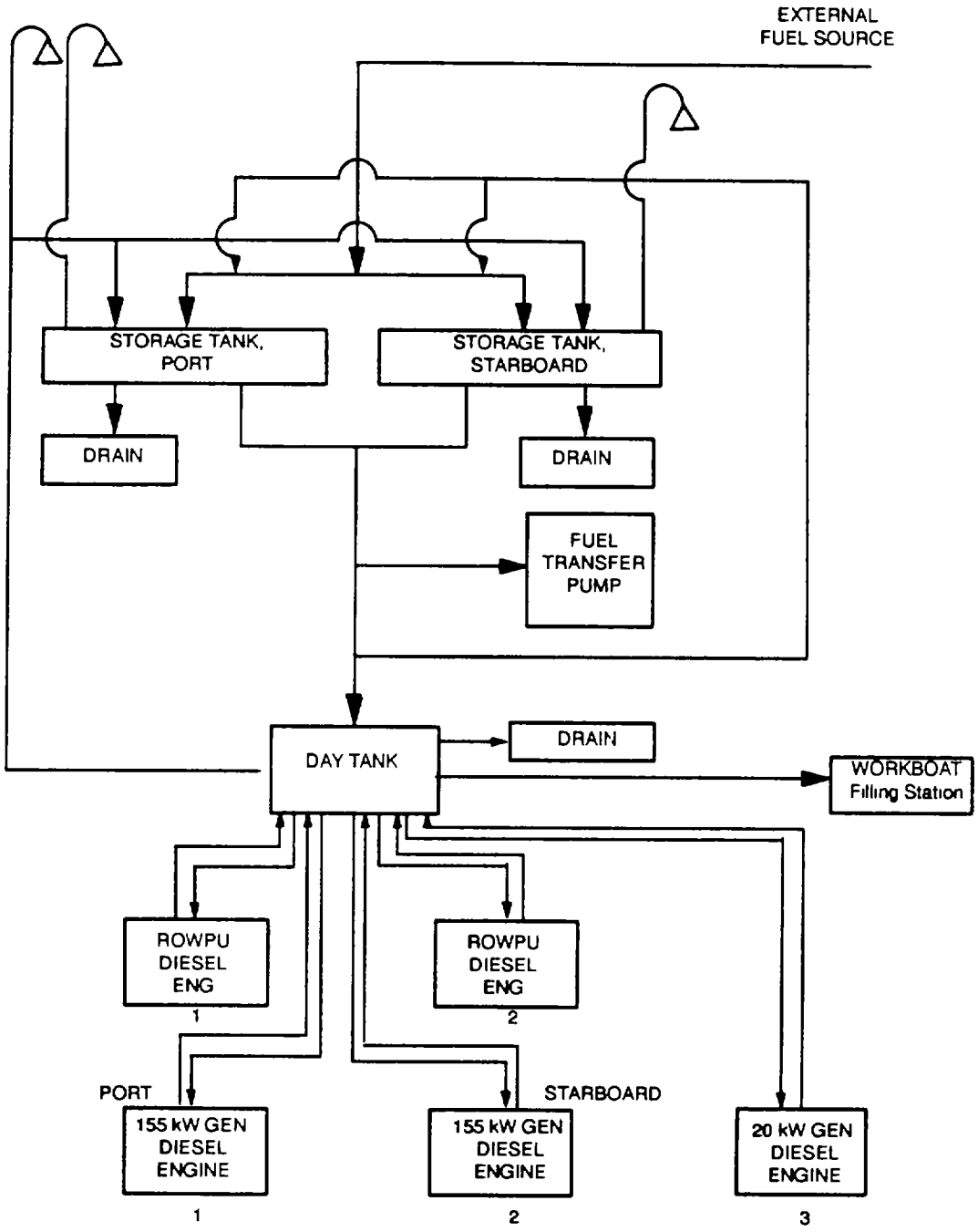


Figure 1-2. Fuel Oil System Block Diagram

Table 1-1. Major Components of Fuel Oil System

Component	Function	Location
Fuel oil port storage tank	Stores 3600 gal of fuel oil	Void 3 port
Fuel oil starboard storage tank	Stores 3600 gal of fuel oil	Void 3 starboard
Fuel oil storage day tank	Stores 320 gal of fuel oil	ROWPU space starboard
3 fuel oil liquid level indicators	Indicate level of fuel in each tank visually with high level switch	One on each storage tank and one on day tank
Fuel oil transfer pump	Used to transfer fuel oil from storage tank to day tank	Void 3 starboard
Fuel oil transfer pump motor controller	For starting and stopping fuel oil transfer pump	Void 3 starboard
Fuel oil transfer pump remote stop switch	For starting and stopping fuel oil transfer pump from ROWPU space	ROWPU space starboard bulkhead
Fuel oil filter	Filters foreign materials from fuel oil before entering fuel oil transfer pump	Void 3 starboard
Workboat fuel oil filling station	Fuel nozzle for filling workboat fuel oil tank	Deckhouse starboard side on weatherdeck forward of sliding door
Fuel oil filling station (fuel oil fill connection)	Fuel oil connection for filling storage tanks from fuel oil source	Deckhouse starboard side on weatherdeck aft of dayroom door
Fuel oil storage tank vent (air escape valve)	Allows free flow of air into fuel oil storage tanks and day tank prevents vacuum or excessive pressure build-up	Top of deckhouse starboard side-rail
Drains	For draining fuel oil tanks in void 3 and one in	One on day tank, one void 2 on storage tanks

1-9 Performance characteristics

a. Fuel oil system limitations
   24-hour daily operation 7 days
   8-hour daily operation 21 days
b. Fuel oil storage tanks and day tank capacities
   Port fuel storage tank 3600 gal
   Starboard fuel storage tank 3600 gal
   Day fuel storage tank 320 gal
c. Diesel service generators 1 (SSG1) and 2 (SSG2) and auxiliary generator
   Direct fuel feed from 320-gal day tank
d. ROWPU's 1 and 2 diesel-engine driven HP pumps
   Direct fuel feed from 320-gal day tank

1-10 Equipment specifications

a. Transfer pump	
Manufacturer	Viking Pump Division
Houdaille Industries, Inc.	
CAGEC	63097
Model no.	H432D
Type	Positive displacement
Capacity	10 gpm @ 25 psi
Quantity	1
b. Transfer pump motor	
Manufacturer	Marathon Electric Manufacturing Co.
CAGEC	38151
Model no.	PB132TTFS8076AAR27W
Type	TFS
Frame	143T
Code	K
Horsepower	1/2
Voltage	440 Vac, 3 ph, 60 Hz
Amperage	2.7
Rpm	1145
Insulation class	F
Duty cycle	Continuous
Quantity	1
c. Fuel storage tank air escape valve	
Manufacturer	Robert H. Wager Co., Inc.
CAGEC	79128
Part no.	1600W
Size	3 in nominal
Connection	Butt welded
Material	Steel
Quantity	2
d. Fuel storage tank Sure Site level indicator	
Manufacturer	Transamerica DeLaval Inc. Gems Sensors Division
CAGEC	04034
Part no.	86615, type C w/ROLI 4-20 milliamps
Type	Visual and remote sensing
Size:	
Nominal	1 in
Length	110 in
Connection	Threaded (NPT)
Quantity	2
e. Fuel storage tank level switch	
Manufacturer	Transamerica DeLaval, Inc.
Gems Sensors Division	
CAGEC	04034
Part No.	48068
Type	Series LS-2050, side-mouthed,
high level switch	

Connection	1/2 in Threaded NPT
Stern (Length)	3 7/16 in
Float (Length)	4 1/8 in
Float material	Brass and Buna
Lead Wires	18 AWG, 24" L. Polymeric
Quantity	3

* Item special ordered from regular Sure Site indicator stock.

f. Fuel oil filter

Manufacturer	Purolator Products Inc. Missile and Aviation Division
CAGEC	12989
Part no.	GP16-01
Capacity	16 gpm
Size	1 in Threaded (NPT)
Quantity	1

g. Day tank Sure Site level indicator

Manufacturer	Transamerica DeLaval Inc. Gems Sensors Division
CAGEC	04034
Part No.	86210, Type 2 w/high level switch
Type	Visual/high level switch
Size:	
Nominal	1/2 in
Length	80 in
Connection	Threaded (NPT)
Quantity	1

h. Transfer pump motor controller

Manufacturer	Square D Co., Bell Electric Products Division
CAGEC	81487
Part No.	8558 SBA-21 AFT-440/110 V, 3 ph, 60 Hz
Type	Nonreversing w/nonfusible disconnect switch
Rating	5 hp, 440 Vac, 3 ph, 60 Hz
Quantity	1
Thermal unit	
Part No.	B1.45
Quantity	3

i. Boat fill station

Nozzle:	
Manufacturer	Richards Industries Inc.
CAGEC	21476
Part No.	OPW-811
Type	Manual
Size	3/4 in nominal
Quantity	1

Hose.

Manufacturer	Dayco Corp. Electric Hose and Rubber Products Co
CAGEC	11288
Part No.	7111-752BL
Type	Marine refueling
Size	3/4 in ID
Length	20 ft
Quantity	1

j. Day tank air escape valve

Manufacturer	Robert H. Wager Co., Inc.
CAGEC	79128
Part No.	1600T
Size	1 1/2 in nominal
Connection	Threaded
Material	Steel
Quantity	1

k. Gate valve

Specification	ANS B16.34
CAGEC	80204
Part No.	ANS B16.34 Type 1, SVCE G
Size	1 in nominal
Connection	Threaded
Rating	150 lb
Material	Steel
Quantity	11

l. Globe valve

Specification	ANS B16.34
CAGEC	80204
Part No.	ANS B16.34 Type 1, SVCE G
Size	1 in nominal
Connection	Threaded
Rating	150 lb
Material	Steel
Quantity	5

m. Globe valve

Military specification	MIL-V-18434
CAGEC	81349
Part No.	Type II, SVCE G
Size	2 1/2 in nominal
Connection	Butt welded
Rating	150 lb
Material	Steel
Quantity	3

n. Globe valve

Supplier	McMaster-Carr Supply Co.
CAGEC	39428
Part No.	4737K12
Size	3/8 in nominal
Connection	Female thread
Rating	800 lb
Material	Steel
Quantity	10

o. Gate valve	
Specification	ANS B16.34
CAGEC	80204
Part No.	ANS B16.34 Type 1, SVCE G
Size	3/4 in nominal
Connection	Threaded
Rating	150 lb
Material	Steel
Quantity	1
p. Swing check valve	
Military specification	MIL-V-18436
CAGEC	81349
Part No.	Group B, Type III
Size	1 in nominal
Connection	Threaded
Rating	125 lb
Material	Cast iron
Quantity	1
q. Globe valve	
Manufacturer	ITT Grinnel Valve Co., Inc. Dia-Flo Division
CAGEC	19243
Part No.	Fig. no. 3210
Size	3/4 in nominal
Connection	Threaded
Material	Bronze
Quantity	1
r. Transfer pump remote stop switch	
Manufacturer	Square D Company
CAGEC	56365
Part No.	BW151
Type	NEMA type 4, one unit, stop
Class	9001
Quantity	1

1-11 Items furnished

1-11.1 Components installed as part of the fuel oil system are listed on the parts list of the drawings referenced in Appendix A and in the Components of End Item List in TM 55-1930-209-14&P-20.

1-11.2 Common and bulk items onboard are listed in the Expendable Supplies and Materials List in TM 55-1930-209-14&P-20.

1-11.3 Repair parts and special tools onboard are listed in the Repair Parts and Special Tools List in TM 551930-209-14&P-18.

1-12 Items required but not furnished. All required items are furnished.

1-13 Tools and test equipment. 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

2-1 General. This system provides diesel fuel, when required, from the day tank via hard piping to service diesel generators, auxiliary generator, ROWPU diesel HP pumps and the workboat fueling station.

2-1.1 Storage tanks. The main fuel storage tanks are filled through the fill station (Figure 1-2). When the tanks are being filled, Equipment Monitoring System (EMS) displays the fuel oil tank levels on the video monitor. This system also triggers visual and audible alarms to indicate that fuel tanks are full and filling operation must be stopped.

2-1.2 Day tank. When day tank's level indicator shows that it requires fuel, transfer fuel from the fuel oil storage tanks. Operate the fuel oil transfer pump to move fuel from storage tanks and discharge it into the day tank. When day tank is nearly full, stop the pump. If pump is not stopped manually, a high level switch cuts off electrical power to pump. An overfill line provides a return to storage tanks in case cutoff switch malfunctions.

2-1.3 Draining tanks. When day tank must be emptied, drain back to storage tank by opening drain valves on the bottom of day tank. Day tank can also be drained to outside facilities by connecting appropriate hose to the drain valve located below the day tank and then opening the drain valve. Storage tanks can be emptied by pumping fuel off barge after making appropriate connections to the off-barge receiving container, operating the necessary valves, and activating the fuel oil transfer pump. Fuel also can be transferred from one storage tank to another by using fuel oil transfer pump. In this operation, the day tank may be bypassed. Storage tanks can also be drained directly to the sludge tank using the bilge pump. See TM 55-1930-209-14&P-15 for use of bilge system.

2-1.4 Workboat fueling. Fuel oil is provided to the workboat via the workboat fuel oil filling station located on deckhouse starboard side. In this operation, fuel Is transferred from day tank to workboat filling station, and through a hose with a nozzle to the workboat fuel tank.

CHAPTER 3 OPERATING INSTRUCTIONS

Section I. Operating controls and indicators

3-1 Operating controls and indicators. Operating controls and indicators consist of liquid level indicators, a transfer pump motor controller, switches, and operating valves. Visual liquid level indicators (Figure 3-1) are mounted on each of the two fuel storage tanks and the day tank. The EMS (TM 55-1930-20914&P-11) continuously monitors fuel oil levels in the storage tanks through a sensor mounted inside each tank. When a fuel oil storage tank is full, FO LEVEL HIGH indicator on the EMS video monitor's generators display (Figure 3-2) lights up. This condition also triggers an audible alarm and a flashing strobe light to warn crew to stop filling the tank. When day tank is full, a high level switch on the liquid level indicator (Figure 3-1) stops transfer pump. Transfer pump motor controller is shown in Figure 3-3. Location of fuel oil system valves is shown in Figure 3-4. Identification, location and function of operating valves are in Table 3-1.

Section II. Prestart procedures

3-2 Prestart procedures. Before performing any fuel oil system operation, check system components for operating condition and perform before operation checks in Chapter 2, TM 55-1930-209 14&P-19. In addition know how the EMS monitors the fuel oil system and how to operate the EMS (TM 55-1930-209-14&P-11).

Section III. Operating procedures

3-3 Operating procedures. Normal fuel oil system procedures include the following:

NOTE

Perform during operation checks In Appendix C as applicable.

a. Filling both fuel oil storage tanks at same time or filling either port or starboard tank (see paragraph 3-3.1).
b. Transferring fuel oil to day tank from both storage tanks or from either port or starboard tank (see paragraph 3-3.2).
c. Providing fuel oil to diesel engines from day tank (see paragraph 3-3.3).
d. Providing fuel oil to workboat (see paragraph 3-3.4).
e. Transferring fuel oil from storage tank to storage tank (see paragraph 3-3.5).
f. Draining day tank to storage tanks or sludge tank (see paragraph 3-3.6).
g. Draining storage tanks to off-barge facility (see paragraph 3-3.7).

WARNINGS

- **During fuel oil transfer operations, neither open flame nor smoking is permitted within 10 feet of the operation. Only minimum number of personnel necessary to conduct fueling operation is permitted in the area.**
- **Observe all safety precautions during fuel oil transfer operations. Make every effort to prevent leaks or spills and clean these immediately.**

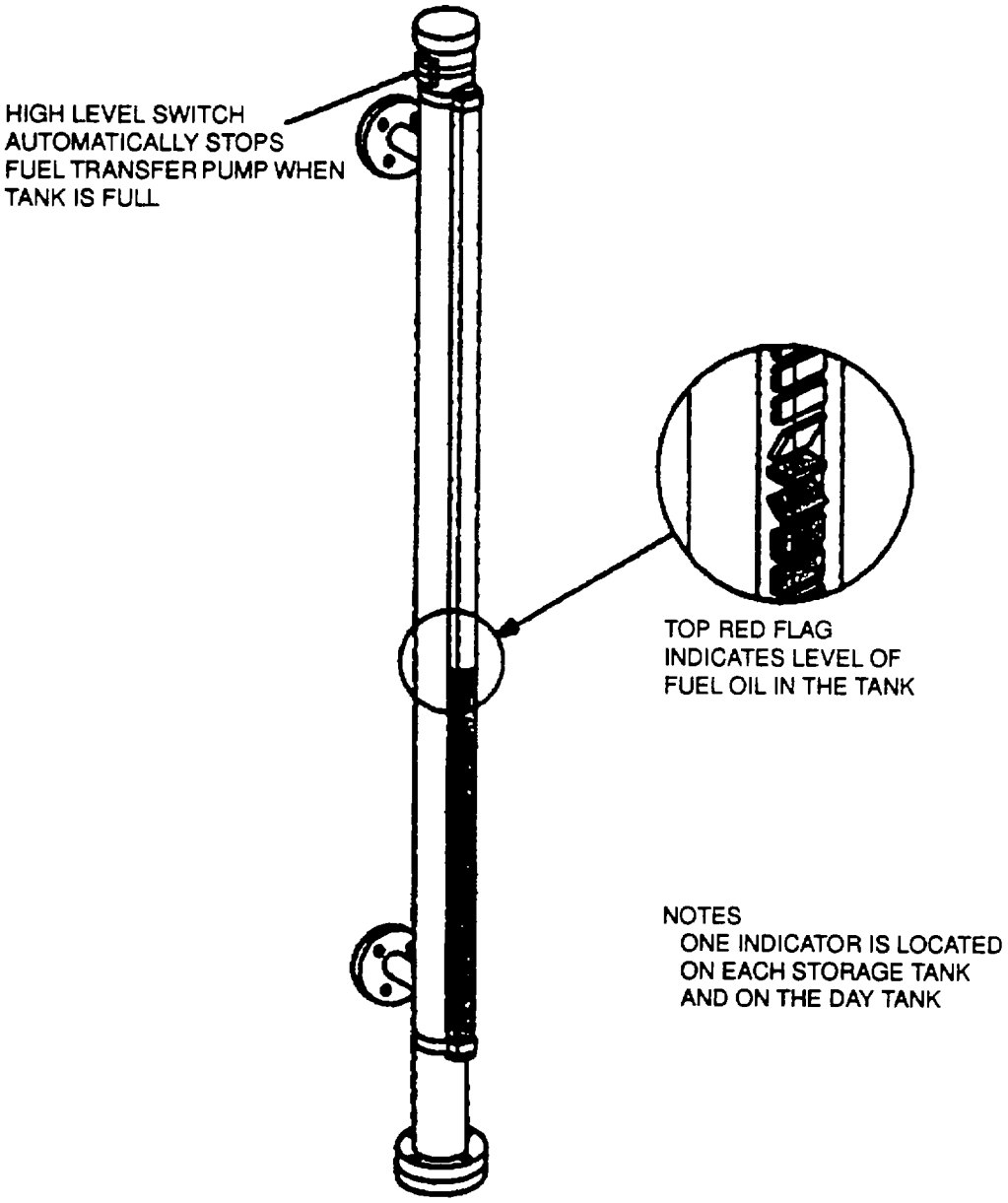


Figure 3-1. Tank Liquid Level Indicator

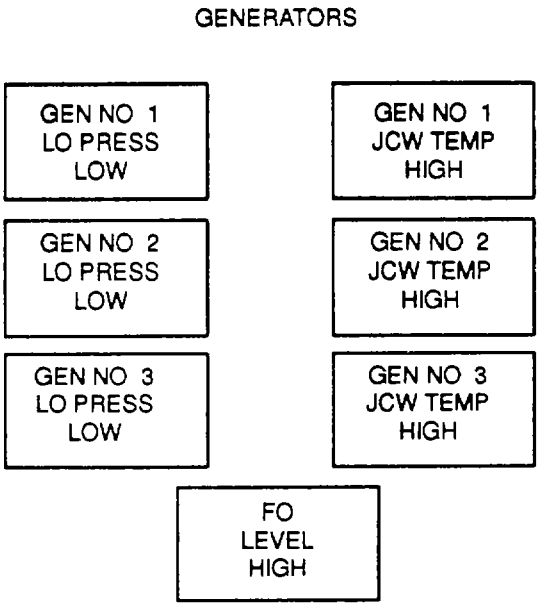


Figure 3-2. Monitoring System Generator Alarms Display

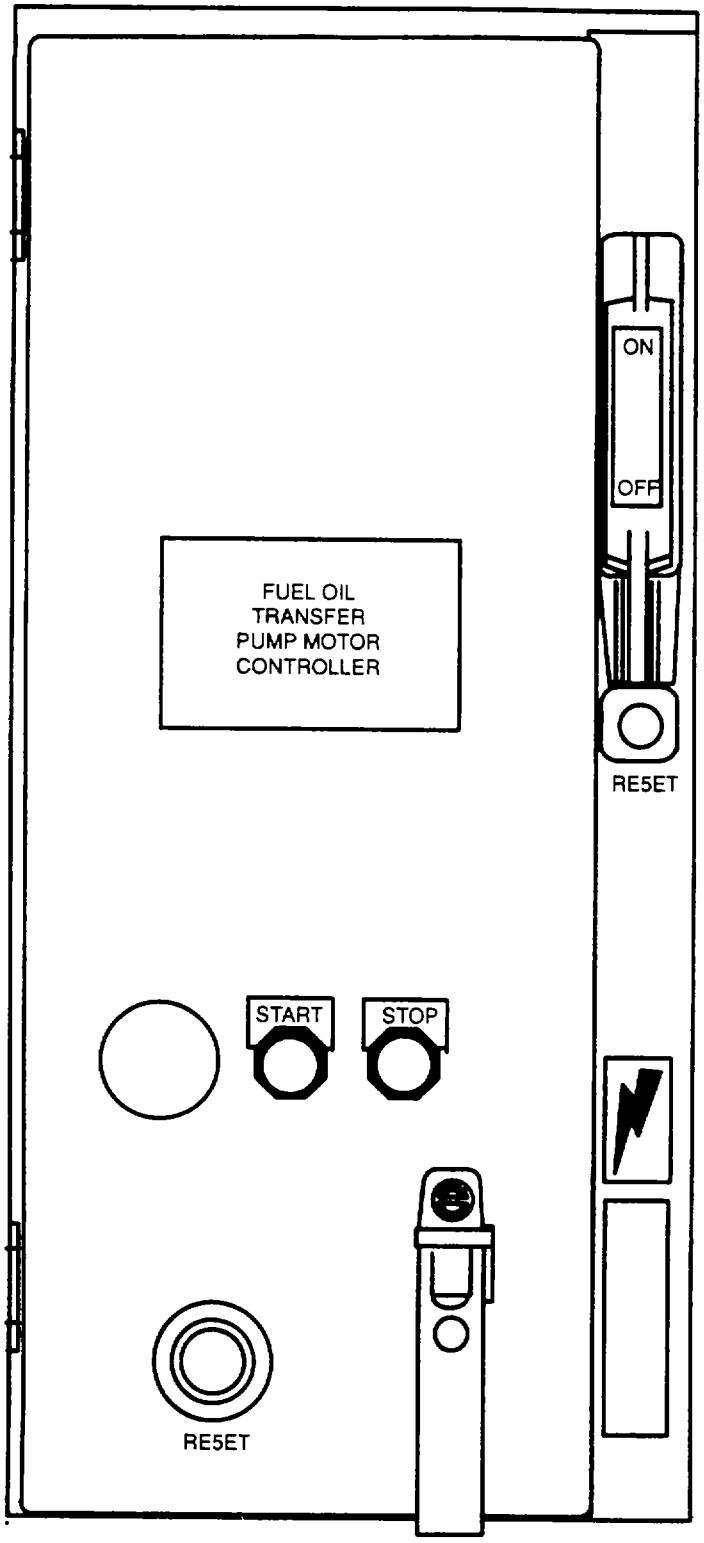
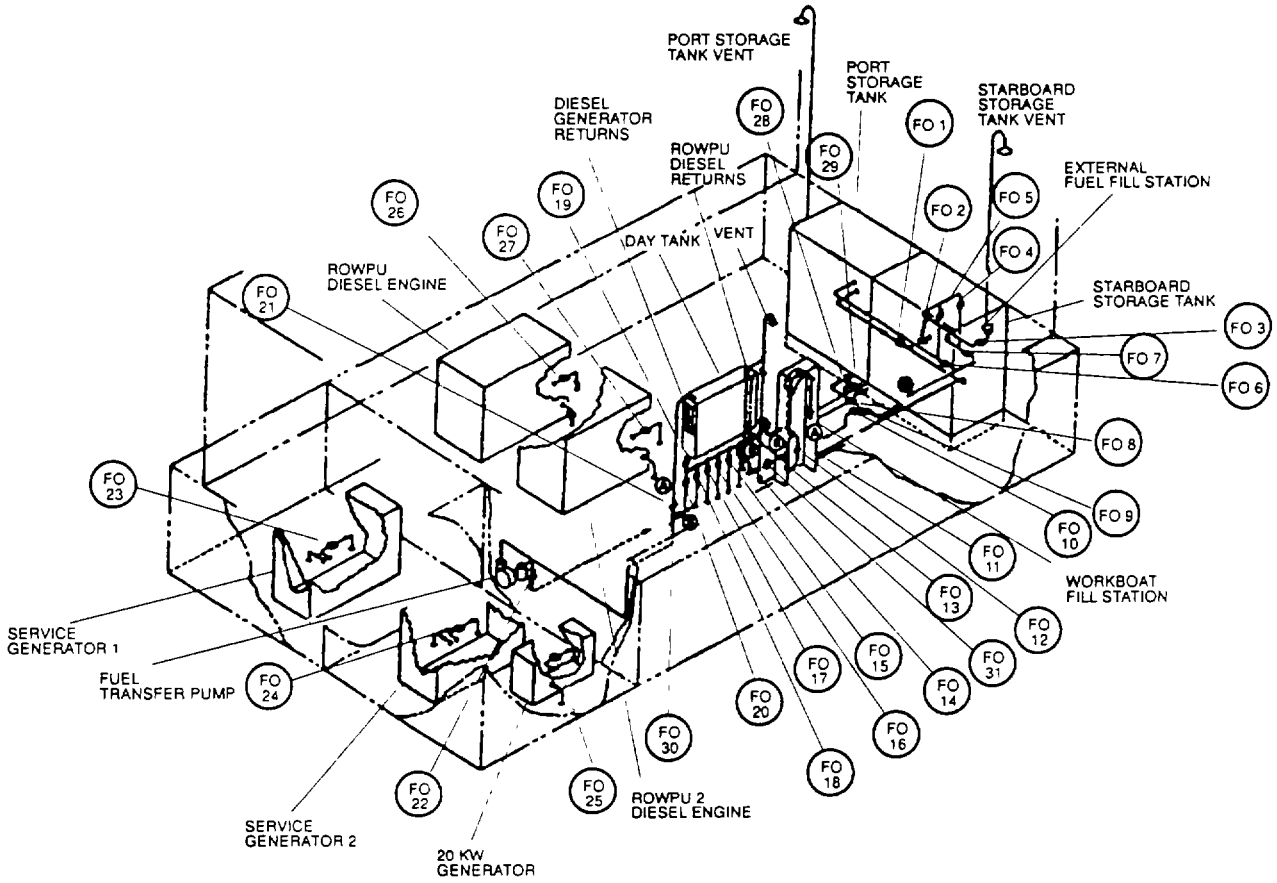


Figure 3-3. Fuel Oil Transfer Pump Motor Controller



NOTE: Valve FO30 is installed on Barges 2 and 3 only.

Figure 3-4. Location of Fuel Oil System Valves

Table 31. Fuel Oil System Valves

Type	Figure 34 Callout	Location	Valve Name and Function
1-in globe valve	FO1	Void 3 starboard overhead in front of starboard storage tank	DAY TANK OVERFLOW TO PORT STORAGE TANK: Allows fuel to flow from day tank overflow to port storage tank
1-in globe valve	FO2	Void 3 starboard overhead in front of starboard storage tank	DAY TANK OVERFLOW TO STARBOARD STORAGE TANK: Allows fuel to flow from day tank overflow to starboard tank
2 1/2-in globe valve	FO3	Weatherdeck on starboard side near fuel fill station	STORAGE TANKS FILL: Allows fuel to flow to valves FO4 and FO5
2 1/2-in globe valve	F04	Deckhouse ROWPU space starboard side forward of day tank	STARBOARD STORAGE TANK FILL: Allows starboard storage tank to be filled
2 1/2-in globe valve	FO5	Deckhouse ROWPU space starboard side forward of day tank	PORT STORAGE TANK FILL: Allows port storage tank to be filled
1-in globe valve	F06	ROWPU space starboard side	STARBOARD TO PORT STORAGE TANK TRANSFER: Allows fuel to be transferred from starboard to port storage tank
1-in globe valve	FO7	ROWPU space starboard side port to starboard storage tank	PORT TO STARBOARD STORAGE TANK TRANSFER: Allows fuel to flow from
1-in gate valve	FO8	Void 3 starboard near bottom of starboard fuel storage tank	PORT STORAGE TANK DISCHARGE: from port storage tank into day tank supply line and for isolating port storage tank
1-in gate valve	FO9	Void 3 starboard in day tank fuel supply line near valves FO8 and FO10	STARBOARD STORAGE TANK DISCHARGE: Allows fuels to be discharged from starboard tank and for isolating starboard storage tank
1-in gate valve	FO10	Void 3 starboard in day tank fuel supply line near valve F09	STORAGE TANKS DISCHARGE: Allows fuel to be discharged from valves FOB AND FO9 to transfer pump
3/4-in gate valve	FO11	ROWPU space forward side of day tank	WORKBOAT SUPPLY: Allows fuel to flow to valve FO12 on weatherdeck boat fill station
3/4-in globe valve	FO12	Weatherdeck in boat fill station	BOAT FILL: Allows fuel to be supplied to workboat
1-in gate valve	FO13	ROWPU space below day tank	DAY TANK DRAIN TO STORAGE TANKS: Allows fuel to be drained to storage tank
3/8-in globe valve	FO14	ROWPU space below day tank	ROWPU1 DIESEL ENGINE SUPPLY: Allows fuel to flow to valve FO26 at HP pump supply side
3/8-in globe valve	FO15	ROWPU space below day tank	ROWPU2 DIESEL ENGINE SUPPLY: Allows fuel to flow to valves FO27 at HP pump supply side

Table 3-1. Fuel Oil System Valves (continued)

Type	Figure 34 Callout	Location	Valve Name and Function
3/8-in globe valve	FO16	ROWPU space below day tank	SERVICE GENERATOR 1 SUPPLY: Allows fuel to flow to valve FO23 (SSG1)
3/8-in globe valve	FO17	ROWPU space below day tank	SERVICE GENERATOR 2 SUPPLY: Allows fuel to flow to valve FO24 (SSG2)
3/8-in globe valve	FO18	ROWPU space below day tank	20 KW GENERATOR SUPPLY: Allows fuel to flow to valve FO25 (SAG)
1-in gate valve	FO19	ROWPU space on left side of day tank	GENERATOR MAIN SUPPLY: Allows fuel transfer from day tank to diesel engine or drain
1-in globe valve	FO20	ROWPU space beside day tank	DAY TANK DRAIN: Allows drainage of day tank
1-in gate valve	FO21	ROWPU space on day tank	DAY TANK FILL: Allows fuel transfer to day tank via transfer pump
1-in gate valve	FO22	Void 3 starboard near shell at frame 75	TRANSFER PUMP SUCTION: Allows suction of fuel from storage tanks
3/8-in ball valve	FO23	Void 4 port supply line to SSG1	SERVICE GENERATOR 1 FUEL SUPPLY: Allows fuel to be supplied to SSG1
3/8-in ball valve	FO24	Void 4 starboard on SSG2	SERVICE GENERATOR 2 FUEL SUPPLY: Allows fuel to be supplied to SSG2
3/8-in ball valve	FO25	Void 4 starboard on 20 kW SAG	20 KW GENERATOR FUEL SUPPLY: Allows fuel to be supplied to SAG
3/8-in ball valve	FO26	ROWPU space portside in HP pump	ROWPU UNIT 1 HIGH PRESSURE PUMP SHUTOFF: Allows fuel to be supplied to HP 1 diesel engine
3/8-in ball valve	FO27	ROWPU space starboard in HP pump	ROWPU UNIT 2 HIGH PRESSURE PUMP SHUTOFF: Allows fuel to be supplied to HP 2 diesel engine
1-in gate valve	FO28	Void 3 port bottom of port storage tank	PORT STORAGE TANK DRAIN: Allows fuel to be drained from port storage tank
1-in gate valve	FO29	Void 3 starboard bottom of starboard tank (Barges 2 and	STARBOARD STORAGE TANK DRAIN: Allows fuel to be drained from starboard storage tank 3 only)
1-in gate valve	FO30	ROWPU space bottom of day tank (Barges 2 and 3 only)	DAY TANK DRAIN TO STORAGE TANKS: Allows fuel to bypass day tank for return to storage tanks
1-in gate valve	FO31	Void 3 starboard in day tank fuel supply line	STORAGE TANKS DRAIN: Allows fuel to be drained from storage tanks to off-barge

3-3.1 Filling fuel oil storage tanks. In this operation, fuel is transferred from a fuel oil-carrying vessel or shore facility through the starboard fuel fill station to either or both storage tanks. As the storage tanks are being filled, the EMS video monitor shows the fuel oil level on its TANK LEVELS display (Figure 3-5). The EMS also activates the alarm bell and strobe light when storage tanks are full.

a. Make sure EMS is on and operating properly before starting fuel transfer.

b. Close (ON) 24 Vdc panel circuit breakers 1 and 4.

c. Make sure all pipes. valves, and fittings involved in this transfer are functioning properly. Correct any problems before starting fueling operation.

d. Make sure fuel vessel is properly positioned and secured.

e. Display red flag (BRAVO) on deckhouse top mast during the daylight and a red light during darkness to warn other vessels that a fueling operation is in progress.

TANK LEVELS

MAIN FUEL	0	700	1500	2100	2300	3500	GALS
TANK NO. 1	I	I	I				
TANK NO. 2	I	I	I	I	I		
BALLAST	0	2200	4400	6600	8000	11000	GALS
TANK	I	I	I	I			

Figure 3-5. Monitoring System Fuel Oil and Ballast Tank Page Display

f. Station a crew member, as a backup to the alarm system, at the tank being filled to observe its fuel oil liquid level indicator. Using intercom system, this crewmember must notify crewmember stationed at point of control for fuel oil flow when the tank is nearly full.

g. Remove cap from fuel fill station on starboard weatherdeck.

h. Attach fuel hose from fuel vessel to fuel fill station on starboard weatherdeck. Make sure hose has sufficient slack to allow for movement of vessels due to waves and currents. Make sure hose is properly suspended between vessels to prevent damage by either the barge or the fueling vessel.

i. Open and/or close fuel oil system valves to fill either or both storage tanks as follows:

o = open x = closed

Open/close valve no.:

Tanks to be filled:	1	2	3	4	5	6	7	8	9	28	29
Both storage tanks	x	x	o	o	o	x	x	x	x	x	x
Port storage tank only	x	x	o	x	o	x	x	x	x	x	x
Starboard storage tank only	x	x	o	o	x	x	x	x	x	x	x

j. When fuel oil vessel is ready, start fuel oil transfer.

WARNING

AVOID OVERFILLING STORAGE TANKS.

NOTE

Bargemaster must immediately stop spillage in the event fuel oil is discharged into or upon navigable waters within contiguous waters of the United States if such discharge causes a film, sheen, or discoloration on the surface of the water. The US Coast Guard (USCG) must be notified Immediately by the fastest method available (either radio or telephone). Violators are subject to a fine. Spillage in foreign areas must be treated in accordance with local applicable regulations.

The EMS monitors fuel levels in the storage tanks and alerts the crew in the following manner. A horn and strobe light are activated on the deckhouse top and in the ROWPU space and a buzzer sounds In the dayroom. In addition, EMS keyboard alarm sounds and video monitor automatically switches to ALARM SUMMARY page which shows in flashing double intensity the tank level status. TANK LEVELS key on keyboard also flashes red.

k. When tanks are full, stop fuel oil transfer.

l. If alarms are activated, stop fuel oil transfer immediately and stop alarms as follows:

(1) Press red flashing TANK LEVELS key on keyboard to change ALARMS page to TANK LEVELS page on video monitor.

(2) Press ACK key on keyboard to stop alarms and automatically change red flashing TANK LEVELS key to white and to stop flashing display on video monitor. Display will now show in double intensity display.

m. Disconnect fuel oil transfer hose and replace fuel oil filling connector cap.

n. Close valves opened in step e.

o. Cease display of red flag (BRAVO) or red signal from mast on deckhouse top.

3-3.2 Transferring fuel oil from storage tanks to day tank. In this operation, fuel oil is transferred from port and starboard fuel oil storage tanks to day tank by using fuel transfer pump. As day tank is being filled, fuel level is shown on visual level indicator mounted on the tank.

a. Make sure power is available either from an onboard service generator or from shore power source. If shore power is not available and a generator is not online, start up SAG by following procedures in TM 55-1930-209-14&P-9. Before attempting to start generator, make sure 24 Vdc power panel emergency shutdown circuit breaker 8P14 is closed (ON).

b. Make sure switchboard circuit breaker P5 is closed (ON) to provide power to power panel 1.

c. Make sure power panel 1 circuit breaker 2P5 is closed (ON) to provide power to fuel oil transfer pump controller.

d. Open and/or close fuel oil valves to transfer fuel oil from either or both storage tanks as follows:

o = open x = closed

Open/close valve no.:

Transfer from:	1	2	6	7	8	9	10	11	13	19	20	21	22
Both storage tanks	o	o	x	x	o	o	o	x	x	x	x	o	o
Port storage tank only	o	x	x	x	o	x	o	x	x	x	x	o	o
Starboard storage tank only	x	o	x	x	x	o	o	x	x	x	x	o	o

e. Start fuel oil transfer pump by pressing black START button on pump controller (Figure 3-3) located above the fuel oil transfer pump in void 3 starboard.

CAUTION

If pump does NOT start moving fuel oil within 1 minute, turn pump OFF before it is damaged. Troubleshoot as given in Table 4-1.

NOTE

Day tank high level switch automatically stops pump when tank is full. If tank overfills, excess fuel in day tank will drain through vent back to storage tanks.

f. If day tank high level switch does not automatically stop pump, manually stop pump by pushing red STOP button on transfer pump remote stop switch between day tank and sliding cargo door, or STOP/RESET button on pump motor controller on aft bulkhead in void 3 starboard.

g. Close valves opened in step c above.

3-3.3 Transferring fuel oil from day tank to diesel engines. In this operation, gravity feed supplies fuel oil from day tank to diesel engine driven generators SSG1 and SSG2, the 20 kW SAG, ROWPU 1 HP pump, and ROWPU 2 HP pump.

a. Make sure diesel engines to be operated are readyto receive fuel oil.

b. Make sure FO valves 28, 29, and 31 are closed on Barge 1. On Barge 2 and 3 ensure that FO valves 28 through 31 are closed.

c. Open/close fuel oil valves as follows'

o = open x = closed

	Open/close valve no.:													
Fuel oil transfer to:	13	14	15	16	17	18	19	20	21	23	24	25	26	27
SSG 1	x	x	x	o	x	x	o	x	x	o	x	x	x	x
SSG2	x	x	x	x	o	x	o	x	x	x	o	x	x	x
20 kW SAG	x	x	x	x	x	o	o	x	x	x	x	o	x	x
ROWPU 1 HP pump	x	o	x	x	x	x	o	x	x	x	x	x	o	x
ROWPU 2 HP pump	x	x	o	x	x	x	o	x	x	x	x	x	x	o

d. To shut down fuel oil supply to diesel engine upon engine shutdown, close fuel oil valves as follows:

Fuel oil transfer stopped to:	Close Fuel Oil (FO) valve no:
SSG1	16 or 23
SSG2	17 or 24
20 kW SAG	18 or 25
ROWPU 1 HP pump	14 or 26
ROWPU 2 HP pump	15 or 27

e. To shut down fuel oil supply to all diesel engines, close valve FO19.

3-3.4 Fueling workboat. In this operation, fuel is supplied by gravity feed from day tank to workboat (TM 55-1930-209-14& P-17) by using the boat fill station.

a. Display red flag (BRAVO) on deckhouse top mast during the daylight and a red light during darkness to warn other vessels that a fueling operation is in progress.

b. Make sure workboat is properly moored, grounded, and ready to receive fuel oil. Stop workboat engine.

c. Make sure fuel nozzle is grounded to workboat to prevent static discharge, before starting refueling operation.

WARNING

Passengers are not allowed on workboat during fueling operation. Only operator shall handle fuel hose on workboat.

d. Open valve FO11.

e. Remove fuel hose with nozzle from its stowed position in fill station on starboard weatherdeck.

f. After nozzle has been inserted into workboat's fuel tank, open valve FO1 2 and operate nozzle to fill boat tank.

WARNING

Do not overfill workboat fuel tank. If small spillage occurs, clean It immediately. Make sure fuel oil does not spill into the water.

g. Have crewman turn workboat ACC switch to ON and watch workboat FUEL gauge. When gauge indicates that workboat tank is nearly full, close valve FO12, drain hose into boat tank and then stow hose.

h. Close valve FO11.

i. Clean up any spills immediately.

j. Cease display of red flag (BRAVO) or red signal from mast on deckhouse top.

3-3.5 Transferring fuel oil from storage tank to storage tank In this operation, fuel oil transfer pump moves fuel oil from one storage tank to the other. As a tank is being filled, tank liquid level indicators show level in receiving tank. The EMS video monitor display shows amount of fuel transferred and activates alarms when storage tank is full.

a. Follow steps a through e in paragraph 3-3.2.

b. Open and/or close fuel oil valves as follows:

o = open x = closed

	Open/close valve no.:												
Transfer from:	4	5	6	7	8	9	10	21	22	28	29	30*	31
Port storage tank to starboard storage tank	x	-	x	o	o	x	o	x	o	x	x	o	x
Starboard storage tank to port storage tank	-	x	o	x	x	o	o	x	o	x	x	o	x

*Valve 30 is installed on Barges 2 and 3 only.

c. Start fuel oil pump by pushing black START button on pump controller.

WARNING

AVOID OVERFILLING STORAGE TANKS. Sloppy fuel handling causes oil spills and sharply increases hazards of a shipboard fire. If transferring small amounts of fuel between storage tanks, one crewmember should observe storage tank liquid level Indicators and operate the pump motor controller. If large amounts are being transferred, check periodically on its progress. This pump moves about 600 gph and the time required for the transfer should be calculated. When near completion, one crewmember should observe fuel oil level Indicators and control the pump.

d. When required levels have been reached, turn pump off by pushing STOP/RESET button on pump controller.

e. Close valves opened in step b.

3-3.6 Draining day tank to storage tanks or sludge tank In this operation, fuel oil is drained by gravity from day tank to either or both storage tanks or to off-barge facility.

a. Display red flag (BRAVO) on deckhouse top mast during daylight and a red light during darkness to warn other vessels that fueling operation is in progress. Cease warning display when operation is completed.

b. To drain day tank to either or both storage tanks or off-barge facility, open and close fuel oil valves as follows:

o = open x = closed

Open/close valve no.:												
Day tank trained to:	1	2	13	14	15	16	17	18	19	20	28	29
Both storage tanks	o	o	o	x	x	x	x	x	o	x	x	x
Port storage tank	o	x	o	x	x	x	x	x	o	x	x	x
Starboard storage tank	x	o	o	x	x	x	x	x	x	x	o	o
	x	x										
Sludge tank	x	x	x	x	x	x	x	x	o	o	x	x

c. When liquid level indicator on day tank shows tank is empty, close valves opened in step b above.

3-3.7 Draining storage tanks to off-barge facility. In this operation, fuel oil is pumped from either or both storage tanks to an authorized off-barge facility. The EMS video monitor gives continuous readout of tank levels while transfer is taking place if TANK LEVELS page display is locked in.

a. Follow steps a and e in paragraph 3-3.2 above.

b. Open and/or close fuel oil valves as indicated below depending on which storage tank(s) to be drained off-barge:

o = open x = closed

	Open/close valve no.:									
Fuel oil transfer from:	6	7	8	9	10	13	21	22	30*	31
Both storage tanks	x	x	o	o	o	x	x	o	o	o
Port tank only	x	x	o	x	o	x	x	o	o	o
Starboard tank only	x	x	x	o	o	x	x	o	o	o

*Valve 30 is installed on Barges 2 and 3 only.

c. Connect utility hose to quick disconnect coupling on FO valve 31 beneath day tank in ROWPU space.

d. Start fuel oil transfer pump by pressing black START button on pump controller located above the fuel oil transfer pump in void 3 starboard.

WARNING

Bargemaster must immediately stop spillage in the event fuel oil Is discharged Into or upon navigable waters within contiguous waters of the United States if such discharge causes a film, sheen, or discoloration on the surface of the water. The USCG must be notified Immediately by the fastest method available (either radio or telephone). Violators are subject to a fine. Spillage In foreign areas must be treated in accordance with local applicable regulations.

CAUTION

If pump does NOT start moving fuel oil within 1 minute, turn pump OFF before it is damaged. Troubleshoot as given in Table 4-1.

e. When TANK LEVELS Page Display on EMS video monitor shows tank(s) is nearly empty, stop fuel oil transfer. Push STOP button on fuel oil pump controller or on remote control stop switch near day tank. Once off-barge transfer has been completed, use bilge pump with pickup foot and hose to completely drain storage tank(s) of remaining fuel oil and residue. This method will transfer this to sludge tank for later disposal.

f. Detach utility hose and replace in appropriate location. Reconnect quick disconnect coupling.

g. Close valves opened in step b.

h. Cease display of red flag (BRAVO) or red warning light from mast on deckhouse top.

3-4 Shutdown

3-4.1 General. Procedures for shutting down the fuel oil system depend upon how long the system will be down, and if personnel will remain aboard. For fuel oil system storage procedures, see Chapter 5. For emergency shutdown procedures, see paragraph 3-4.2 below.

NOTE
Perform after operation procedures in Appendix C as applicable.

3-4.1.1 Shutdown procedures

a. If system will be down for a few hours (less than 12 hours) and personnel will remain aboard:

(1) Make sure there are no leaks of fuel oil. If there are any leaks, close appropriate valves.

(2) Make sure fuel oil transfer pump is turned off, either at pump motor controller or remote off switch beside day tank.

b. If system will be down for extended time (more than 12 hours but less than 7 days) and personnel will be off barge:

(1) Close (OFF) all valves.

(2) Open (OFF) power panel circuit 2P5.

(3) Open (OFF) switchboard circuit breaker P5.

3-4.2 Emergency shutdown

3-4.2.1 General. The barge has two emergency shutdown modes. One mode shuts down individual systems such as the ventilation system or a diesel HP 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, 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 3-6) control shore power, ventilation systems, ROWPU 1 diesel HP pump, ROWPU 2 diesel HP pump, SAG, SSG 2, and SSG 1. Six red total shutdown buttons are:

- 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.

3-4.2.2 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. Buttons will pop out and again be in the ready position.

c. When 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

3-5 Operation under extreme conditions. Operation of fuel oil system in extreme heat creates a special problem with lubricants. The manufacturers' service manuals/instructions, in Appendix B of this TM, provide additional information.

3-5.1 Operation in extreme heat

a. Lubricants. Hot weather lubricants, such as SAE 40, must be used.

b. Motors. Electric motors have a tendency to run hot and protective devices in the motor will stop the motor to prevent damage. When this happens, allow motor to cool and it will automatically restart.

3-5.2 Operation in extreme cold

a. Lubricant. Use cold weather lubricants.

b. Motors. Fuel oil will become thicker during cold weather and pumps may not move fuel at the rated 600 gph.

CHAPTER 4 MAINTENANCE INSTRUCTIONS

Section I. General

4-1 Maintenance concept

4-1.1 Unit level and Intermediate Direct Support/Intermediate General Support (IDS/IGS) maintenance on fuel oil system is performed onboard by barge crewmembers whenever possible.

4-1.2 Any IDS/IGS maintenance beyond the 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 the terminal operating area. Components to be disposed of are processed by this unit.

4-1.5 The Maintenance Allocation Chart Is in TM 55-1930-209-14& P-18. For maintenance of other systems on the barge, consult the appropriate manual.

4-2 Maintenance procedures. Maintenance instructions are contained in the following sections: Section II-Preventive maintenance checks and services; Section III - Troubleshooting; Section IV - Maintenance procedures.

Section II. Preventive maintenance checks and services

4-3 See TM 55-1930-209-14&P-8, Appendix C for preventive maintenance checks and services for the Fuel Oil System. See TM 55-1930-209-14&P-19 for complete preventive maintenance checks and services for all ROWPU Barge Systems.

Section III. Troubleshooting

4-4 Component. Troubleshoot pump according to troubleshooting procedures in pages 5 thru 8, Section TSM000 of Technical Service Manual, found in Appendix B.

4-5 Fuel oil system. Troubleshoot fuel oil system as given in Table 4-1.

Section IV. Maintenance instructions

4-6 General. Maintenance instructions for individual components are provided in manufacturers' service manuals/instructions contained in Appendix B. Instructions on maintenance of fuel oil system, using repair parts listed in TM 551930-209-14 & P-18, is provided in paragraph 4-7. Repair consists of disassembling, repairing, replacing, and reassembling equipment. No special tools are required.

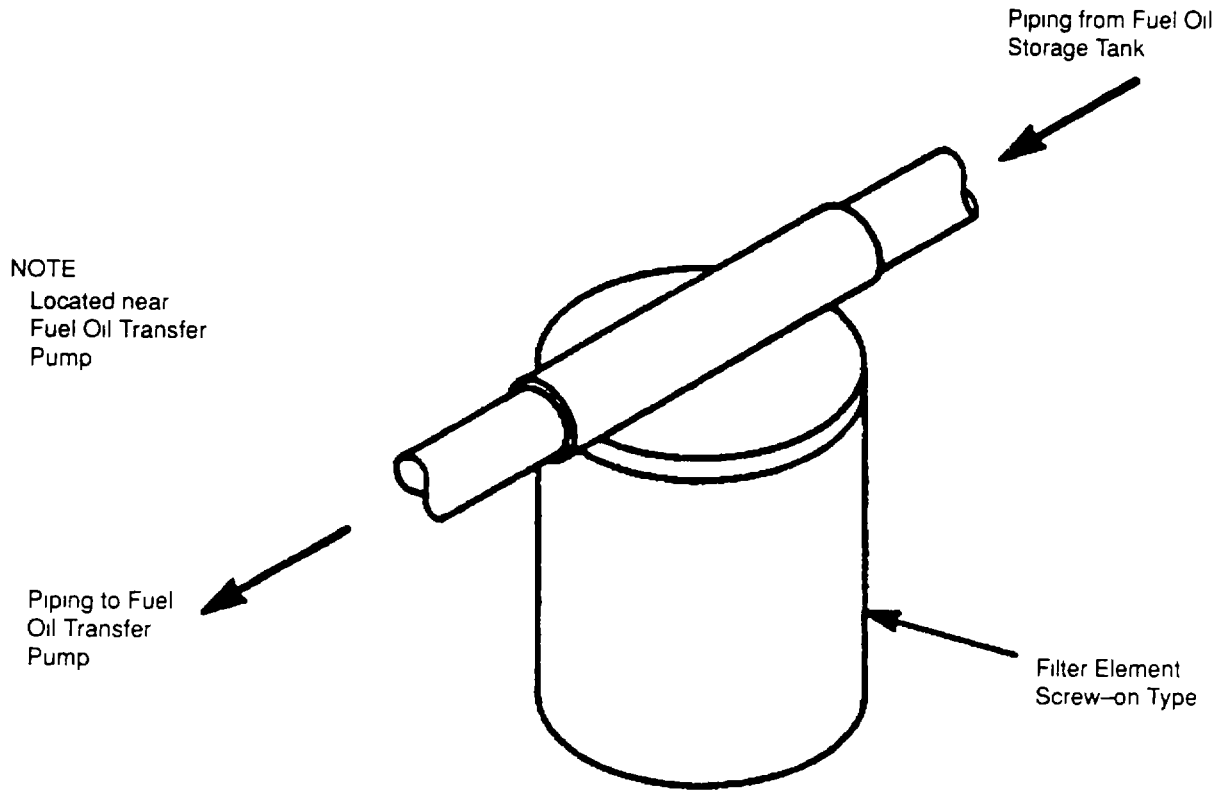


Figure 4-1. Fuel Oil Filter

Table 4-1. Fuel Oil System Troubleshooting

Condition	Possible Cause	Suggested Action
A. Filling fuel oil storage tanks (paragraph 3-3.1):		
1. Port tank will not fill	a. FO valve(s) 3 and/or 5 closed	a. Open valve(s)
	b. FO valve(s) 4 and/or 6 open	b. Close valve(s)
2. Starboard tank will not fill	a. FO valve(s) 3 and/or 4 closed	a. Open valve(s)
	b. FO valve(s) 5 and/or 7 open	b. Close valve(s)
3. Port and starboard tanks will not fill	a. FO valve(s) 3, 4 and/or 5 closed	a. Open Valve(s)
	b. FO valve(s) 6 and/or 7 open	b. Close valve(s)

Table 4-1. Fuel Oil System Troubleshooting (Continued)

Condition	Possible Cause	Suggested Action
4. Port and starboard tanks overflowed	a. Monitoring system malfunctioning	a. Troubleshoot system as described in TM 55-1930-209-14&P-11
	b. Liquid level switch malfunctioning	b. Repair or replace switch
	c. Fuel oil visual level indicator clogged or damaged	c. Unclog or repair indicator
	d. Tank filling operation not being observed by crewmember	d. Station crewmember at tank being filled
B. Transferring fuel oil from storage tanks to day tank (paragraph 3-3.2):		
1. Fuel will not transfer from port storage tank	a. Fuel oil transfer pump circuit breaker 2P5 power panel 1 open (OFF) or P5 on switchboard open (OFF)	a. Close circuit breakers
	b. Pump not operating because: (1) Motor controller off (2) Fuse in motor controller blown (3) Pump malfunctioning (4) Remote stop switch malfunctioning (5) Liquid high level switch malfunctioning	b. Troubleshoot as follows: (1) Start pump (2) Replace fuse (3) Troubleshoot pump per pages 5-8, Appendix B (4) Repair or replace switch (5) Repair or replace high level switch
	c. Pump motor controller malfunctioning (loose wiring, broken connectors, etc.)	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 8,10, 21 or 22 closed	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or change filter
	f. Fuel oil line or check valve clogged or damaged	f. Isolate, clear or repair clogged line. Check valve
2. Fuel will not transfer from starboard storage tank	a. Fuel oil transfer pump circuit breaker 2P5 on power panel 1 open (OFF)	a. Close circuit breaker

Table 4-1. Fuel Oil System Troubleshooting (Continued)

Condition	Possible Cause	Suggested Action
	b. Pump malfunctioning	b. Troubleshoot pump per TSM000. pages 58, Appendix B
	c. Pump controller malfunctioning	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 9, 10, 21 or 22 closed	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or replace filter
	f. Fuel oil line or check valve clogged	f. Isolate and clear or repair line or check valve
3. Fuel will not transfer from both tanks	a. Fuel oil transfer pump circuit breaker 2P5 on power panel 1 open (OFF)	a. Close circuit breaker
	b. Pump malfunctioning	b. Troubleshoot pump per TSM000 pages 5-8, Appendix B
	c. Pump motor controller malfunctioning	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 8, 9, 10, 21 and/or 22 closed	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or change filter
	f. Fuel oil line or check valve clogged check valve	f. Isolate, clear, repair line or
C. Transferring fuel oil from day tank to diesel engines (paragraph 3-3.3):		
1. Fuel will not transfer to SSG1	a. FO valve(s) 16, 19 or 23 closed	a. Open valve(s)
	b. Shutdown system off	b. Turn on
	c. Supply line clogged or damaged	c. Unclog line or repair
2. Fuel will not transfer to SSG2	a. O valve(s) 17, 19 or 24 closed	a. Open valve(s)

Table 4-1. Fuel Oil System Troubleshooting (Continued)

Condition	Possible Cause	Suggested Action
	b. Shutdown system off	b. Turn on
	c. Supply line clogged or damaged	c. Unclog line
3. Fuel will not transfer to 20 kW SAG	a. FO valve(s) 18,19 or 25 closed	a. Open valve(s)
	b. Shutdown system off	b. Turn on
	c. Supply line clogged or damaged	c. Unclog line or repair
4. Fuel will not transfer	a. FO valve(s) 14, 19 or 26 to ROWPU 1 HP pump	a. Open valve(s) closed
	b. Shutdown system off	b. Turn on
	c. Supply line clogged or damaged	c. Unclog line or repair
D. Fueling workboat (paragraph 3-3.4):		
1. Fuel will not flow to	a. FO valve(s) 11 and/or 12 workboat fuel oil tank	a. Open valve(s) closed
	b. Nozzle malfunctioning nozzle	b. Repair or replace
	c. Supply line clogged or damaged	c. Unclog line or repair
E. Transferring fuel from storage tank to storage tank (paragraph 3-3.5):		
1. Fuel will not transfer from port to starboard	a. Fuel transfer pump circuit breaker 2P5 on power panel tank	a. Close circuit breaker 1 open
	b. Fuel oil transfer pump malfunctioning	b. Troubleshoot pump per TSM000 pages 5-8. Appendix B
	c. Pump motor controller malfunctioning	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 7, 8, 10, 22 or 30 closed (Note: Valve 30 installed on Barges 2 and 3 only)	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or charge filter
	f. Fuel oil line or check valve clogged	f. Unclog line or repair check valve

Table 4-1. Fuel Oil System Troubleshooting (Continued)

Condition	Possible Cause	Suggested Action
2. Fuel will not transfer from starboard to port	a. Fuel transfer pump circuit breaker 2P5 on power panel 1 open	a. Close circuit breaker
	b. Fuel oil transfer pump malfunctioning	b. Troubleshoot pump per TSMOOO pages 5-8, Appendix B
	c. Pump motor controller malfunctioning	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 6, 9, 10, 22 or 30 closed (Note: F030 installed on Barges 2 and 3 only)	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or replace filter
	f. Fuel oil or check valve clogged or damaged	f. Unclog or repair line or check valve
3. Tank overflowed	a. Monitoring system malfunctioning	a. Troubleshoot monitoring system as described in TM 55-1930-209-14&P-11
	b. Liquid level switch malfunctioning	b. Repair or replace switch
	c. Fuel oil liquid level indicator clogged or damaged	c. Unclog or repair indicator
	d. Tank transfer operation not being observed by crewmember	d. Station crewmember at tank
F. Draining day tank to storage tank or sludge tank (paragraph 3-3.6)		
1. Day tank not draining to port storage tank	a. FO valve(s) 1, 13 or 19 closed	a. Open valve(s)
	b. FO valve(s) 2 and/or 20 open	b. Close valve(s)
	c. Line clogged or damaged	c. Unclog or repair line
2. Day tank not draining to starboard storage tank	a. FO valve(s) 2,13 or 19 closed	a. Open valve(s)
	b. FO valve(s) 1 or 20 open	b. Close valve(s)
	c. Line clogged or damaged	c. Unclog or repair line

Table 4-1. Fuel Oil System Troubleshooting (Continued)

Condition	Possible Cause	Suggested Action
3. Day tank not draining to both storage tanks	a. FO valve(s) 1, 2, 13 /or 19 closed	a. Open valve(s)
	b. FO valve 20 open	b. Close valve
	c. Line clogged or damaged	c. Unclog or repair line
4. Day tank not draining to sludge tank	a. FO valve(s) 19 and/or 20 closed	a. Open valve(s)
	b. FO valve(s) 13, 14, 15, 16, 17 and/or 18 open	b. Close valve(s)
	c. Line clogged or damaged	c. Unclog or repair line
G. Draining storage tanks to off-barge facility (paragraph 3-3.7)		
1. Fuel oil will not drain from port storage tank	a. Fuel oil transfer pump circuit breaker 2P5 on power panel 1 open (OFF) or P5 on switchboard open (OFF)	a. Close circuit breaker
	b. Pump malfunctioning	b. Troubleshoot pump per TSM000, pages 5-8, Appendix B
	c. Pump motor controller malfunctioning (loose wiring, broken connectors, etc.)	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 8, 10, 22, 30 and/or 31 closed (Note: Valve FO 30 installed on Barges 2 and 3 only)	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or charge filter
	f. Fuel oil line or check valve clogged or damaged line or check valve	f. Isolate and clear or repair clogged
2. Fuel oil will not drain from starboard storage tank	a. Fuel oil transfer pump circuit breaker 2P5 on power panel 1 open (OFF) or P5 on switchboard open (OFF)	a. Close circuit breaker
	b. Pump malfunctioning	b. Troubleshoot pump per TSM000, pages 58, Appendix B

Table 4-1. Fuel Oil System Troubleshooting (Continued)

Condition	Possible Cause	Suggested Action
	c. Pump motor controller malfunctioning (loose wiring, broken connectors)	c. Troubleshoot controller as described in TM 55-1930-209-14&P-9
	d. FO valve(s) 9,10, 22, 30 and/or 31 closed.	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or change filter
	f. Fuel oil line or check valve clogged or damaged line or check	f. Isolate and clear or repair clogged valve
3. Fuel oil will not drain from day tank	a. Fuel oil transfer pump circuit breaker 2P5 on power panel 1 open (OFF) or P5 on switchboard open (OFF)	a. Close circuit breaker
	b. Pump malfunctioning	b. Troubleshoot pump per TSM000, pages 5-8, Appendix B
	c. Pump motor controller malfunctioning (loose wiring, broken connectors, etc.)	c. Troubleshoot controller as described in TM 55-1930--209-14&P-9
	d. FO valve(s) 9, 10, 22, 30 and/or 31 closed (Note: Valve FO 30 installed on Barges 2 and 3 only)	d. Open valve(s)
	e. Fuel filter clogged	e. Clean or change filter
	f. Fuel oil line or check valve clogged or damaged line or check	f. Isolate and clear or repair clogged valve

CAUTION

When performing maintenance, be sure to observe precautions listed In this TM and In manufacturers' manuals and Instructions.

a. Always use new seals and gaskets before reassembling components disassembled for repair. Be sure to only use seals and gaskets same as the original. Always install carefully, so as not to damage seals and gaskets during assembly.

b. When replacing any O-rings, make certain all surfaces are completely clean and free of dirt, grit and foreign material. Prior to installation, apply a thin coat of silicone grease to the O-ring for ease of assembly. It -ring must be installed over threads, sharp corners, or edges, protect -ring by applying tape over threads, sharp corners, or edges.

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

d. When replacing electrical components, exercise care when making soldered or crimped connections. Check all grounding. Check that all current-carrying components are properly insulated to avoid a short circuit. Check for abrasion and chafing of insulation on all wires and cables. Repair with tape or replace as necessary.

WARNING

Be sure electric power is shut off when performing maintenance. Observe all safety precautions specified in this TM and in manufacturers' manuals/instructions.

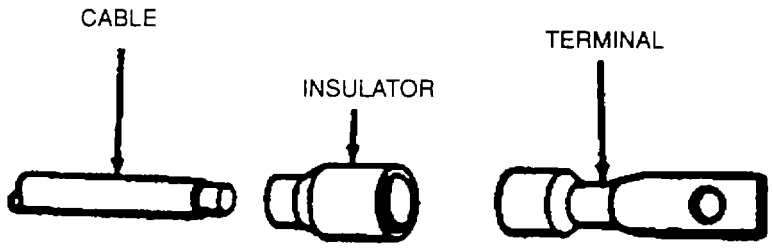


Figure 4-2. Replacement of Crimped Terminals

(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.

e. When replacing bearings, follow procedures in TM 9-214. Lubricate bearings with recommended lubricant. When installing bearings 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.

4-7 Fuel oil system

4-7.1 Fuel transfer pump adjustment

WARNING

Be sure electrical power is shut off before performing maintenance on fuel transfer pump.

a. OPEN (OFF) power panel 1 circuit breaker 2P5. Redtag circuit breaker with: 'WARNING - DO NOT ACTIVATE - REPAIRS BEING MADE." Be sure pump is cool before starting repair.
b. Adjust fuel transfer pump end clearance in accordance with page 6, Section TS 312 of General Purpose Pumps Manual in Appendix B.

4-7.2 Repair

NOTE

Refer to Figure 2 on page 1, and Figure 7 on page 3, in Section TSM000 of Technical Service Manual in Appendix B when repairing fuel transfer pump.

a. Open (OFF) power panel 1 circuit breaker 2P5 for fuel oil transfer pump. Redtag circuit breaker with "WARNING - DO NOT ACTIVATE - REPAIRS BEING MADE."
b. Close valves F021, FO22, and F030 . (Note: Valve FO30 installed on Barges 2 and 3 only.)
c. Place container under piping and disconnect piping.
d. Unscrew mounting bolts and remove pump.
e. Disassemble, repair, and reassemble pump as given in Manufacturers' instructions referenced above. Repair parts (head gasket, idler bushing, casing bushing, mechanical seal on idler pin) are listed in TM 55-1930-20-14& P-1 8.
f. Install pump assembly and tighten mounting bolts.
g. Connect piping.
h. Check alignment as given in manufacturer's service instructions referenced above.
i. Remove red tag and close fuel pump circuit breaker 2P5 on power panel 1.
j. Start up and check that pump operates satisfactorily.
k. Record this replacement in maintenance logbook.

47.3 Fuel filter element replacement. Unscrew filter and discard element. Wipe filter clean and install new filter element.

4-7.4 Valve replacement. Replace or repack worn or damaged valves in accordance with TM 55-503.

4-7.5 Liquid level indicator

a. Removal

(1) Empty fuel tank as given in paragraph 3-3.7.
(2) Tag and disconnect wires.
(3) Disconnect two piping unions connecting liquid level indicator.
(4) Remove liquid level indicator.

b. Disassembly and repair

(1) Unclamp transmitter which includes switches.
(2) Unclamp flag channel assembly from casing.
(3) Remove top and bottom end caps and remove float assembly from inside of casing.
(4) Wipe clean flag channel assembly.
(5) Reinstall new ROLI transmitter, visual flag channel assembly and switches as necessary. Orient parts as shown in Transamerica Delavel Drawing No. 87707 in Appendix B.

c. Installation

(1) Install liquid level indicator with two unions to tank.
(2) Connect wires tagged previously.

CHAPTER 5 STORAGE

5-1 Short-term storage. If barge is taken out of service for more than 7 days, but less than 30 days, follow shutdown procedures in steps a and b below. Inspect for damage, corrosion, and pilferage.

NOTE
Valve numbers are the same as callouts in Figure 3-4.

a. Stop fuel transfer pump and open (OFF) fuel pump circuit breaker 2P5 on power panel 1 on ROWPU space port bulkhead.

b. Make sure FO10, FO19, F020, FO28, and FO29 are closed.

5-2 Administrative storage. If barge is 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. Perform periodic inspections and services as outlined in Appendix C.

5-2.1 If not used in administrative storage, fuel oil system will be processed as specified in steps a thru i below and inspected as specified in paragraph 5-2.2.

NOTE
Valve numbers are the same as callouts in Figure 3-4.

a. Perform after operation preventive maintenance checks in Appendix C.

b. Open (OFF) fuel pump circuit breaker 2P5 on power panel 1 on ROWPU space port bulkhead.

c. Perform the following when authorized by Bargemaster:

(1) Drain both storage tanks and day tank.

(2) Drain all piping by opening lines at lowest point. Be sure to provide drain pans where necessary before opening line.

(3) Cap off port storage tank, starboard storage tank, and day tank vents.

d. Remove fuel filter element and discard. Wipe filter clean and install new filter element.

e. Lubricate fuel transfer pump in accordance with page 7, Section TSM000 of Technical Service Manual, found in Appendix B of this TM.

f. Clean fuel transfer pump's painted metal surfaces with a clean, lint-free cloth moistened with cleaning solvent (P-D-600, Type II). Scrub off hard deposits with a bristle brush dipped in solvent. Dry surfaces with a clean, lint-free cloth.

g. Clean fuel storage tank and day tank liquid level indicators with a clean, lint-free cloth.

h. Thoroughly clean all other external surfaces to remove any corrosion or other foreign matter. Remove any corrosion by wire brushing or sanding. Clean all surfaces except electrical parts with soapy water and stiff bristle brush, then flush with clean water. Clean fuel transfer pump motor starter by wiping with a clean cloth moistened with silicone spray lubricant, or similar substance.

i. Touch up paint as necessary to prevent further corrosion; match surrounding areas in accordance with TB 43-0144. Do not paint threads or label plates.

5-2.2 Fuel oil system, if not used during storage, will be inspected at least once every 30 days. Check for corrosion, damage, or pilferage. Correct as necessary. Log inspection and report findings to bargemaster.

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 fuel oil system for normal operations as specified in steps a thru d below before releasing to depot.

a. Observe all safety cautions and warnings.

b. Perform before operation checks in Appendix C.

c. Make sure fuel oil system operates satisfactorily while performing operating procedures in paragraph 3-3 as authorized by bargemaster.

d. Perform during operation checks in Appendix C.

e. Upon successful completion of inspection, release system to depot for long-term storage.

CHAPTER 6 MANUFACTURER'S SERVICE MANUALS/INSTRUCTIONS

6-1 General. Manufacturers' service manuals/instructions provide additional information on fuel oil system components. A copy of each manual/instruction listed below is in Appendix B. It may be necessary to refer to both these manuals/instructions and the drawings listed in Appendix A while performing operational or maintenance procedures discussed in this TM.

Component	Document title	Manufacturer
Transfer pump H1432D	Section TS312, General Purpose Pumps 32 and 432 Series - Large Maintenance and Repair Instructions Section TSM000, Technical Service Manual Installation, Start Up, Troubleshooting, Preventive Maintenance, Do's and Don'ts	Viking Pump Division Houdaille Industries Inc Cedar Falls, Iowa 50613 (515) 2774220
Tank air escape valve 1600T	Tank Air Escape Valve Model 1600	Robert H. Wager Co. Inc. Passaic Avenue Chatham, New Jersey 07928 (210) 635-9200
Day tank liquid high level switch series LS-2050 part no. 48068	GEMS Liquid Level Switches	Transamerica DeLaval Inc Gems Sensors Division Cowles Road Plainville, CT 06062 (203) 677-1311
SureSite day tank liquid level indicator part no. 86210, Type 2	GEMS Liquid Level Indicators	
Storage tank Liquid Level indicator part no. 86615, Type C w/ROLI 4-10 milliamp	GEMS Liquid Level Indicators Dwg. No. 87707, Flag Position (Special Order)	
Transfer Pump Motor Controller	See TM 55-1930-209-14&P-9	

CHAPTER 7 MANUFACTURERS' WARRANTIES/GUARANTEES

7-1 General. Information on the warranty/guarantee for fuel oil system components is supplied below.

Component	Manufacturer	Duration	Coverage
Fuel transfer Pump H432D	Viking Pump Division Houdaille Industries, Inc. Cedar Falls, Iowa 50613 (515) 277-4220	1 year from date of startup	Material and workmanship
Storage tank air escape valve 1600T	Robert H. Wager Co., Inc. Passaic Avenue Chatham, New Jersey 07928 (210) 635-9200	1 year from date of ship-ment	Material and workmanship
Fuel tank liquid level switch series LS-2050 part no. 48068	Transamerica DeLaval GEMS Sensors Division Cowles Road Plainville, CT 06062 (203) 677-1311	1 year from date of pur-chase	Material and workmanship
SureSite day tank liquid level indicator part no. 86210, Type 2			
Storage tank SureSite liquid level indicator part no. 86615, Type C w/ROLI 4-20 milliamp			
Transfer pump motor controller	See TM 55-1930-209-14&P-9		

APPENDIX A

REFERENCES

A-1 Drawings

US Army Belvoir Research and Development Center Drawings (97403)

13226E1892	ROWPU/Barge Arrangement
13226E1893	List of Label Plates
13226E1894	Fuel Oil System
13226E 1932	Electrical Power Schematic Diagram
13226E1935	Electrical Power System Layout Diagram
13226E1939	Motor Controllers Schematic and Wiring Diagram
13226E1928	Alarm/Casualty Monitoring System
13226E1944	Equipment Shut Down System

A-2 Painting

TB 43-0144	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

Fed Spec P-C-680	Metal Cleaning Solvent for Army Use

A-5 Maintenance

DA PAM 738-750	The Army Maintenance Management System (TAMMS)
TM 55-503	Marine Salvage and Hull Repair

APPENDIX B

MANUFACTURERS' SERVICE MANUALS/INSTRUCTIONS

Component	Document title	Manufacturer
Transfer pump H1432D	Section TS312, General Purpose Pumps 32 and 432 Series - Large Maintenance and Repair Instructions	Viking Pump Division Houdaille Industries Ing. Cedar Falls, Iowa 506T3 (515) 277-4220
	Section TSM000, Technical Service Manual Installation, Start Up, Troubleshooting, Preventive Maintenance, Do's and Don'ts	
Tank air escape valve 1600T	Tank Air Escape Valve Model 1600	Robert H. Wager Co. Inc. Passaic Avenue Chatham, New Jersey 07928 (210) 635-9200
Day tank liquid high level switch series LS-2050 part no. 48068	GEMS Liquid Level Switches	Transamerica DeLaval Inc. Gems Sensors Division Cowles Road Plainville, CT 06062 (203) 677-1311
SureSite day tank liquid level indicator part no. 86210, Type 2	GEMS Liquid Level Indicators	
Storage tank Liquid Level Indicator part no. 86615, Type C w/ROLI 4-10 milliamp	GEMS Liquid Level Indicators Dwg. No. 87707, Flag Position (Special Order)	
Transfer Pump Motor Controller	See TM 55-1930-209-14&P-9	

GENERAL PURPOSE PUMPS
32 AND 432 SERIES - LARGE

MAINTENANCE AND REPAIR INSTRUCTIONS

INTRODUCTION

The illustrations used in this article are for identification purposes only and should no1 he used for ordering parts. Secure a parts list from the factor or a Viking representative Always give complete name of part, part number and material Kith the model and serial number of the pump when ordering repair parts.

UNMOUNTED PUMP AND UNIT MODEL NUMBERS

UNMOUNTED PUMP		UNITS
PACKED	**MECH. SEAL**	
G32 H32 HL32 J32 K32 KK32 L32 LQ32 LL32 Q32 M32 N32	G432 H432 HL432	Units Are Designated By The Un-mounted Pump Model Number Fol lowed By A Letter Indicating Drive Style B=Bracket Mounted D=Direct Drive V=V Belt

This bulletin deals exclusively with series 32 and series 432 General Purpose Pumps Refer to figures 1 thru 12 for general configuration and nomenclature used in this bulletin

Maintenance

Figure 32 and 432 pumps are designed for long, trouble free life under a wide variety of application conditions with a minimum of maintenance, however, the following should be considered

1. LUBRICATION-Periodic external lubrication should be applied slowly with a hand gun at all lubrication fittings provided. A good quality of general purpose grease is satisfactory in the majority of cases, however, applications involving very high or low temperatures may require other types of lubricants. Suggested frequency of lubrication is once every 500 hours of operation. Do not over grease. Consult the factory if you have specific lubrication questions.
2. PACKING ADJUSTMENT-New packed pumps generally require some initial packing adjustment to control leakage as packing "runs-in". Make initial packing adjustments carefully and do not over-tighten the packing gland After initial adjustment occasional inspection will reveal the need for packing gland adjustment and, or replacement of the packing See instructions in disassembly and re-assembly regarding re-packing the pump.
3. END CLEARANCE ADJUSTMENT-After long term operation it is sometimes possible to improve the performance of the pump, without major repair, thru adjustment of end clearance of the pump Refer to instructions under Step 3 of assembly.

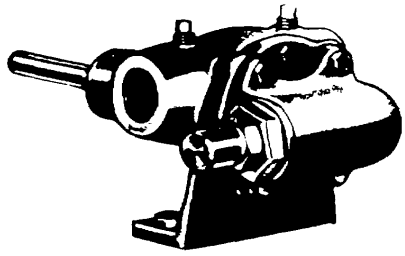


FIGURE 1 G SIZE UNMOUNTED PUMP

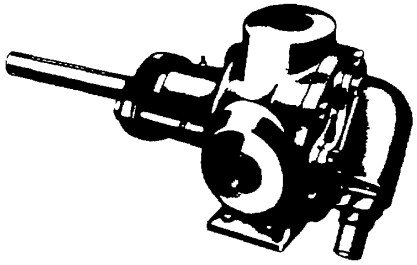


FIGURE 2 H AND HL SIZES UNMOUNTED PUMP

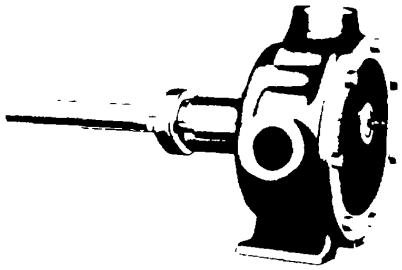


FIGURE 3 J,K,KK, AND L SIZES UNMOUNTED PUMP

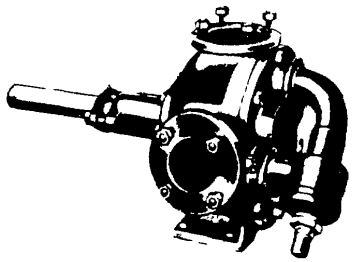


FIGURE 4
LQ, LL, Q, M, AND N SIZES UNMOUNTED PUMP

4 CLEANING THE PUMP - It Is good practice to keep the pump as clean as possible. This will facilitate Inspection, adjustment and repair work and help prevent omission of lubrication to fittings covered hidden with dirt.

5 STORAGE - If the pump is to be stored or not used for any appreciable length of time it should be drained and a light coat of lubricating and preservative oil should be applied to the internal parts. Lubricate all fittings.

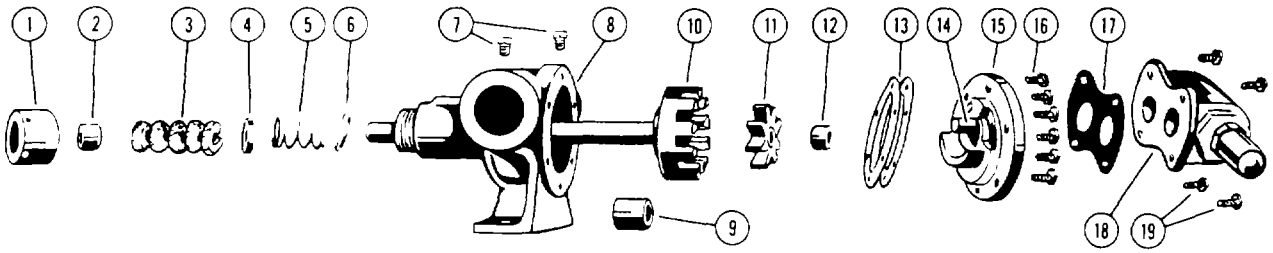


FIGURE 5 EXPLODED VIEW MODEL G32 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Nut	11	Idler and Bushing
2	Outer Packing Gland	12	Idler Bushing
3	Packing	13	Head Gasket
4	Inner Packing Gland	14	Idler Pin
5	Packing Spring	15	Head and Idler Pin
6	Packing Spring Washer	16	Capscrew For Head
7	Pipe Plug	17	Relief Valve Gasket
8	Casing and Bushing	18	Relief Valve
9	Casing Bushing	19	Capscrew for Valve
10	Rotor and Shaft		

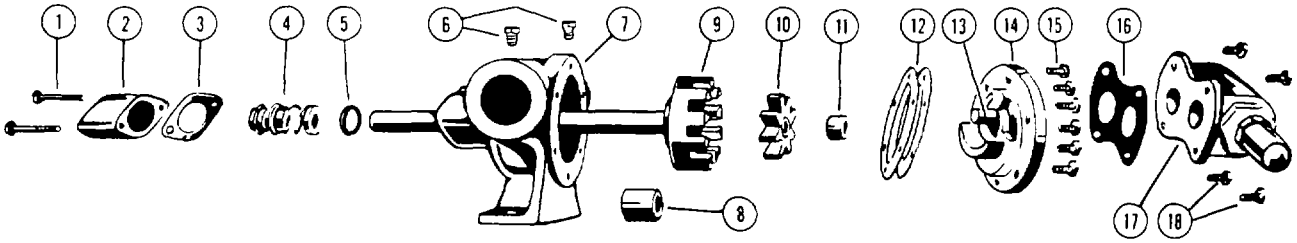


FIGURE 6 EXPLODED VIEW MODEL G432 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Capscrew for End Cap	10	Idler and Bushing
2	End Cap	11	Idler Bushing
3	Gasket for End Cap	12	Head Gasket
4	Mechanical Seal (Complete)	13	Idler Pin
5	Set Collar with Capscrew	14	Head and Idler Pin
6	Pipe Plug	15	Capscrew for Head
7	Casing and Bushing	16	Relief Valve Gasket
8	Casing Bushing	17	Relief Valve
9	Rotor and Shaft	18	Capscrew for Valve

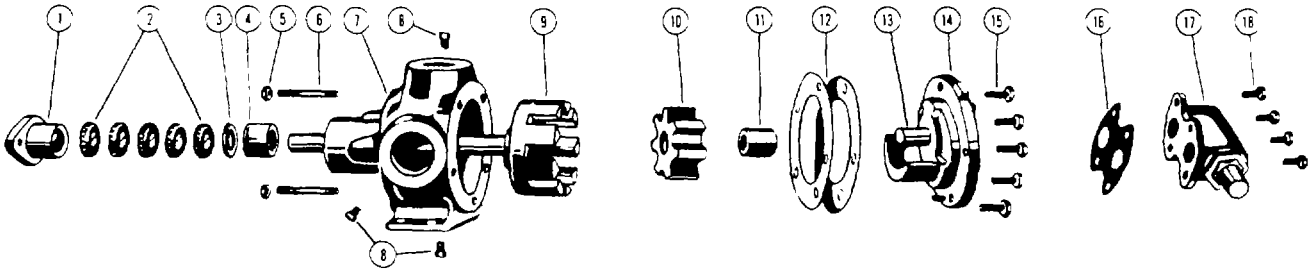


FIGURE 7 EXPLODED VIEW MODEL H AND HL32 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Gland	10	Idler and Bushing
2	Packing	11	Idler Bushing
3	Packing Retainer Washer	12	Head Gasket
4	Casing Bushing	13	Idler Pin
5	Packing Gland Nut	14	Head and Idler Pin
6	Packing Gland Stud	15	Capscrew for Head
7	Casing and Bushing	16	Relief Valve Gasket
8	Pipe Plug	17	Relief Valve
9	Rotor and Shaft	18	Capscrew for Valve

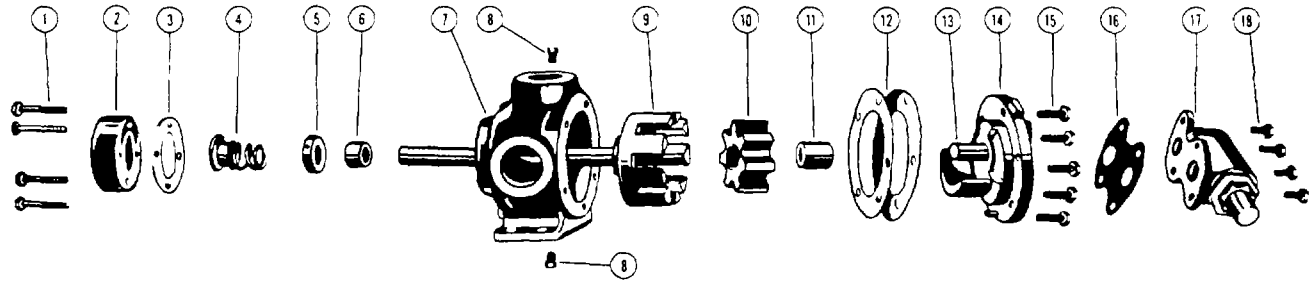


FIGURE 8 EXPLODED VIEW MODEL H AND HL432 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Capscrew for End Cap	10	Idler and Bushing
2	End Cap	11	Idler Bushing
3	Gasket for End Cap	12	Head Gasket
4	Mechanical Seal	13	Idler Pin
5	Set Collar with Capscrew	14	Head and Idler Pin
6	Casing Bushing	15	Capscrew for Head
7	Casing and Bushing	16	Relief Valve Gasket
8	Pipe Plug	17	Relief Valve
9	Rotor and Shaft	18	Capscrew for Valve

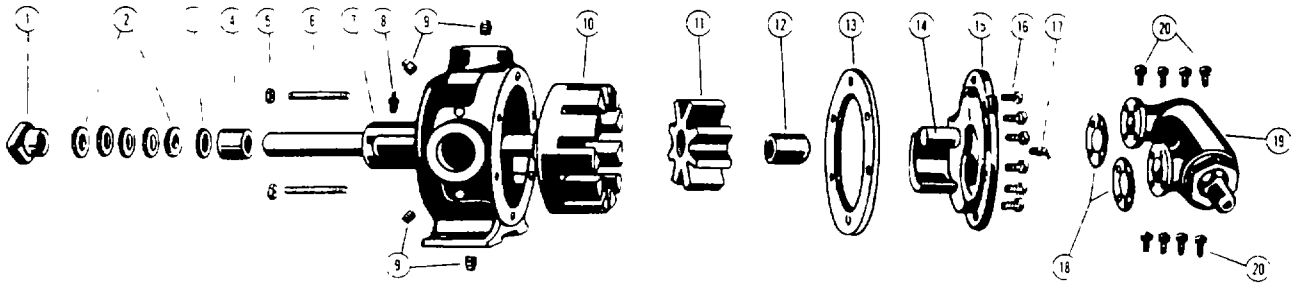


FIGURE 9 EXPLODED VIEW MODEL J32, K32, KK32 AND L32 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Gland	11	Idler and Bushing
2	Packing	12	Idler Bushing
3	Packing Retainer Washer	13	Head Gasket
4	Casing Bushing	14	Idler Pin
5	Packing Gland Nut	15	Head and Idler Pin
6	Packing Gland Stud	16	Capscrew for Head
7	Casing and Bushing	17	Grease Fitting
8	Grease Fitting	18	Relief Valve Gasket
9	Pipe Plug	19	Relief Valve
10	Rotor and Shaft	20	Capscrew for Valve

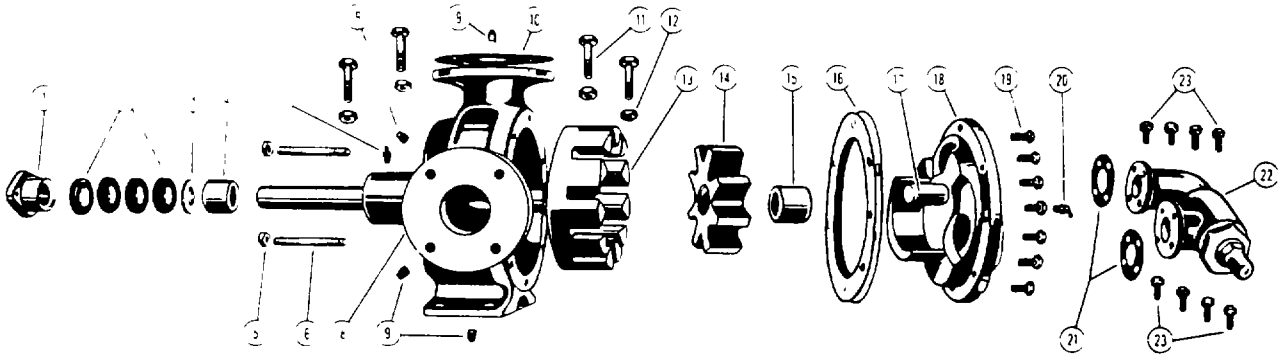


FIGURE 10 EXPLODED VIEW MODEL LQ32 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Gland	13	Rotor and Shaft
2	Packing	14	Idler and Bushing
3	Packing Retainer Washer	15	Idler Bushing
4	Casing Bushing	16	Head Gasket
5	Packing Gland Nut	17	Idler Pin
6	Packing Gland Stud	18	Head and Idler Pin
7	Grease Fitting	19	Capscrew for Head
8	Casing and Bushing	20	Grease Fitting
9	Pipe Plug	21	Relief Valve Gasket
10	Pipe Flange Gasket	22	Relief Valve
11	Capscrew for Flanges	23	Capscrew for Valve
12	Hex Nut For Flanges		

GENERAL PURPOSE PUMPS
32 AND 432 SERIES - LARGE

MAINTENANCE AND REPAIR INSTRUCTIONS

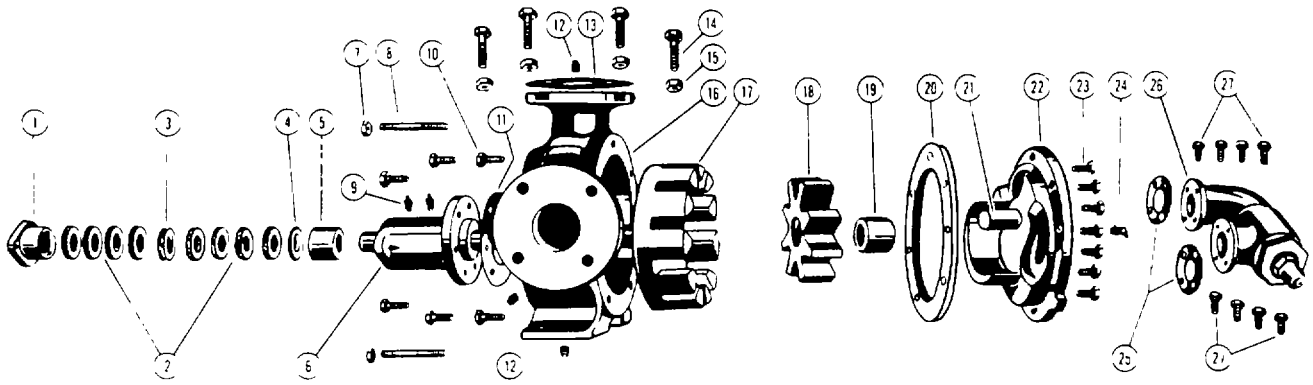


FIGURE 11 EXPLODED VIEW MODEL LL32 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Gland	15	Nut for Flanges
2	Packing	16	Casing
3	Lantern Ring	17	Rotor and Shaft
4	Packing Retainer Washer	18	Idler and Bushing
5	Bushing for Rotor Bearing Sleeve	19	Idler Bushing
6	Rotor Bearing Sleeve and Bushing	20	Head Gasket
7	Packing Gland Nut	21	Idler Pin
8	Packing Gland Stud	22	Head and Idler Pin
9	Grease Fitting	23	Capscrew for Head
10	Capscrew for Rotor Bearing Sleeve	24	Grease Fitting
11	Gasket for Rotor Bearing Sleeve	25	Relief Valve Gasket
12	Pipe Plug	26	Relief Valve
13	Pipe Flange Gasket	27	Capscrew for Valve
14	Capscrew for Flanges		

Disassembly

1. Remove the head from the pump If pump is furnished, with a relief valve it need not be removed from head or disassembled at this point.

CAUTION: DO NOT ALLOW THE IDLER TO FALL FROM THE IDLER PIN. TILTING THE HEAD UP AS IT IS REMOVED WILL PREVENT THIS OCCURRENCE. AVOID DAMAGING THE HEAD GASKET IF POSSIBLE.

2. Remove the idler and bushing assembly from the idler pin. Replace all excessively' worn parts. See Step #8.
3. Remove the packing gland.
4. If you have a mechanical seal pump, remove the end cap and the mechanical seal is exposed
5. Remove the mechanical seal by sliding off the end of the shaft. Loosen the setscrew in the set collar and remove it.

CAUTION: REMOVE THE SNAP RING FROM THE SHAFT USED IN SOME MECHANICAL SEAL PUMPS BEFORE REMOVING THE ROTOR AND SHAFT.

6. Careful remove the rotor and shaft from the pump.

CAUTION: AVOID DAMAGING THE CASING OR ROTOR BEARING SLEEVE BUSHING.

7. THRUST WASHERS-Rotor thrust Rasher and rotor bearing sleeve thrust washer-used in Q.M and N size pumps should be removed, examined for excessive wear and replaced if necessary. These thrust washers are located on the hub of the rotor and the casing end of rotor bearing sleeve.
8. If it Is necessary to replace the casing, rotor bearing sleeve or idler bushing and or repack the pump, remove the old packing and lantern ring and packing retainer washer. Some pumps don't have a lantern ring.

If the casing, rotor bearing sleeve or idler bushing shows signs of wear It should be replaced. If it is necessary to install a new carbon graphite bushing, extreme care should be taken to prevent breaking, as it is a brittle material and easily cracked. If cracked this bushing will quickly disintegrate. An arbor press

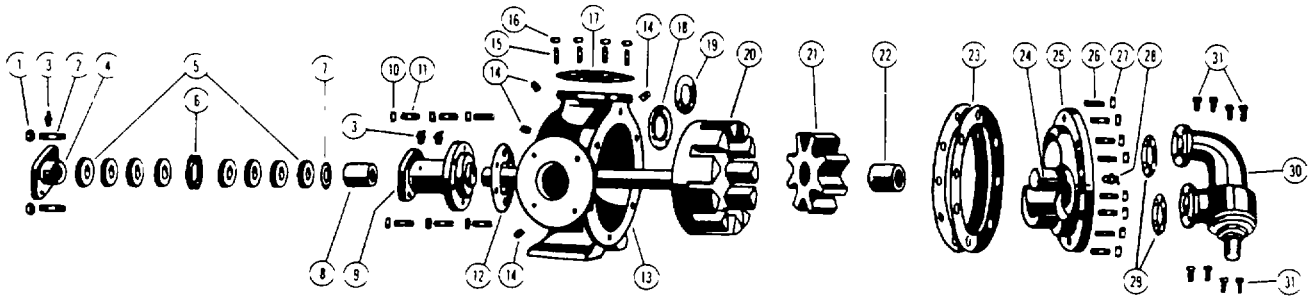


FIGURE 12 EXPLODED VIEW MODEL Q32, M32, AND N32 PUMP

ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Gland Nut	17	Pipe Flange Gasket
2	Packing Gland Stud	18	Rotor Bearing Sleeve Washer
3	Grease Fitting	19	Rotor Thrust Washer
4	Packing Gland	20	Rotor and Shaft
5	Packing	21	Idler and Bushing
6	Lantern Ring	22	Idler Bushing
7	Packing Retainer Washer	23	Head Gasket
8	Bushing for Rotor Bearing Sleeve	24	Idler Pin
9	Rotor Bearing Sleeve and Bushing	25	Head and Idler Pin
10	Nut for Rotor Bearing Sleeve	26	Stud for Head
11	Stud for Rotor Bearing Sleeve	27	Nut for Head
12	Gasket for Rotor Bearing Sleeve	28	Grease Fitting
13	Casing	29	Relief Valve Gasket
14	Pipe Plug	30	Relief Valve
15	Stud for Flanges	31	Capscrew for Valve
16	Nut for Flanges		

should always be used in installing carbon graphite bushings Be sure the bushing is started straight. DO NOT STOP -the pressing operation until the bushing is in proper position. Starting and stopping this operation invariably results in a bushing failure. Carbon graphite bushings with extra interference fits are frequently furnished for high temperature operation. These bushings must be installed by a shrink fit. Heat the iron casing or idler to 875° F. and install cool bushings with an arbor press. If facilities are not available for this temperature, it is possible to install with 450° F. temperature. However the lower the temperature the greater the possibility of cracking the bushing. Check bushings for cracks after installation. For additional information on high temperature applications see Engineering Service Bulletin ESB-3.

All parts should be checked for wear before the pump is put together. When making major repairs, such as replacing a rotor and shaft, it is usually considered advisable to also install a new head and idler. When making minor repairs, where only an idler bushing and idler pin are required. other new parts are usually not necessary. When all the necessary parts are available. the pump can be assembled

Reassembly

1. Thrust washers used in Q, M and N size pumps should be assembled on the rotor hub and rotor bearing sleeve. Put the plain washer on the two locating pins on the rotor hub. Put the grooved face washer on the pins on the rotor bearing sleeve with the grooved face toward the rotor.
2. Remove all burrs and rough surfaces from the rotor and shaft and assemble in the casing. Start the shaft through the casing or rotor bearing sleeve bushing and slowly turning the rotor. push it into the casing as far as it will go.
3. Place the head gaskets on the' head. The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. The

Gasket Table (Figure 13) gives the normal amount of gaskets used on each pump.

GASKET TABLE

PUMP MODEL	NORMAL AMOUNT USED	ONE SET OF GASKETS CONSISTS OF THE FOLLOWING
G 32 G 432	010 015	2 005 3 002
H HL 32 H HL 432	010 015	2 006 2 002
J K KK 32	015 020	1 015 1 010 1 003
L LQ LL 32	025 030	1 015 1 010 1 003
Q 32	012 030	2 015 1 006
M N 32	015 036	2 015

FIGURE 13

4. Put the idler on the idler pin in the head.
5. The head can now be assembled on the pump. Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Tighten the head capscrews or nuts and then check the end clearance. If the pump shaft cannot be rotated, more gaskets must be added. If, however, the pump has any noticeable end play, remove enough gaskets so the pump has no appreciable end play but still turns freely.
6. Pack the pump. It is good practice to install a set of new packing. The pump should be packed with a packing suitable for the liquid being pumped.

NOTE: If the pump has a lantern ring it must be located below the grease fitting. The grease fitting may be removed to facilitate positioning of the lantern ring.

Cut the packing into individual rings that wrap exactly around the shaft. Install and seat each ring one at a time, staggering the ring joints from one side of the shaft to the other. Lubricate the packing rings with oil, grease or graphite to aid in assembly. A length of pipe or tubing will help in seating the packing rings.

7. Install the mechanical seal: Place the setcollar on the shaft and tighten setscrew. See figure 14 for setcollar location.

The seal is simple to install and good performance will result if care is taken in its installation.

NOTE: Never touch the sealing faces with anything except the fingers or a clean cloth. Spread a film of lubricating oil on the inside diameter of the synthetic rubber bellows. Check the end of the pump shaft for sharp burrs or edges which might cut the bellows. Slide the seal rotary member over the shaft and up against the setcollar. The spring washer and spring must be put on the shaft first and in that order. (See Figure 14). Coat the synthetic rubber seal seat with lubricating oil and push the seal seat into the end cap. Put the end cap gasket on the end of the casing. Slide end cap over the shaft and flush both the seal seat and carbon wear ring in the seal rotary member with oil. Push the end cap up until the mating surfaces or the seal meet. Install the capscrews and tighten evenly.

8. Install the packing gland and nuts. The gland must enter the stuffing box at least one-eighth of an inch after tightening the packing gland nuts. Be sure the packing does not wedge between the stuffing box and the gland, as this may split the stuffing box.

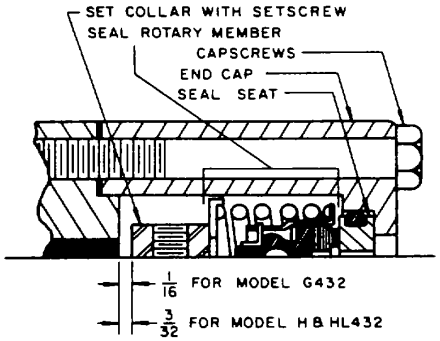


FIGURE 14
SECTIONAL VIEW, SEAL

Valve Instructions

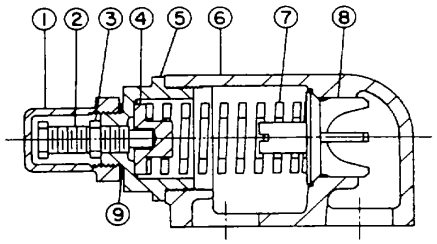


FIGURE 15 G.H. AND HL SIZE

GENERAL PURPOSE PUMPS
32 AND 432 SERIES — LARGE

MAINTENANCE AND REPAIR INSTRUCTIONS

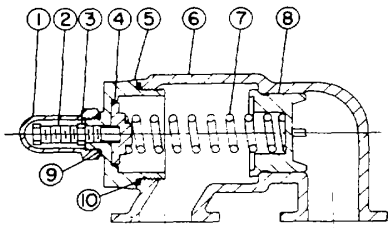


FIGURE 16 J,K,KK,L,LL SIZE

FIGURE 16 J,K,KK,L,LL,SIZE

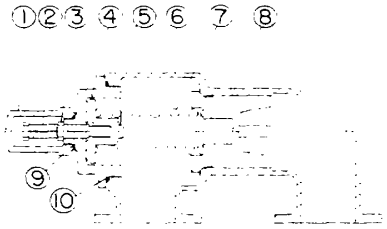


FIGURE 17 Q,M,AND N SIZE

LIST OF PARTS

1. Valve Cap	6. Valve Body
2. Adjusting Screw	7. Valve Spring
3. Lock Nut	8. Poppet
4. Spring Guide	9. Cap Gasket
5. Bonnet	10. Bonnet Gasket

Disassembly

1. Remove valve cap.
2. Measure and record the length of extension of the adjusting screw.
3. Loosen the lock nut and back out adjusting screw until spring pressure is released.
4. Remove bonnet spring guide, spring and poppet from valve body. Clean and inspect all parts for wear or damage and repair or replace as necessary.

Reassembly

Follow the procedure outlined under disassembly.
If valve is removed for repairs, be sure to replace in same position. The valve cap should point towards the suction port.

Pressure Adjustment

If the pressure setting of the valve is to be changed from that which the factory has set, the following instructions should be carefully followed: Remove the valve cap which covers the adjusting screw, and loosen the lock nut which locks the adjusting screw so pressure setting will not change during operation of pump. A pressure gauge somewhere in the discharge line must be used for actual adjustment operation. The adjusting screw should be turned in for increasing the pressure or turned out for decreasing the pressure. With the discharge line closed at a point beyond the pressure gauge, the gauge will show the maximum pressure the relief valve will allow while pump is in operation.

Important

In ordering parts for relief valve on head, always be sure to give Model and Serial Number of pump as it appears on name plate and the name of the part wanted. When ordering springs, be sure to give the pressure setting desired.

Form 1/82-15M

Suggested Reference: Hydraulic Institute Handbook, 14th Edition.

INSTALLATION

General

Before installation is started a few items of a general nature should be considered.

1. *Location* — always locate the pump as close as possible to the supply of liquid to be pumped. Locate it below the liquid supply if at all practical. Viking pumps are self priming but the better the suction conditions the better the performance.
2. *Accessibility* — the pump should be located where it is accessible for inspection, maintenance, and repair. For large pumps, allow room to remove the rotor and shaft without removing the pump from the base.
3. *Port Arrangement* — since the pumps have different port arrangements depending on the model, port location should be checked before starting the installation. The ports may be upright, opposite or at right angles to each other, see Figure 1. The right angle ports are normally right-hand, see Figure 2; some models are available with left-hand arrangements; still other models are available with the right angle ports located in any one of eight positions including right-hand and left-hand.

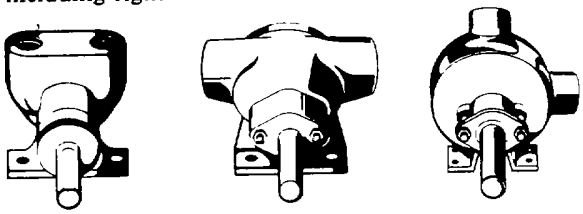


FIGURE 1

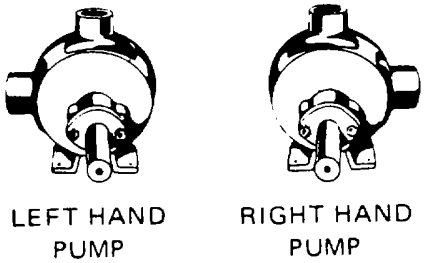


FIGURE 2

4. *Suction/Discharge* — shaft rotation will determine which port is suction and which discharge. A look at Figure 3 will show how rotation determines which port is which; as the pumping elements (gears) come out of mesh, point "A" on Figure 3, liquid is drawn into the suction port; as the gears come into mesh, point "B", the liquid is forced out the discharge port. Reversing the rotation reverses the flow through the pump. When determining shaft rotation, always look from the shaft end of the pump. Unless otherwise specified, rotation is assumed to be clockwise (CW), which makes the suction port on the right side of the pump. The idler pin, which is offset in the pump head, should be properly positioned toward and an equal distance between the port connections.

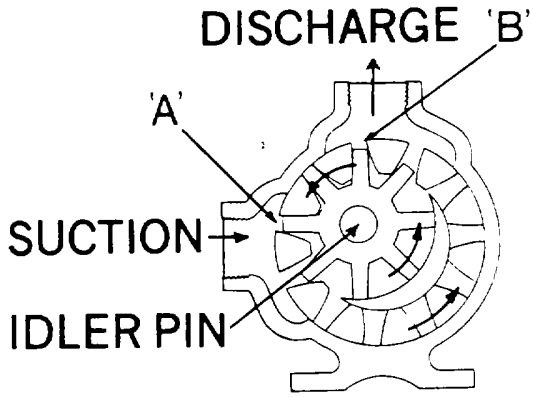
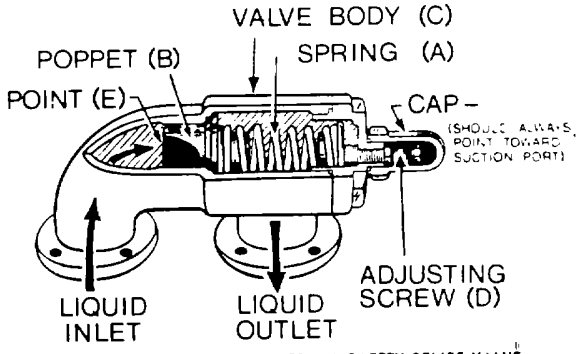


FIGURE 3

5. *Safety Relief Valve* — the Viking pump is a positive displacement pump. This means that when the pump is rotated, liquid will be delivered to the discharge side of the pump. If there is no place for this liquid to go — discharge line is blocked or closed — the pressure will build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. To prevent the possibility of any one or more of these things happening in case of unintentional closing of the discharge line, the use of a safety relief valve is recommended. A safety relief valve will relieve the pressure at a predetermined value, thus protecting the entire system.



CUT-AWAY OF VIKING INTERNAL SAFETY RELIEF VALVE

FIGURE 4

The safety relief valve mounted on Viking pumps and most in-line valves are of the spring loaded poppet design. See Figure 4. The spring (A) holds poppet (B) against the seat in the valve body (C) with a given force determined by the spring size and by how tightly it is compressed by the adjusting screw (D). The

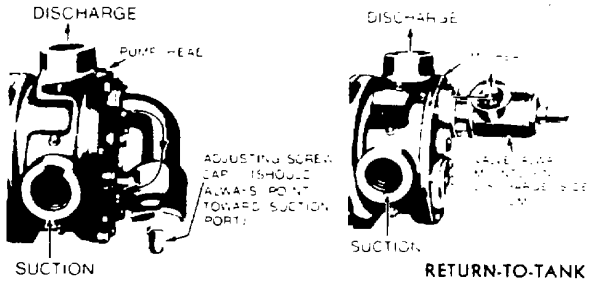
pump discharge pressure pushes against the under side of the poppet at point (E). When the force exerted by the liquid under the poppet exceeds that exerted by the spring, the poppet lifts and liquid starts to flow through the valve. As the discharge pressure builds up, more and more of the liquid flows through until a pressure is reached at which all of the liquid being pumped is going through the valve. This pressure is the relief valve setting.

CAUTION:

THE INTERNAL TYPE SAFETY RELIEF VALVE MOUNTED ON THE VIKING PUMP SHOULD ALWAYS HAVE THE CAP OR BONNET POINTED TOWARD THE SUCTION SIDE OF THE PUMP. THE RETURN-TO-TANK TYPE SAFETY RELIEF VALVE SHOULD ALWAYS BE MOUNTED ON THE DISCHARGE SIDE OF THE PUMP. IF PUMP ROTATION IS PERMANENTLY REVERSED CHANGE THE RELIEF VALVE. TURN THE INTERNAL TYPE END FOR END; MOVE THE RETURN-TO-TANK TYPE TO THE OTHER PORT. IF, ON A PARTICULAR INSTALLATION IT IS THE INTENT TO REVERSE THE PUMP ROTATION FREQUENTLY, *(e.g., USING ONE PUMP TO FILL A TANK AND THEN BY USE OF A REVERSING SWITCH OR OTHER MEANS CHANGING ROTATION TO PERMIT THE SAME PUMP TO CIRCULATE THE LIQUID THROUGH A HEATER OR TO LOAD OUT)* THEN OVER PRESSURE PROTECTION MUST BE PROVIDED FOR *BOTH* SIDES OF THE PUMP OR FOR BOTH ROTATIONS. USE AN INTERNAL SAFETY RELIEF VALVE TO PROTECT ONE SIDE AND AN IN-LINE SAFETY RELIEF VALVE TO PROTECT THE OTHER; USE AN IN-LINE SAFETY RELIEF VALVE ON EACH SIDE OF THE PUMP OR USE SOME MEANS OF LIMITING TORQUE THAT IS FUNCTIONAL IN BOTH DIRECTIONS OF ROTATION.

PUMPS OR SYSTEMS WITHOUT SAFETY RELIEF VALVES SHOULD HAVE SOME FORM OF OVER PRESSURE PROTECTION, e.g., TORQUE LIMITING DEVICES, RUPTURE DISCS, ETC.

Viking pumps can be furnished with either an internal safety relief valve — one which directs the flow from the valve back to the suction side of the pump — or a return-to-tank valve which directs the flow through piping back to the supply tank. See Figure 5. An inline safety relief valve mounted in the discharge piping also directs the flow back to the supply tank. This type of valve should be mounted close to the pump so that the pressure drop through the piping between the pump and the valve is at a minimum. Be sure there are no shutoff valves between the pump and relief valve. Piping from a return-to-tank or an in-line valve to the supply tank



INTERNAL SAFETY RELIEF VALVE — RETURN-TO-TANK SAFETY RELIEF VALVE

FIGURE 5

NOTE: on some models the safety relief valve is mounted on the pump casing instead of the pump head

should also be as short and large as possible.

The spring loaded poppet-type valve is strictly a differential valve, sensing only those pressures on each side of the poppet. It should **not** be used as a pressure or flow control device. **It is intended strictly as a safety relief valve.**

The pressure at which either the return-to-tank or internal safety relief valve bypasses can be changed by turning the adjusting screw. Do not back the adjusting screw all the way out. Stop when spri tension is off the screw (the screw starts to tu easily).

For details on maintenance of the relief valve see Technical Service Manual covering your model series.

6. *Motor*—follow local electrical codes when hooking up motors.

Foundation

Every pump should have a good foundation. It may be any structure sufficiently strong to hold the pump rigid and to absorb any strain or shock that may be encountered.

A certified print of the pumping unit should be used in preparing the foundation. Ask for one. If a separate foundation is provided, make it at least four inches wider and longer than the base of the unit.

When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

Alignment

CHECK ALIGNMENT AFTER MOUNTING

For detailed coupling alignment procedures see Viking service bulletin ESB-61.

The pump, drive, and motor were properly alignec the time they were assembled. During shipping an mounting the alignment is often disturbed. **CHECK IT!**

1. Check pump ports to be sure they are square and in proper position; shim or move pump as required.
2. If the pump is driven by a flexible coupling(s) eith direct connected to the motor or through a reduce remove any coupling guards or covers and check

alignment of the coupling halves. A straightedge (a piece of key stock works nicely) across the coupling must rest evenly on both rims at the top, bottom, and sides. See Figure 6.

3. If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See Figure 6A.

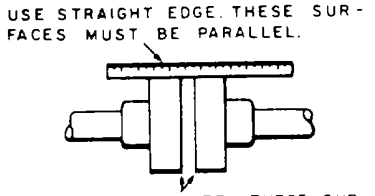
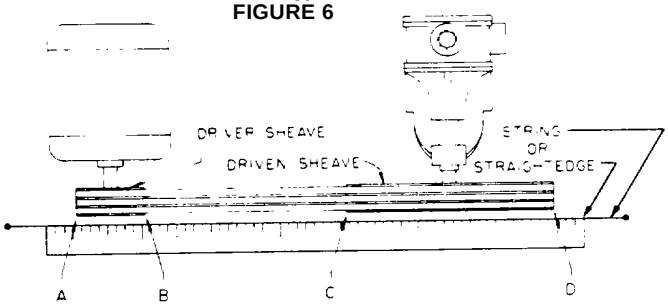


FIGURE 6



WHEN SHEAVES PROPERLY ALIGNED ALL POINTS A, B, C, D WILL TOUCH STRING OR STRAIGHTEDGE

FIGURE 6A

4. Make a final check on alignment after piping is hooked up. See item 13 under "Installation—Piping".

   Figures 7, 8, and 9 show typical units—direct, gear reducer and V-belt drive.

5. For high temperature applications (those above 300°F) allow pump to reach operating temperature, then recheck alignment.

Piping

The cause of many pumping problems can be traced to suction piping. It should always be as large and short as practical. For help in selecting the proper size piping, both suction and discharge, refer to Viking General Catalog Section 510.

Before starting layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections.
2. Be sure the inside of the pipe is clean before hooking it up.
3. *Foot valve* — When pumping a light liquid with a suction lift, a foot valve at the end of the suction

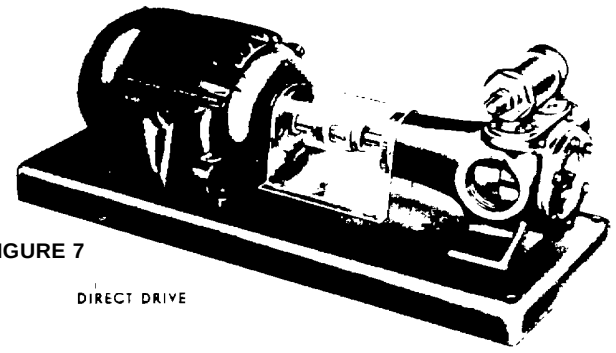


FIGURE 7

DIRECT DRIVE

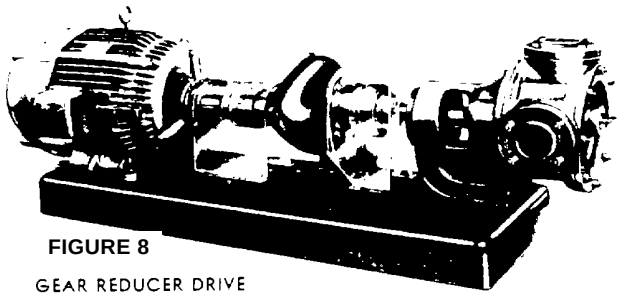


FIGURE 8

GEAR REDUCER DRIVE

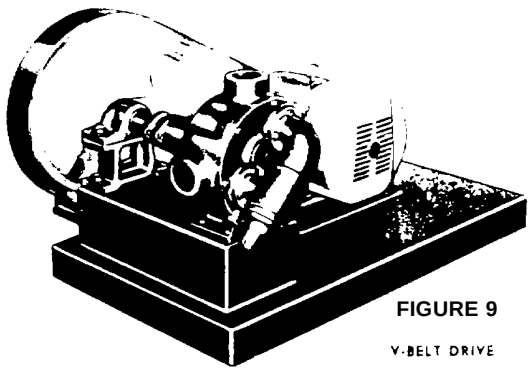


FIGURE 9

V-BELT DRIVE

TECHNICAL SERVICE MANUAL

INSTALLATION, START UP, TROUBLE-SHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

piping or a check valve in the first horizontal run will hold the liquid in the line and make it easier for the pump to prime. Be sure the foot or check valve is big enough so that it doesn't cause excessive line loss.

4. When approaching an obstacle in the suction or discharge line, go around the obstacle instead of over it. Going over it creates an air pocket. See Figure 10.

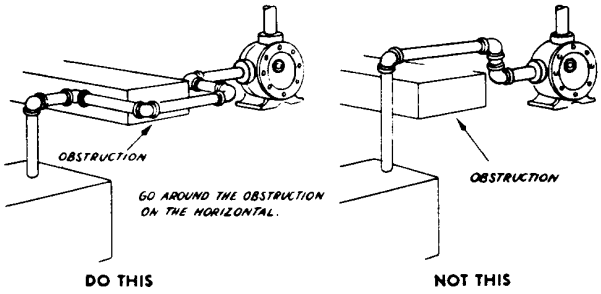


FIGURE 10

5. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
6. For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no foot valve. See Figure 11.
7. When piping a hot or cold system (liquid being handled is at a temperature different from the air surrounding the pump), be sure allowance is made for expansion and contraction of the piping. Loops, expansion joints, or unsecured (this does not mean unsupported) runs should be used so the pump casing is not distorted or put into a bind.
8. **STRAINER**— It is always good practice to consider a strainer on the suction side of a positive displacement pump. The strainer will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh or perforation size should be big enough so that it does not cause excessive pressure drop, but it should be fine enough to protect the pump. When in doubt as to the proper size, check with the manufacturer, giving him pipe size, flow rate, and viscosity involved. Provision should be made for cleaning the strainer. If the pump operates continuously, a bypass should be built around the strainer or two strainers should be put in parallel with proper valving so they can be isolated for cleaning. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects.

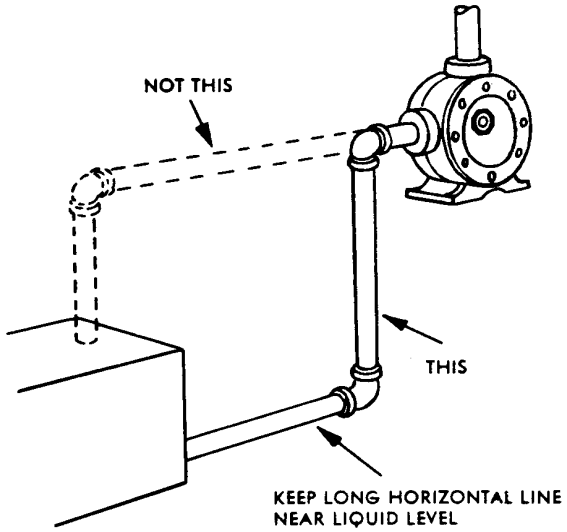


FIGURE 11

9. If the pump is not equipped with a safety relief valve, consideration should be given to mounting one in the discharge line. See discussion on safety relief valves under START UP.
10. The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.
11. When fastening the piping to the pump it should not be necessary to impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment, and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.
12. All joints of the piping system should be tight; pipe dope or teflon tape will help assure leak-free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.
13. **ALIGNMENT**— Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between th rotor and casing. Because of manufacturing tolerances, bushing clearances, etc., the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain. Making this check is most desirable on installations involving Q, M and N size standard duty pumps.

14. The auxiliary piping hooked to jackets, glands, etc. for heating, cooling, quenching, or for other purposes should receive the same attention as the piping handling the liquid pumped.
15. Provide a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. This is particularly important
    1. When handling a cold liquid such as refrigeration ammonia that can warm up to ambient temperatures when the pump Is shut off or
    2. When handling a liquid such as asphalt or molasses that has to be heated before it can be pumped.

The rise in temperature causes the liquid to expand; if there is no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture

START UP

Before pushing the "start" button, check the following.

1. Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. Check alignment See suggestions under "Installation Alignment" in this manual.
3. Check piping to be sure there is no strain on the pump casing.
4. Rotate the pump shaft by hand to be sure it turns freely.
5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under "Installation General" item 4 in this manual.
6. Check any safety relief valve to be sure it is installed correctly. See discussion on safety relief valve under "Installation General".
7. Check suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below liquid level.
8. Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the liquid to go.
9. Lubricate any grease fitting on the pump using a good, general purpose #2 ball bearing grease. Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended.
10. For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should weep a little to keep it cool and lubricated.
11. Do not use the Viking pump to flush, pressure test or prove the system with water. Either remove the pump or run piping around it while flushing or testing. Pumping water, dirty or otherwise, can do more damage in a few minutes than months of normal service.
12. Check to be sure all guards are in place.
13. Now you are ready to push the "start" button gently.

If the pump begins to deliver liquid within 60 seconds, you're in business. If it does not, push the "stop" button. Do not run the pump longer than one minute without liquid in it; you will ruin it. Review the steps just outlined, consider what the suction and discharge gauges indicate, see page 6 , if everything appears to be in order, put some liquid in the pump, a lubricating liquid is best This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until liquid begins to flow.

If the pump still does not deliver, the cause may be one or more of the following.

1. Suction line air leaks; vacuum gauge reading should help determine if this Is the problem.
2. End of suction pipe not submerged deep enough in liquid.
3. Suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, suggest you review again all points given under START UP; read through Trouble-Shooting in this manual and try again. If it still does not pump, contact your Viking representative.

TROUBLE-SHOOTING

A Viking pump which is properly installed and maintained will give long and satisfactory performance.
*NOTE: Before making any pump adjustment or opening the pump liquid chamber in any manner, make sure that

1) any pressure in the pumping chamber has been vented through the suction or discharge lines or other openings provided for this purpose, 2) the driver has been "locked out" so that it cannot inadvertently be started while work is being done on the pump and 3) the pump has been allowed to cool down to the point where there is no chance of anyone being burned.

If trouble does develop, one of the first steps toward finding the difficulty is to install a vacuum gauge in the suction port and a pressure gauge in the discharge port. Readings on these gauges often will give a clue as to

where to start looking for the trouble.

Vacuum Gauge-Suction Port

1. High reading would indicate.
   a. Suction line blocked-foot valve stuck, gate valve closed, strainer plugged.
   b. Liquid too viscous to flow through the piping.
   c. Lift too high.
   d. Line too small.
2. Low reading would indicate.
   a. Air leak in suction line.
   b. End of pipe not in liquid.
   c. Pump is worn.
   d. Pump is dry-should be primed.
3. Fluttering, jumping, or erratic reading
   a. Liquid vaporizing.
   b. Liquid coming to pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
   c. Vibrating from cavitation, misalignment, or damaged parts.

Pressure Gauge-Discharge Port

1. High reading would indicate
   a. High viscosity and small and/or long discharge line.
   b. Gate valve partially closed.
   c. Filter plugged.
   d. Vertical head did not consider a high specific gravity liquid.
   e. Line partially plugged from build up on inside of pipe.
   f. Liquid in pipe not up to temperature.
   g. Liquid in pipe has undergone a chemical reaction and has solidified.
   h. Relief valve set too high.
2. Low reading would indicate
   a. Relief valve set too low.
   b. Relief valve poppet not seating properly.
   c. Bypass around the pump partially open.
   d. Too much extra clearance.
   e. Pump worn.
3. Fluttering, jumping, or erratic reading
   a. Cavitation.
   b. Liquid coming to pump in slugs.
   c. Air leak in suction line.
   d. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

A. Pump does not pump.
   1. Lost its prime-air leak, low level in tank, foot valve stuck.
   2. Suction lift too high.
   3. Rotating in wrong direction.
   4. Motor does not come up to speed.
   5. Suction and discharge valves not open.
   6. Strainer clogged.
   7. Bypass valve open, relief valve set too low, relief valve poppet stuck open.
   8. Pump worn out.
   9. Any changes in the liquid system, or operation that would help explain the trouble, e.g. new source of supply, added more lines, inexperienced operators, etc.
   10. Tighten end clearance.
   11. Head position incorrect. See Fig. 3.

B. Pump starts, then loses its prime.
   1. Supply tank empty.
   2. Liquid vaporizing in the suction line.
   3. Air leaks or air pockets in the suction line; leaking air through packing or mechanical seal.
   4. Worn out.

C. Pump is noisy.
   1. Pump is being starved (heavy liquid cannot get to pump fast enough). Increase suction pipe size or reduce length.
   2. Pump is cavitating (liquid vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the liquid, raise the liquid level closer to the pump; if the liquid is above the pump, increase the head of liquid.
   3. Check alignment.
   4. May have a bent shaft or rotor tooth. Straighten or replace.
   5. Relief valve chatter; increase pressure setting.
   6. May have to anchor base or piping to eliminate or reduce vibration.
   7. May be a foreign object trying to get into the pump through the suction port.

D. Pump not up to capacity.
   1. Starving or cavitating-increase suction pipe size or reduce length.
   2. Strainer partially clogged.
   3. Air leak in suction piping or along pump shaft.
   4. Running too slowly; is motor the correct speed and is it wired up correctly.
   5. Bypass line around pump partially open.
   6. Relief valve set too low or stuck open.
   7. Pump worn out.
   8. Tighten end clearance.
   9. Head position incorrect. See Fig. 3.

E. Pump takes too much power.
   1. Running too fast--Is correct motor speed, reducer ratio, sheave size, etc. being used.
   2. Is liquid more viscous than unit sized to handle; heat the liquid, increase the pipe size, slow the pump down, or get a bigger motor.
   3. Discharge pressure higher than calculated, check with pressure gauge. Increase size or reduce length of pipe, reduce speed (capacity), or get bigger motor.

4. Packing gland drawn down too tight.
5. Pump misaligned.
6. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

F. Rapid Wear.

On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump would show a smooth wear pattern on all parts. **Rapid wear,** occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. Some of the causes, evidence and cures are listed here.

CAUSE	EVIDENCE	CURE
1. Abrasives	Gouges or marks made by large, hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Flush the system with the pump removed. Install strainer in suction line. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
2. Corrosion	Rust, general overall aggressive attack or sloughing off of metal.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the liquid. Check to see whether or not the liquid has been contaminated to make it more corrosive than anticipated.
3. Exceeding operating limits	Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat.	Review General Catalog for operating limits on particular model involved.
4. Insufficient extra clearance	Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Increase end clearance and/or contact your distributor or the factory with details of the application so that information regarding proper extra clearance may be provided.
5. Lack of lubrication	Noisy bearings, localized heating at bearings or lip seal, smoke, rapid bushing wear.	Be sure all zerks are greased before starting and instructions for lubrication of drive equipment are followed; consider use of auxiliary lubricating equipment.
6. Misalignment	Wear on only one part of a surface, e.g., one side of the casing, one side of the packing gland, only a portion of the face of the head.	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
7. Run dry	Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; seal seats and idler pins changing color because of high heat.	Be sure there is liquid in the system at the time of start up. Provide some kind of automatic alarm or shut-off if supply tank runs dry.

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the cost per gallon pumped.

A. Lubrication—Grease all zerks after every 500 hours of operation or after 60 days, whichever occurs first. If service is severe, grease more often. Do it gently with a hand gun. Use a #2 ball bearing grease for normal applications. For hot or cold applications use appropriate grease.

B. Packing Adjustment—Occasional packing adjustment may be required to keep leakage to a slight weep; if impossible to reduce leakage by gentle tightening, replace packing or use different type. See Technical Service Manual on particular model series for details on repacking.

C. End Clearance Adjustment—After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See TSM on particular model series for procedure on adjusting end clearance for pump involved.

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VIKING PUMP HOUDAILLE
ONE OF THE HOUDAILLE PUMP GROUP

D. Examine Internal Parts—Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will elminate the need to replace more expensive parts at a later date. See TSM on particular model series for procedure in removing head of the pump. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.

E. Cleaning the Pump—A clean pump is easier to inspect, lubricate, adjust, and runs cooler; plus, it looks better.

F. Storage—If a pump is to be out of service or stored for a long time, drain it and protect it from rusting inside and out.

DO'S AND DON'TS

Do's and Don'ts for installation, operation, and maintenance of Viking pumps to assure safe, long, trouble-free operation.

Installation —

1. Do install pump as close to supply tank as possible.
2. Do leave working space around the pumping unit.
3. Do use large, short, and straight suction piping.
4. Do install a strainer in the suction line.
5. Do double-check alignment after the unit is mounted and piping is hooked up.
6. Do provide a safety relief valve for the discharge side of the pump.
7. Do cut out the center of gaskets used as port covers on flanged port pumps.
8. Do record pump model number and serial number and file for future reference.

Operation —

1. Don't run pump at speeds faster than shown in the catalog for your model.
2. Don't require pump to develop pressures higher than those shown in the catalog for your model.
3. Don't operate pumps at temperatures above or below limits shown in the catalog for your pump.
4. Don't operate pumps without all guards being in place.
5. Don't operate pump without a safety relief valve on the pump or in the discharge piping; be sure valve is mounted and set correctly.
6. Don't exceed catalog limits for temperature and pressures of fluids in jacketed areas of pump.
7. Don't use the pump in a system which includes a steam blow or an air or vapor blow or purge **without** provision for overspeed shutdown in case the pump starts to act as a turbine and overspeeds the drive.
8. Don't operate the pump with all of the liquid bypassing through a pump mounted internal type safety relief valve or without any flow of liquid going through the pump for more than a couple of minutes. Operation under either of these conditions may res in a heat buildup in the pump which could cau hazardous conditions or happenings.
9. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

Maintenance —

1. Do make sure any pump that has residual system pressure in it or that has handled high vapor pressure liquids, e.g., LP-gas, ammonia, Freons, etc. has been vented through the suction or discharge lines or other openings provided for this purpose.
2. Do make sure that if the pump is still hooked to the driver while maintenance is being performed that the driver has been "locked out" so that it cannot be inadvertently started while work is being done on the pump.
3. Do make sure any pump that has handled a corrosive, flammable, hot, or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.
4. Don't drop parts during disassembly, e.g., idler can slip from the pin as the head is removed from the pump; it may drop on your foot, plus it may get nicked or gouged.
5. Don't stick fingers in the ports of a pump! T close running parts may trim more than you. fingernails if the pump is rotated.
6. Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
7. Do remember that a few simple preventative maintenance procedures such as periodic lubrication, adjustment of end clearance, examination of internal parts, etc., will extend the service life of your pump.
8. Do **obtain,** read and keep maintenance instructions furnished with your pump.

WAV 11/83-75

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Tank Air Escape Valves

Model 1600

Description: Model 1600 Wager Tank Air Escapes consist of a body (of any material) equipped with a 30 x 30 mesh monel flame screen and a ¼ x ¼ mesh monel protecting screen, separated by a spacer ring. These parts are held in place on the body by means of a monel cap and #316 stainless steel screws.

Connections are either screwed IPS, flanged ASA or weld type as required.

Although somewhat similar in design to the Wager Inverted Vent Check Valves, these Tank Air Escapes are *not* equipped with a ball float.

Function: Wager Tank Air Escapes serve to allow the free passage of air into tanks, dry cargo holds, or storage spaces . . . and prevent vacuum or pressure build-up during pumping operations. Since these valves have no float for automatic closing, they should be placed in locations which are not accessible to sea water. The fine monel flame screen protects tank fluids or dry cargo dust from igniting in the event of deck fires and prevents the entrance of insects into areas serviced by these valves.

A coarse monel Protecting Screen, separated from the Flame Screen by a spacer ring, prevents any mechanical damage to the Flame Screen and acts as a deterrent to clogging this inner screen with paint.

Features:

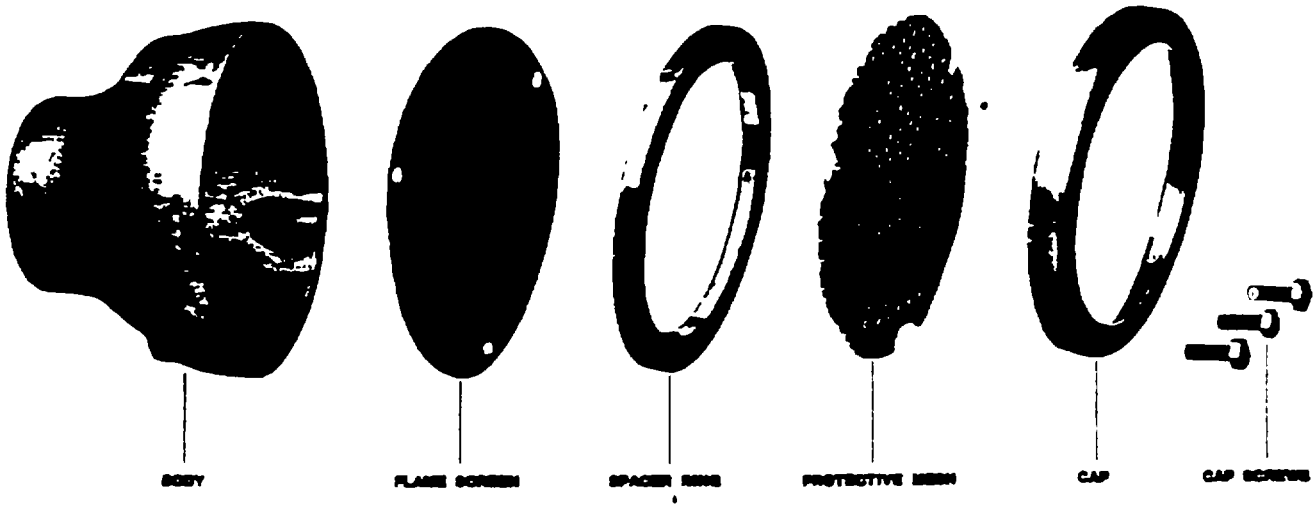
1 — OPEN AREA RATIO: Meets latest requirements for ABS, USMA, USCG and U. S. Navy.

2 — ACCESSIBILITY OF PARTS: Removal of the cap screws facilitates cleaning, inspection and/or replacement.

3 — RESISTANCE TO CORROSION: Monel and Stainless Steel are used for trim insuring long life.

4 — BODY MATERIAL: Steel, Stainless Steel, Cast Iron or Bronze.

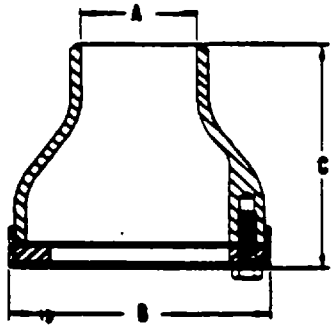
Exploded View



Robert H. Wager Co., Inc.–Passaic Ave., Chatham, N. J. 07928 • Tel. 201-635-9200

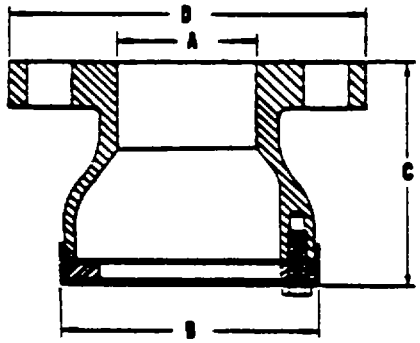
Tank Air Escape Valves

Weld Type 1600-W



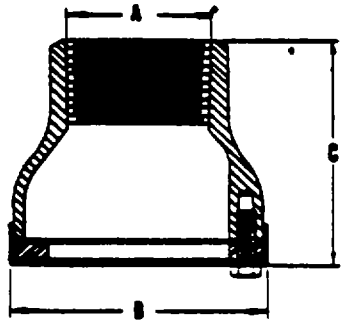
A	1-1/2	2	2-1/2	3	3-1/2	4	5	6	8	10	12
B	3-5/8	4-1/2	5-3/8	6-1/4	–	7-1/4	10-1/4	11-1/2	14-1/2	17-1/2	20-3/4
C	3-11/32	3-11/32	3-29/32	3-29/32	–	4-11/32	7-3/4	8-3/4	8-3/4	13-3/4	15-1/2
Wt.	2-1/2	3-1/4	4-1/4	5	–	8-1/2	25-1/2	35	60	85	105

Flanged Type 1600-F



A	1-1/2	2	2-1/2	3	3-1/2	4	5	6	8	10	12
B	3-5/8	4-1/2	5-3/8	6-1/4	–	7-1/4	10-1/4	11-1/2	14-1/2	17-1/2	20-3/4
C	3-11/32	3-11/32	3-29/32	3-29/32	–	4-11/32	7-3/4	8-3/4	8-3/4	13-3/4	15-1/2
D	5	6	7	7-1/2	–	9	10	11	13-1/2	16	19
Wt.	5-1/2	6-1/4	10	13	–	16-1/2	41	53	87	120	200

Threaded Type 1600-T



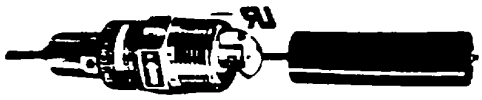
A	1-1/2	2	2-1/2	3	3-1/2	4	5	6	8	10	12
B	3-5/8	4-1/2	5-3/8	6-1/4	–	7-1/4	10-1/4	11-1/2	14-1/2	17-1/2	20-3/4
C	3-11/32	3-11/32	3-29/32	3-29/32	–	4-11/32	7-3/4	8-3/4	8-3/4	13-3/4	15-1/2
Wt.	2-1/2	3-1/4	4-1/4	5	–	8-1/2	25-1/2	35	60	85	105

GEMS® LIQUID LEVEL SWITCHES

SINGLE STATION

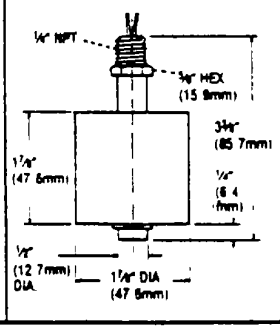
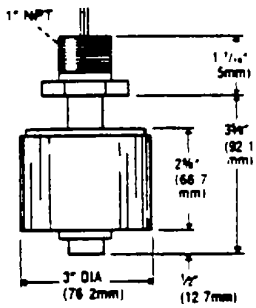
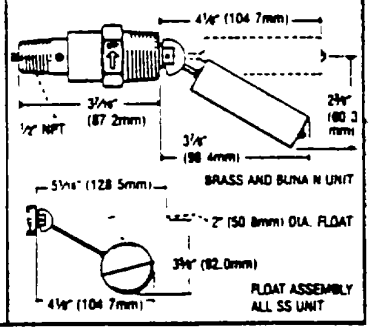
LS-30 Series Similar to the LS-3, but with a larger displacement float. High reliability at low cost for volume OEM applications where space is less restricted. Construction is all-Polysulfone.

LS-54000 Series Designed for use in corrosive liquids and vapors . . . constructed of PVDF (KYNAR) . . . these plastic units offer broad chemical compatibilities.



LS-2050 Series LS-2050 units are side-mounted in the tank, right at the point of high, low or intermediate level sensing. Ideal for tanks with "hard-to-get-at" tops or bottoms. Float-and-cam action is positive.

Specifications . . .

	LS-30	LS-54000	LS-2050	
Stem (or Housing) Mat	Polysulfone	Kynar	Brass	316 SS
Float Material	Polysulfone	Kynar	Buna N	316 SS
Operating Temp	0° to +225°F	+40° to +140°F	0° to 180°F	0° to 300°F
Pressure Rating	50 psi, max	50 psig, max	150 psig, max	900 psig, max.
Mtg & Mtg Attitude	¼" NPT	1" NPT	1" NPT, Horizontal ± 15°	
Switch	SPST 15/100W*, SPDT 15W	SPST 15/100W*, SPDT 15W	SPST 100W* or SPDT 15W	
Switch Diff in liquid	——	——	⅛" min	
Liquid Sp Gr	——	0.72 min	8 min	9 min
Other Mat contacting Liquid	316 SS	——	Teflon/Indox	
Lead Wires	#22 AWG, 24" L. Polymeric	#18 AWG, 24" L. Polymeric	#18 AWG, 24" L. Polymeric	
Dimensional Data . . .				

Standard Models . . .

Series	Stem Mat.	Float Mat.	Switch	P/N
LS-30	Polysulfone	Polysulfone	SPST, 15W	46201
	Polysulfone	Polysulfone	SPST, 100W*	46202
	Polysulfone	Polysulfone	SPDT, 15W	46203
LSP-54000	Kynar	Kynar	SPST 15W N O	63771
			SPST 15W N C	63772
			SPST, 100W*, N O	63773
			SPST, 100W*, N C.	63774
			SPDT 15W	63775

Series	Housing Mat.	Float Mat.	Switch	P/N
LS-2050	Brass	Buna N	SPDT, 15W	30288
	316 SS	316 SS	SPDT 15W	30290
	316 SS	316 SS	SPST, 100W*, N O	48068
	316SS	316 SS	SPST, 100W* N C	48069

Note 1 Gems LS-2050 Series Level Switches are available FM-approved, explosion-proof for Class I, Division 1, Group D hazardous areas. Consult Gems Sensors Division.

Note 2 GEMS LS-30 and LS-2050 Series Level Switches are **UL Recognized—File No. E45168.**

*Level switch units with 50W and/or 100W switches are not UL recognized.

GEMS
Single Station Level Switches

Compact and yet rugged, simple in design, GEMS Single Station Level Switches bring maximum reliability to high, low or intermediate liquid level detection in almost any tank or vessel. A comprehensive group of standard models in a variety of materials offers compatibility with most liquids. Repeatability is precise . . . effects of shock, vibration, pressure or vacuum are minimized. Many standard models are UL-recognized.

Applications . . .

These units are widely used in storage tanks and reservoirs of all types . . in chemical processing systems . . for automatic safety interlocks, pump motor control, etc. Small in design . . . low in cost . . these level switches are extensively used to meet many level control requirements in a variety of market areas

Custom Designs . . .

While the standard units listed in this catalog meet the wide variety of liquid level monitoring requirements, GEMS will supply units designed for specific customer needs. Please consult Gems Sensors Division.

Construction . . .

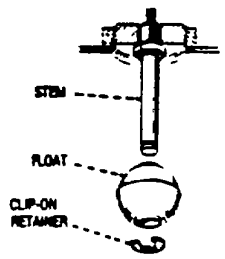
Rigid quality control and the ruggedness built into every Gems unit assure long, trouble-free service life. For various materials of construction see "Specifications" for individual single station models on the following pages

Installation and Maintenance . . .

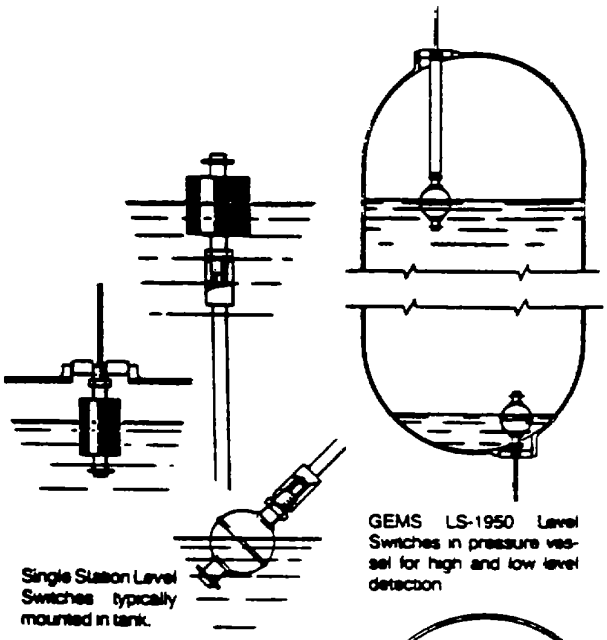
A standard NPT female boss in tank top or bottom is all that is required for rapid installation Units operate normally in any attitude from the vertical to a 30° inclination, with lead wires up or down. Standard IPS pipe extends units to any intermediate level in the tank. Wire leads connect to alarm or other remote indicator Maintenance is minimum . only occasional "wipe-down" cleaning if the liquid is excessively contaminated

Electrical Data . . .

Standard reed switches are hermetically sealed, magnetically actuated, make-and-break type. Switches are SPST or SPDT in various wattage ratings, depending on model. Complete electrical ratings for GEMS level switches are on page 14

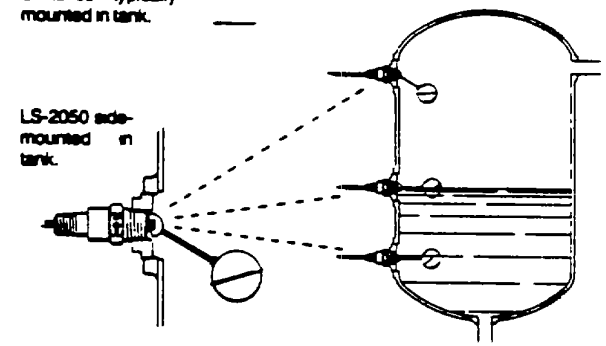


Normally open or normally closed operation of SPST switches is selectable by inverting the float on the unit stem as shown without disturbing the installation



Single Station Level Switches typically mounted in tank.

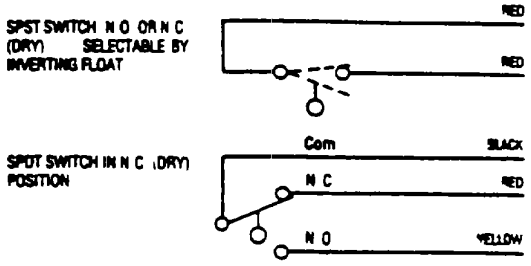
GEMS LS-1950 Level Switches in pressure vessel for high and low level detection



LS-2050 side-mounted in tank.

GEMS LS-2050 all-stainless-steel Level Switches sensing high, low and intermediate levels in pressure tank.

Typical Wiring Diagrams . . . Standard Models



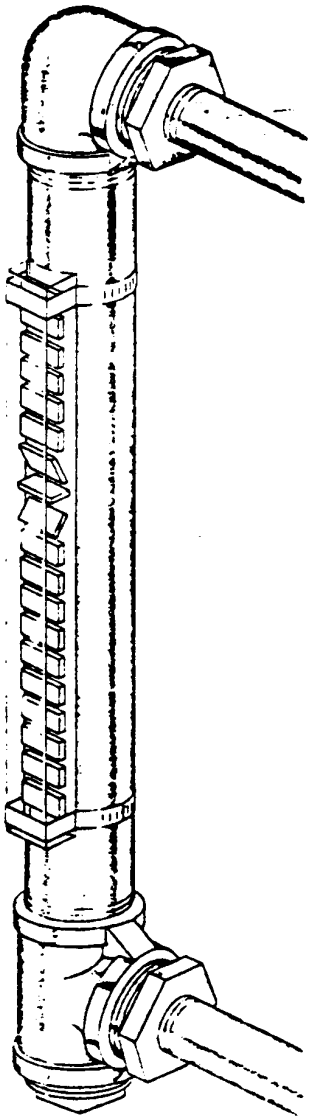
Ordering Information . . .

Specify units by P N (part number) from 'Standard Models charts when ordering GEMS Single Station Level Switches

GEMS FabriSite Components, Easy To Assemble In Your Plant, To Your Exact Requirements

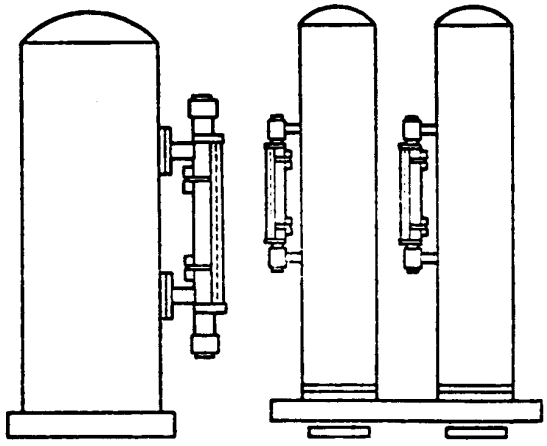
GEMS, foremost name in liquid level detection and indication, introduces GEMS FabriSite Components. Available are 4 Flag Assemblies; 3 Float Assemblies; 2 Clamps; 2 Switch Module and Clamp Assemblies. Each component offers quick and easy custom-assembly without the need of any special tools. Components are rugged, stand-up to pressure, shock, and vibration. Use non-magnetic standard 2½" I.P.S. SCH 40 Pipe, 2" I.P.S. SCH 80 Plastic Pipe or 1¼" (31.8mm) Dia. Tubing, .083 wall thickness, for MINI FabriSite Casing which is available from your local plumbing distributor, as are all needed fittings. GEMS FabriSite Liquid Level Indicator Assemblies are ideal wherever liquid level indication accuracy is called for. They are safer than sight glass assemblies, and provide greater visibility — will not cloud up — and they have the capability to replace your present sight glass assemblies. Whether you are presently using GEMS Liquid Level Indicators, or have the need to create your own GEMS FabriSite custom system, GEMS high quality FabriSite components and optional custom assemblies deliver both dependability and economy.

Liquid Level Indicator Assembly using GEMS FabriSite Components . . .



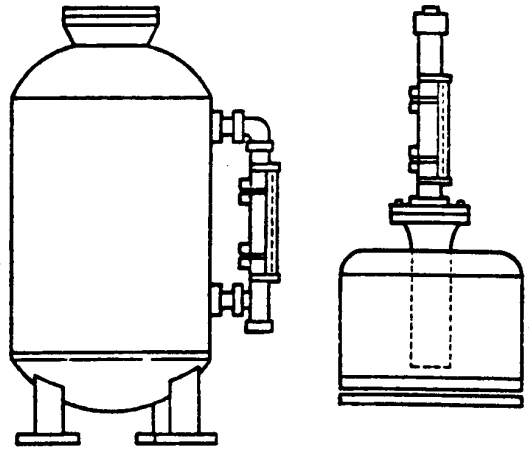
*Patent Pending

TYPICAL INSTALLATIONS . . .



WATER TREATMENT

LIQUID DISTILLING EQUIPMENT



FOOD PROCESSING EQUIPMENT

UNDERGROUND TREATMENT

6

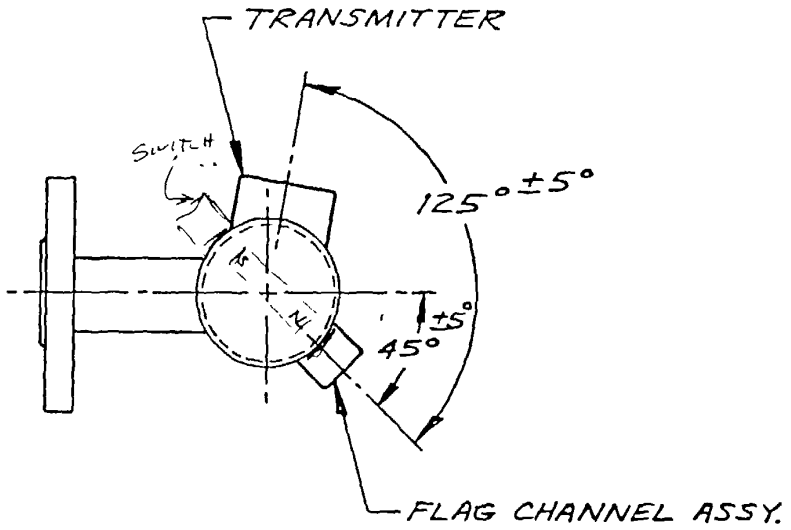
ISSUE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	TOTAL

DWG. NO 87707 REV A

1. transmiter must be 125° counter clockwise from the flag assembly
2. switch capsule must be 180° from the flag assembly.

REVISIONS

CDN.	LTR.	DESCRIPTION	DATE	APPROVED
85672	A	ADDED "TOP VIEW"	8/20	RT



TOP VIEW

		UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES TOLERANCES EXCEPT AS NOTED: DECIMAL XX ± 010 .XXX ± 005 FRACTIONAL ±1/64" ANGULAR ±2° MACHINE FILLETS AND BREAK MACHINED EDGES 005 – 015	CONTRACT NO	TRANSAMERICA DELAVAL INC GEMS SENSORS DIVISION PLAINVILLE CONN 06062	Transamerica Delaval
			CUSTOMER	TITLE FLAG POSITION	
NEXT ASSY.	USED ON	MATERIAL	DWN S.PUPECKI DATE 5/24/85	SIZE A	CODE IDENT. NO 01031
APPLICATION			CHKD DPD DATE 5/28/85	DWG NO. 87707	REV. A
DRAWING LEVEL			APPD RJr DATE 5-25-85	SCALE NONE	SHEET 3 OF 3

APPENDIX C

Preventive maintenance checks and services (PMCS) for the Fuel Oil System

C-1 Introduction to PMCS

NOTE

TM 55-193209-14&P-19 contains PMCS for all systems on the ROWPU Barge. This appendix contains only PMCS for the Fuel Oil 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

(a) You are the assigned operator and have not operated the item since the last weekly PMCS.

(b) 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 fail from the item 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, orbIlge system.

WARNING

Class 1, 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. Continuos 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, ;ad corrective action taken in the PMCS log book.

C-2 Major components. The fuel oil system consists of two storage tanks, a day tank, draining tanks, and the workboat filling station. In addition, it includes the fuel oil transfer pump and pump motor controller, fuel oil filter, fluid level indicators, switches, gauges, valves, piping, and associated electrical circuitry. Chapter 1 lists the major components of the fuel oil system, their basic function and location on the barge.

C-3 Fuel Oil System Description. The fuel system on board the ROWPU barge provides fuel for two 155 kW diesel ship service generators, a ship auxiliary generator, and two ROWPU high pressure (HP) pump diesel engines, and a fueling station for the workboat. The system provides a centralized receiving, storage and distribution system for all barge operations.

Table C-1. Preventive Maintenance Checks and Services for Fuel Oil System

B - Before
D - During
A - After

D - Daily
W - Weekly
M - Monthly

Q - Quarterly
S - Semiannually
A - Annually

ITEM NO.	INTERVAL									ITEM TO BE INSPECTED	PROCEDURES CHECK FOR HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE
	B	D	A	D	W	M	Q	S	A			
										FUEL OIL SYSTEM		
											CAUTION **When transferring fuel between storage tanks, monitor storage tank liquid level indicators. Always operate transfer pump motor controller in a manner to avoid tank overills. Avoid excess fuel splashes from hose nozzle when using workboal fill station. Clean up fuel spillage immediately; careless fuel handling causes spills and increases hazards of shipboard fire.**	
1			•		•	•				All Components	a. Wipe components clean, especially fuel oil storage tank and day tank liquid level indicators.	
	•	•	•	•	•	•					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.	Securements or fasteners missing or loose.
	•		•		•	•					d. Check for damage especially to pressure gauges, filters, and control panels. Notify shift leader or bargemaster so repairs can be made.	Pressure gauges, filters or control panels damaged.
	•		•		•				•		e. Remove rust and corrosion. Touch up or paint In accordance with TB 43-0144 as necessary. Do not paint threads or labels.	

Table C-1. Preventive Maintenance Checks and Services for Fuel Oil System (Continued)

B - Before
D - During
A - After

D - Daily
W - Weekly
M - Monthly

Q - Quarterly
S - Semiannually
A - Annually

ITEM NO.	INTERVAL									ITEM TO BE INSPECTED	PROCEDURES CHECK FOR HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE
	B	D	A	D	W	M	Q	S	A			
2										Fuel Transfer Pump		
											NOTE **Before filling storage tanks or workboat fuel tank, be sure all posted safety precautions are observed. Notify US Coast Guard of overboard spills Into surrounding water.**	
	•		•		•						a. Check wiring for loose connections and frayed cables. Use insulated tools to secure, repair or replace cables as necessary.	Connections loose or cables frayed.
	•										b. Start up after administrative or longterm storage.	
											CAUTION **Pump must start within 60 seconds. DO NOT try to turn over pump for more than 60 seconds. Pump will be damaged.**	
											1) Start pump. If pump does not start within 60 seconds, notify shift leader or bargemaster of problem.	
											2) If authcrized by shift leader or bargemaster, prime pump, using lubricating liquid, if available.	
											3) Start pump. If fuel does not flow within 2 minutes, stop and vent discharge line until fuel flows into container placed under discharge line.	
											4) If pump still does not discharge fuel, notify shift leader or bargemaster.	
		•									c. Check that fuel transfer pump is operating normally and not leaking more than a slight weep (Class II). If fuel oil flow does not start within 1 minute, notify shift leader or bargemaster.	Class II leaks.
		•									d. Note unusual noises or overheating of fuel transfer pump motor which might indicate a pending malfunction.	Fuel transfer pump motor overheating.
						•					e. Lubricate fuel transfer pump using grease gun with #2 ball bearing grease for normal operation. Use appropriate grease for hot or cold weather. In extreme heat, lubricate with hot weather lubricant such as SAE 40.	

Table C-1. Preventive Maintenance Checks and Services for Fuel Oil System (Continued)

B - Before
D - During
A - After

D - Daily
W - Weekly
M - Monthly

Q - Quarterly
S - Semiannually
A - Annually

ITEM NO.	INTERVAL									ITEM TO BE INSPECTED	PROCEDURES CHECK FOR HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE
	B	D	A	D	W	M	Q	S	A			
								•			f. Check transfer pump for leaks, capacity and pressure. Il leakage is greater than a slight weep, replace mechanical seal as follows. **CAUTION** **Never touch sealing faces with anything except fingers-or a clean cloth to ensure a good seal.** 1) Remove capscrews attaching end cap. 2) Remove end cap to expose mechanical seal. 3) Remove mechanical seal by sliding off end of shaft. 4) Check end of pump shaft for sharp burrs or edges which might cut seal bellows. 5) Spread a film of lubricating oil on inside diameter of synthetic rubber bellows 6) Slide seal rotary member over shaft and up against set collar, so that spring washer and spring go on first. 7) Coat synthetic rubber seal seat with lubricating oil and push seal seat into end cap. 8) Put end cap gasket on end of casing. 9) Slide end cap over shaft. 10) Flush both seal seat and carbon wear ring In seal rotary member with oil. 11) Push end cap up until mating surfaces of end cap and casing or seal meet. 12) Install capscrews and tighten evenly	Class III leaks.

Table C-1. Preventive Maintenance Checks and Services for Fuel Oil System (Continued)

B - Before
D - During
A - After

D - Daily
W - Weekly
M - Monthly

Q - Quarterly
S - Semiannually
A - Annually

ITEM NO.	INTERVAL									ITEM TO BE INSPECTED	PROCEDURES CHECK FOR HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE
	B	D	A	D	W	M	Q	S	A			
							•				If pump is loosing capacity or pressure, adjust end clearance as follows: **NOTE** **If pump is furnished with relief valve, it is not necessary to remove valve from pump head.** 1) Remove capscrews attaching head to casing. 2) Remove head gasket. 3) Install proper amount of head gaskets to provide necessary end clearance within pump, so pump turns freely with no end play. 4) Attach head to casing using cap-screws.	
3	•			•						Storage and Day Tanks	a. Check liquid levels in storage tanks and day tank before transferring fuel. Fill tanks as necessary.	
		•			•						b. Check fuel storage and day tank visual liquid level indicators for damage. Report mal or nonfunctioning level switches to shift leader or bargemaster.	
									•		c. Drain and flush clean the liquid level indicator to reduce magnetic buildup. Dry surfaces with a clean, lint-free cloth.	
		•									d. Monitor proper operation of fuel storage tank liquid level switches on EMS video displays on fuel oil system.	
		•									e. Check that day tank high level switch automatically stops fuel transfer pump when day tank is full.	
						•					f. Check air tank escape valve frame screen and protective mesh for clogging and excessive corrosion. Clean or replace as necessary.	

Table C-1. Preventive Maintenance Checks and Services for Fuel Oil System (Continued)

B - Before
D - During
A - After

D - Daily
W - Weekly
M - Monthly

Q - Quarterly
S - Semiannually
A - Annually

ITEM NO.	INTERVAL									ITEM TO BE INSPECTED	PROCEDURES CHECK FOR HAVE REPAIRED OR ADJUSTED AS NECESSARY	EQUIPMENT IS NOT READY/ AVAILABLE
	B	D	A	D	W	M	Q	S	A			
4						•	•			Valves	a. Operate each valve through its full range of operation. b. Check valves. Replace or remake worn or damaged valves in accordance with TM 55-503.	
5							•			Fuel Oil Line Filter Element	a. Remove and replace screw-on fuel line filter element. b. Discard old filter.	
6	•		•			•				Fuel Catch Basin	a. Check for clogging in catch basin. If dogged, use compressed air to unclog strainer. b. Check for fuel in catch basin. Clean basin with water.	
7	•		•			•				Fuel Oil Filling Station	a. Check fuel hose and nozzle for leaks, cracks and bends. Repair or replace as required. b. Check that ball valve moves freely Repair or replace as required.	Class III leaks. Ball valve inoperable

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
06874

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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: 065357-000