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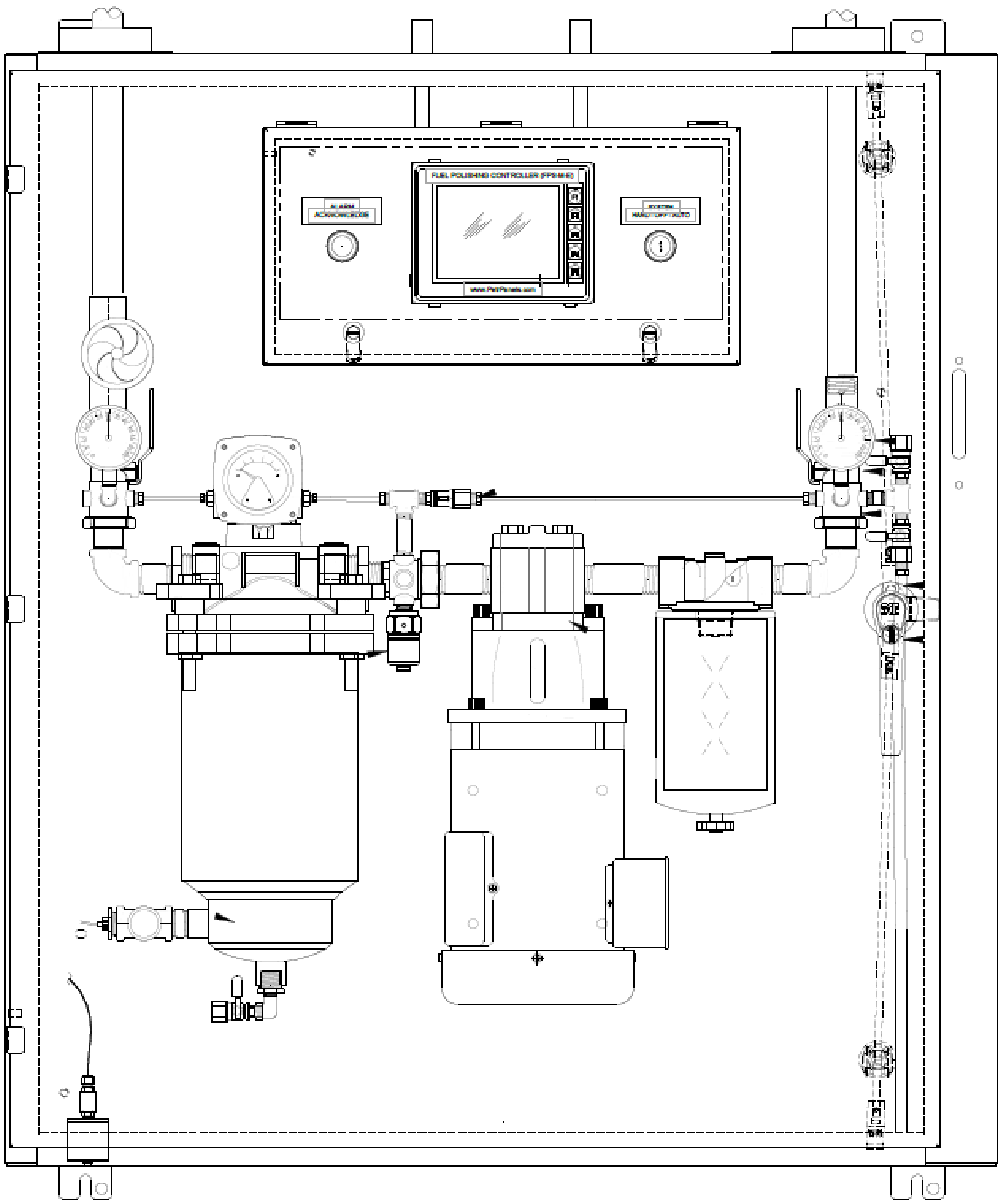
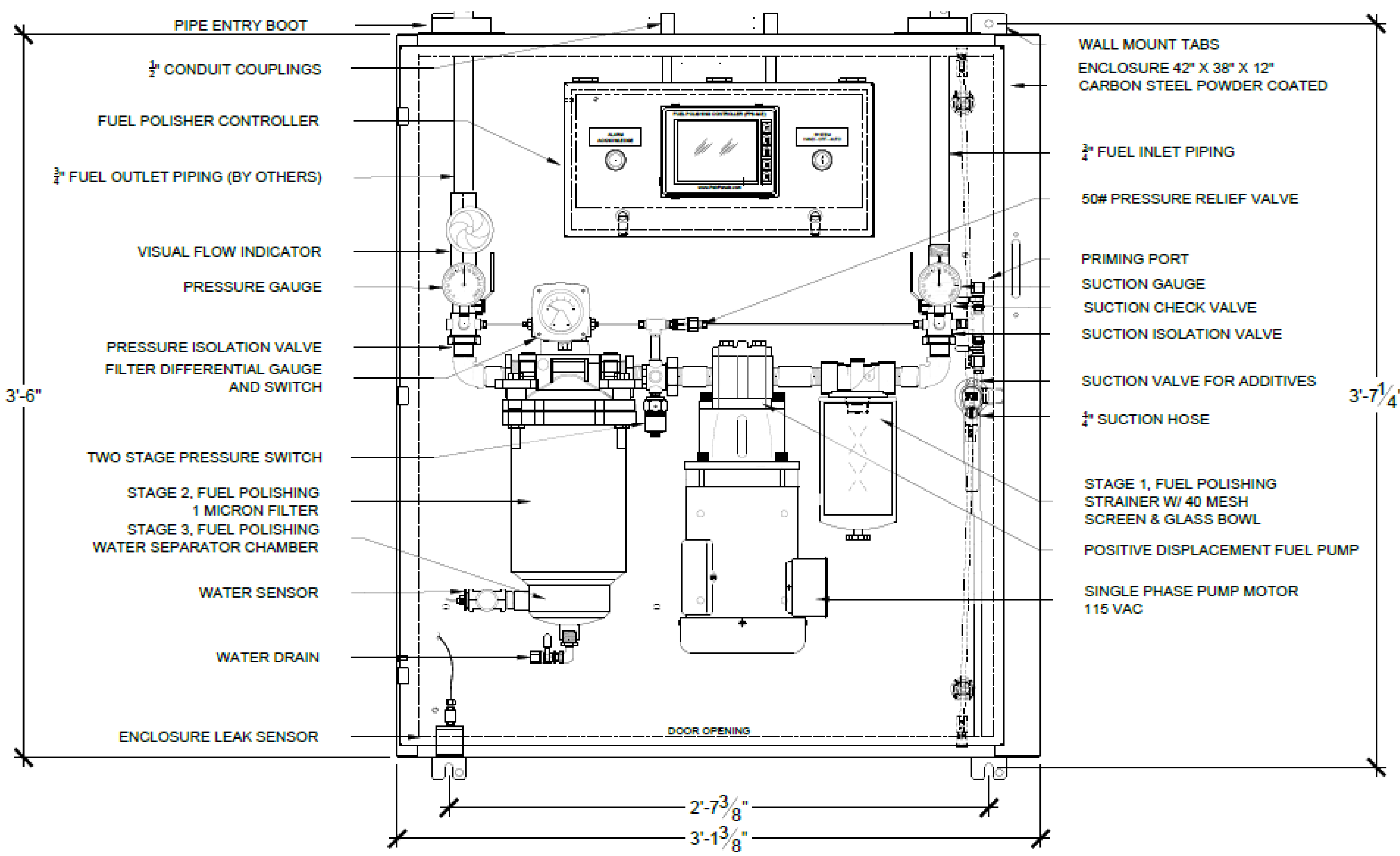
SafeSite fuel system controls

FUEL POLISHING SYSTEM (FPS)
OPERATIONS AND MAINTENANCE MANUAL



620 Herndon Parkway, Suite 120
Herndon, VA 20170
703-563-0320 F: 703-5630330

Table of Contents



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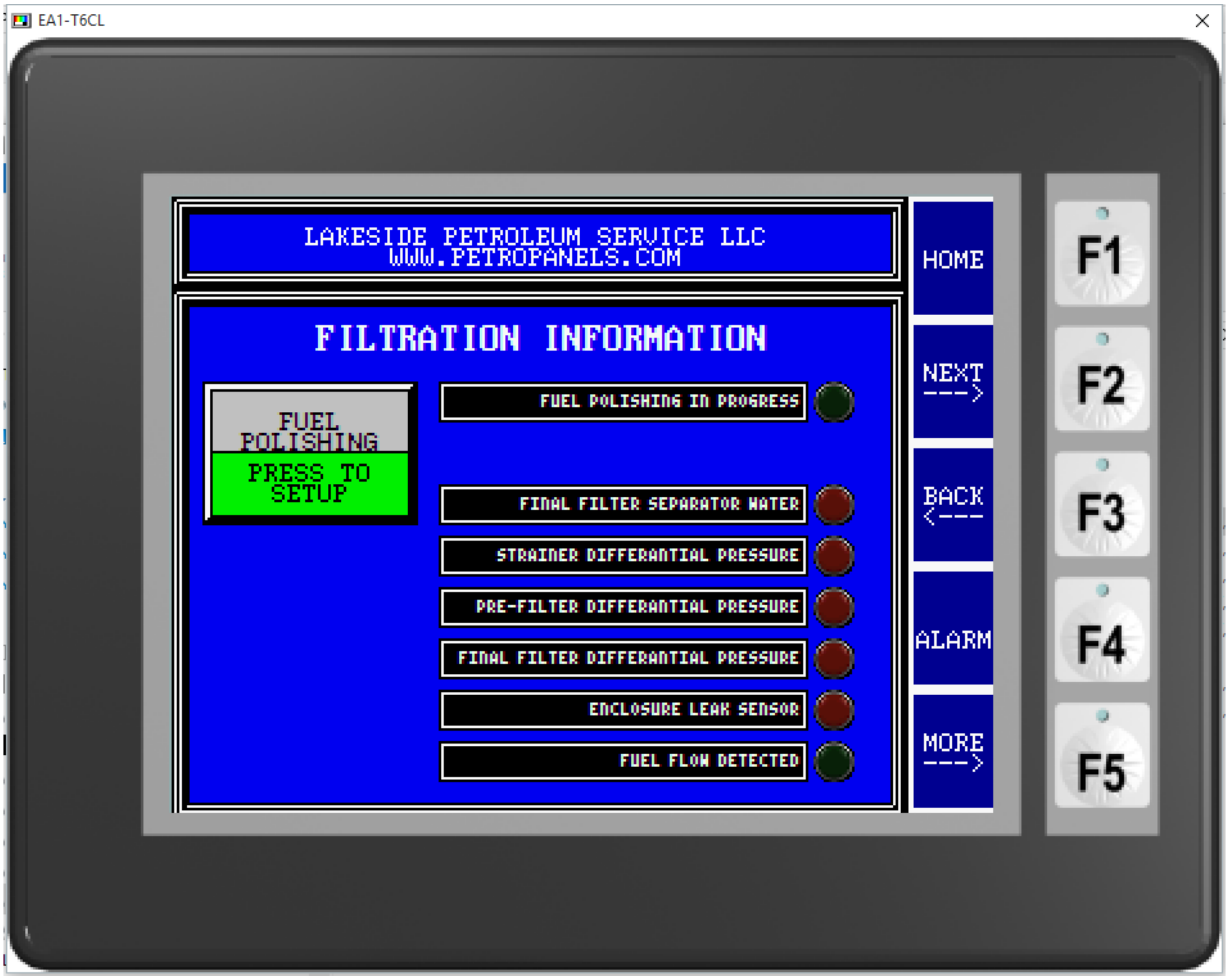
MAIN SCREEN

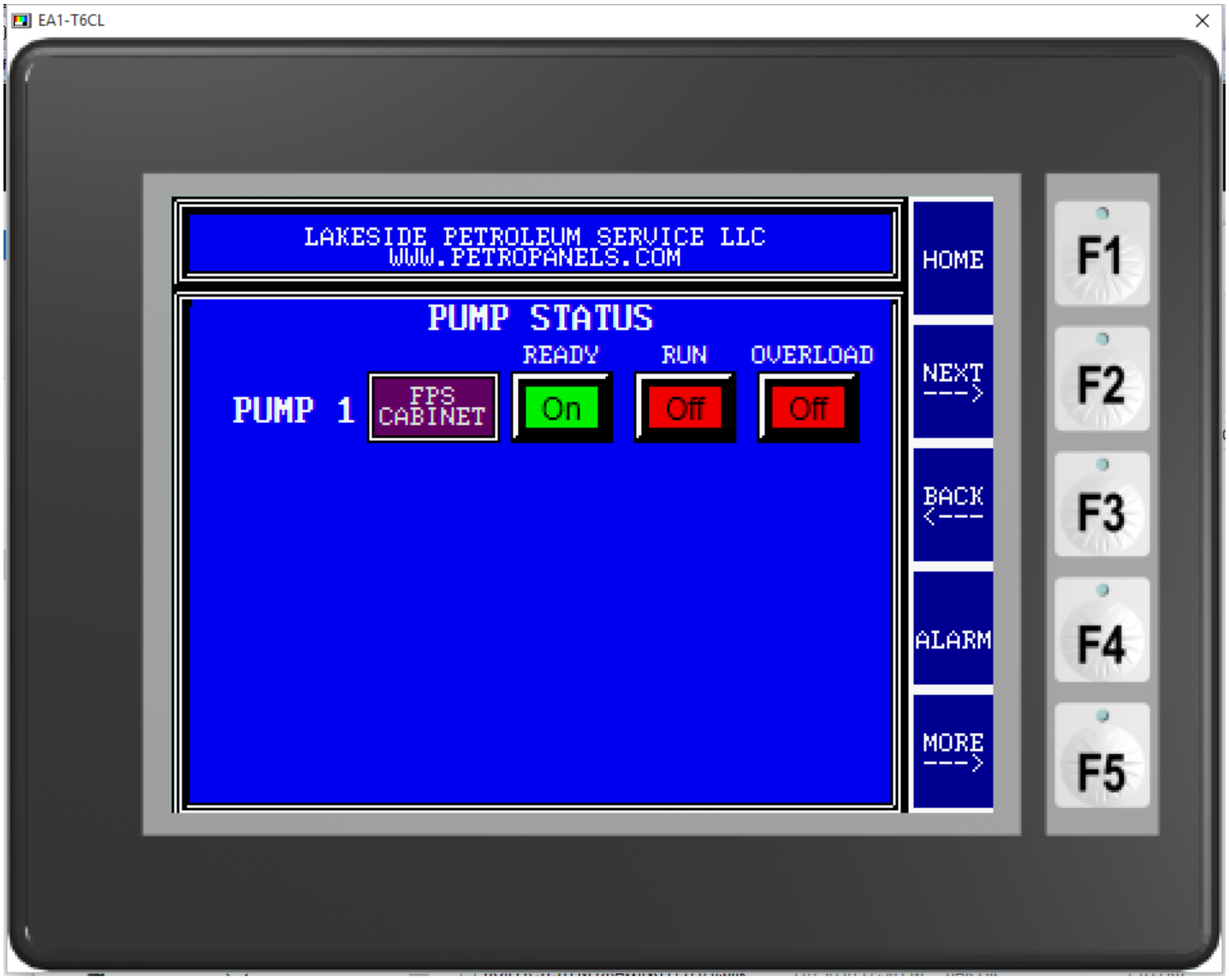


TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F2 (NEXT)	GO TO THE NEXT AVAILABLE SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN
F4 (ALARM)	GO TO THE ALARM SCREEN
F5 (MORE)	GO TO MANUAL RUN AND PROGRAMMING SCREENS

THE MAIN SCREEN IS WHERE THE STATUS INDICATIONS FOR OF THE SYSTEM FLOW SENSOR, THREE DIFFERENTIAL PRESSURE SWITCHES, FILTER WATER SENSOR AND THE ENCLOSURE LEAK SENSOR ARE LOCATED. BY PRESSING THE “FUEL POLISHING” BUTTON YOU WILL CHANGE TO THE MANUAL RUN SCREEN.

PUMP STATUS

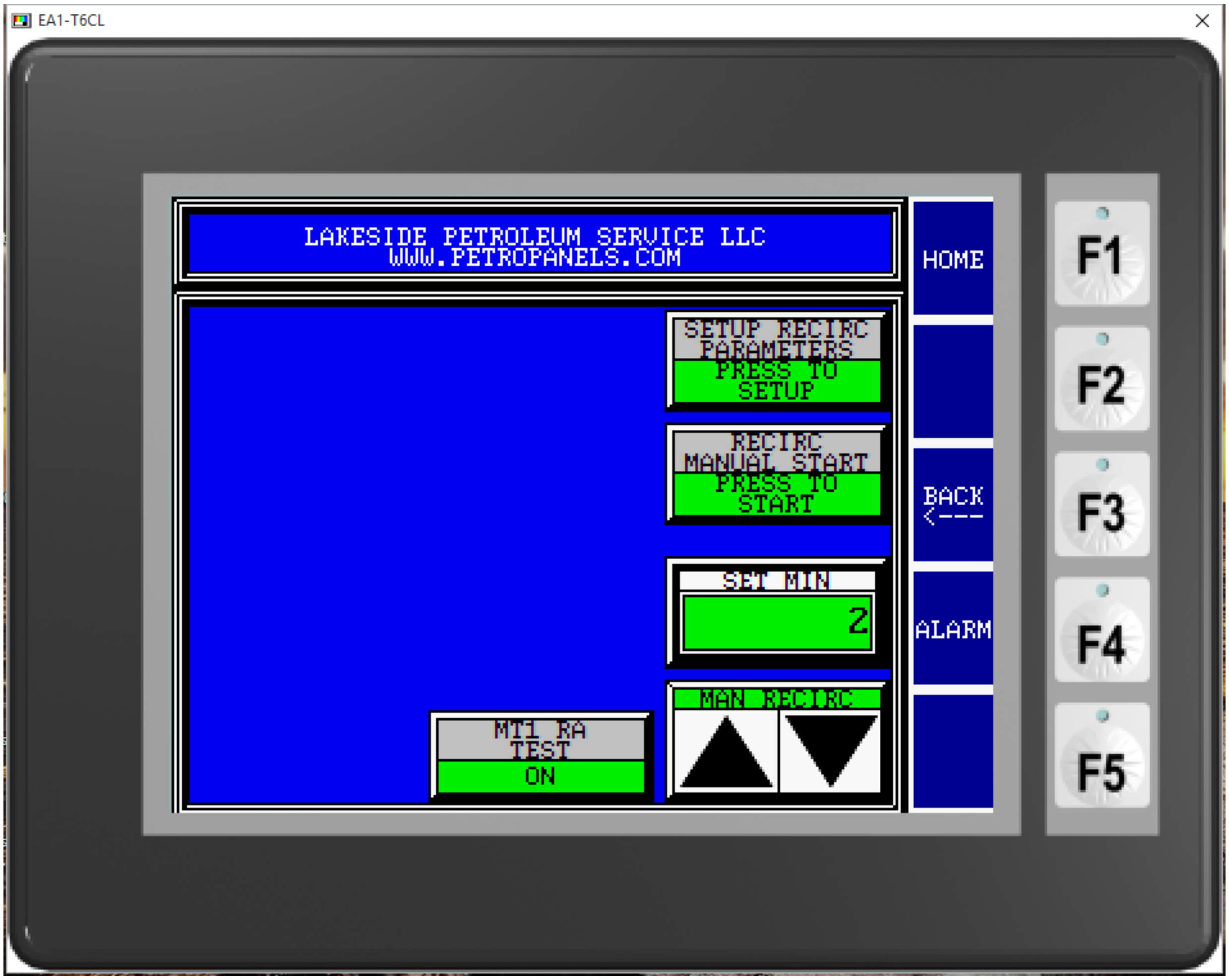


TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F2 (NEXT)	GO TO THE NEXT AVAILABLE SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN
F4 (ALARM)	GO TO THE ALARM SCREEN
F5 (MORE)	GO TO MANUAL RUN AND PROGRAMMING SCREENS

THE SCREEN SHOW THE STATUS OF THE FPS-14 PUMP, READY, RUN AND OVERLOAD BY DISPLAYING EITHER GREEN OR RED.

MANUAL RUN



TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN
F4 (ALARM)	GO TO THE ALARM SCREEN

IN THE MANUAL RUN SCREEN FOR CAN START AND RUN THE SYSTEM ON DEMAND. SELECT THE RUN DURATION TIME BY PRESSING EITHER UP OR DOWN ON THE “MAN RECIRC” BUTTON”. PRESS THE “RECIRC MANUAL START” BUTTON TO START THE FUEL POLISHING SYSTEM PUMP. BY PRESSING THE “SETUP RECIRC PARAMETERS” BUTTON YOU CAN SETUP THE FUEL POLISHING TO AUTOMATICALLY RUN ON A PROGRAMMABLE SCHEDULE. THE MT1 RA TEST” SERVES NO PURPOSE UNLESS REMOTE ALARMS ARE USED. WHEN PRESSING THE REMOTE ALARM CAN BE TESTED.

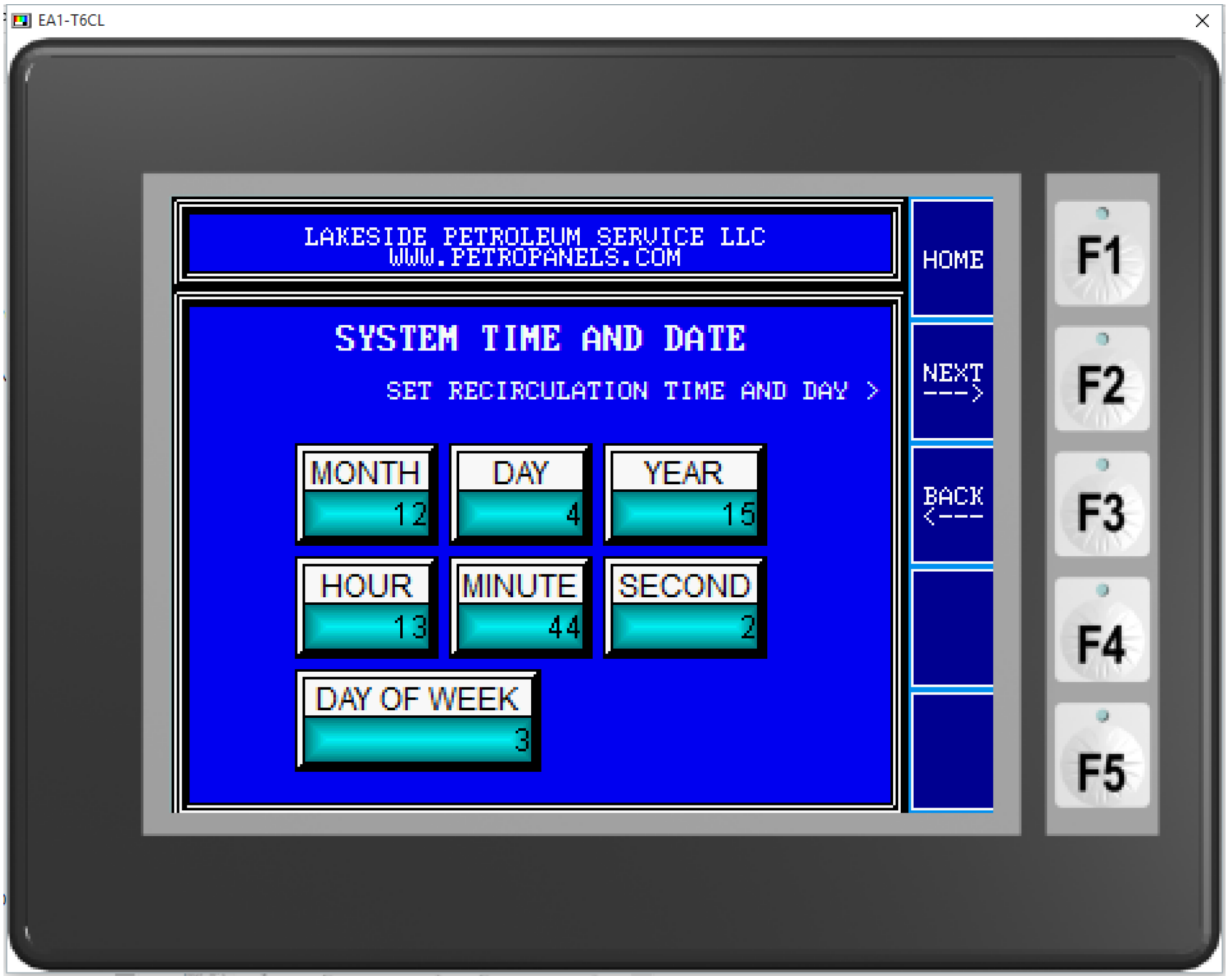
AUTO RECIRCULATION SETUP

TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN
F4 (VIEW CLOCK)	GO TO THE VIEW CLOCK SCREEN

TO SETUP THE AUTOMATIC FUEL POLISHING ON A SCHEDULE ENTER THE FOLLOWING INFORMATION. PRESS THE GREEN OR RED INDICATOR LIGHT ADJACENT TO THE DAY OF THE WEEK TO ENABLE OR DISABLE THAT DAY FOR FUEL POLISHING. ENTER THE HOURS – MINUTE – TO START THE FUEL POLISHING AND THEN THE DURATION IN HOURS.

VIEW CLOCK



TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F2 (NEXT)	GO TO THE SET RECIRC TIME SCREEN. (FPS AUTOMATIC SCHEDULE)
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN

ON THIS SCREEN YOU CAN VIEW THE CURRENT TIME AND DATE.

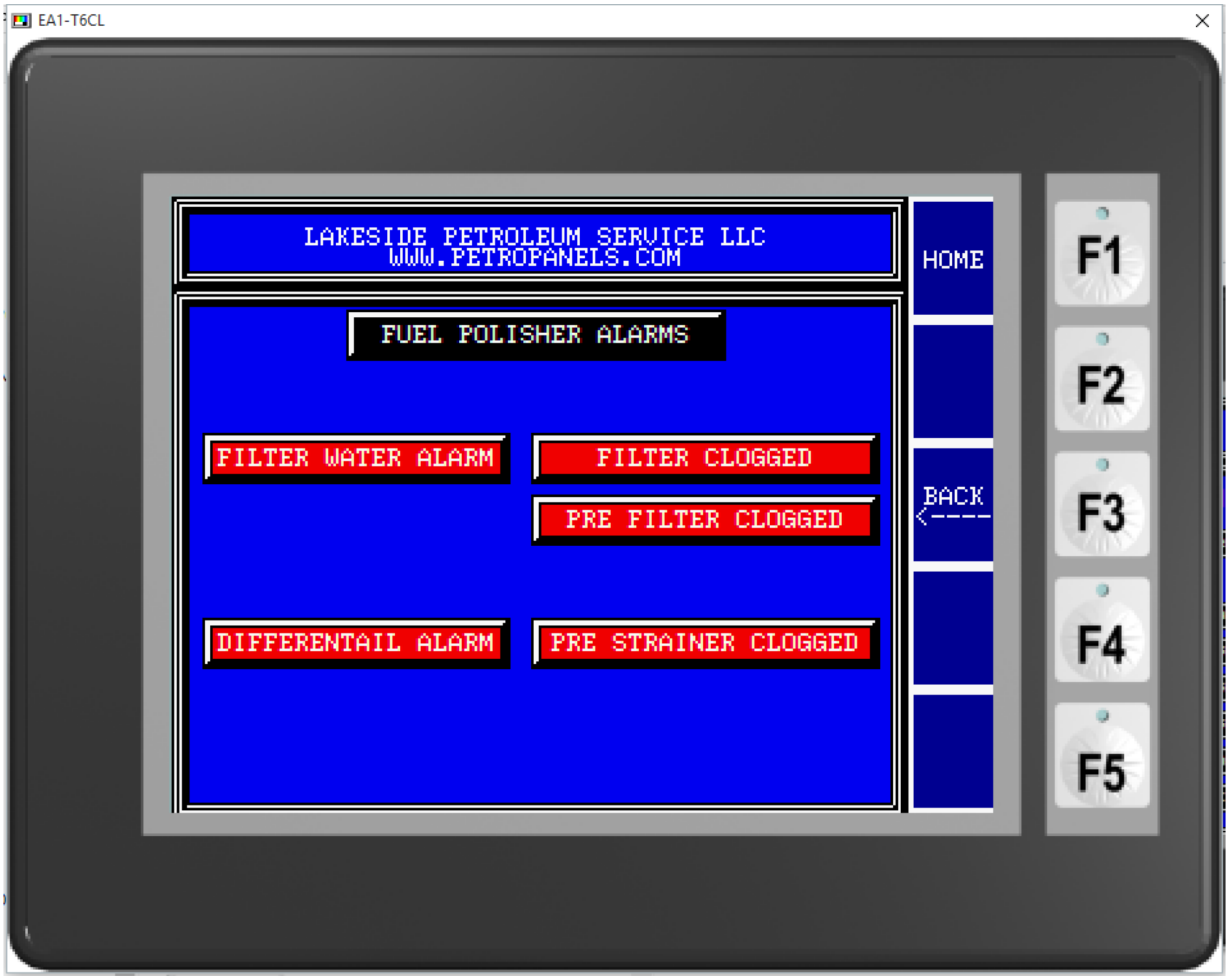
SYSTEM ALARM MENU

TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN
F4 (ALARM)	GO TO THE ALARM SCREEN

THE PRESENT ALARM SCREEN IS WHERE A MENU OF THE ALARMS ARE DISPLAYED. BY PRESSING ON EACH ITEM LISTED IN RED YOU CAN VIEW MORE INFORMATION ABOUT THE ALARM. PRESS THE “FUEL POLISHING” RED BOTTOM IF DISPLAYED TO SEE WHAT ALARMS ARE PRESENT. BY PRESSING THE “RESET ALL HISTORY” BUTTON THE STORED ALARMS WILL BE ERASED IF THE CONDITIONS OF THE ALARM HAS BE RECTIFIED.

FUEL POLISHER ALARMS



TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN

THE FUEL POLISHING ALARMS SHOWS THE STATUS IN RED IF AN ALARM IS PRESENT.

SYSTEM SETUP MENU

TO CHANGE TO ANOTHER SCREEN PRESS ONE OF THE FOLLOWING BUTTONS

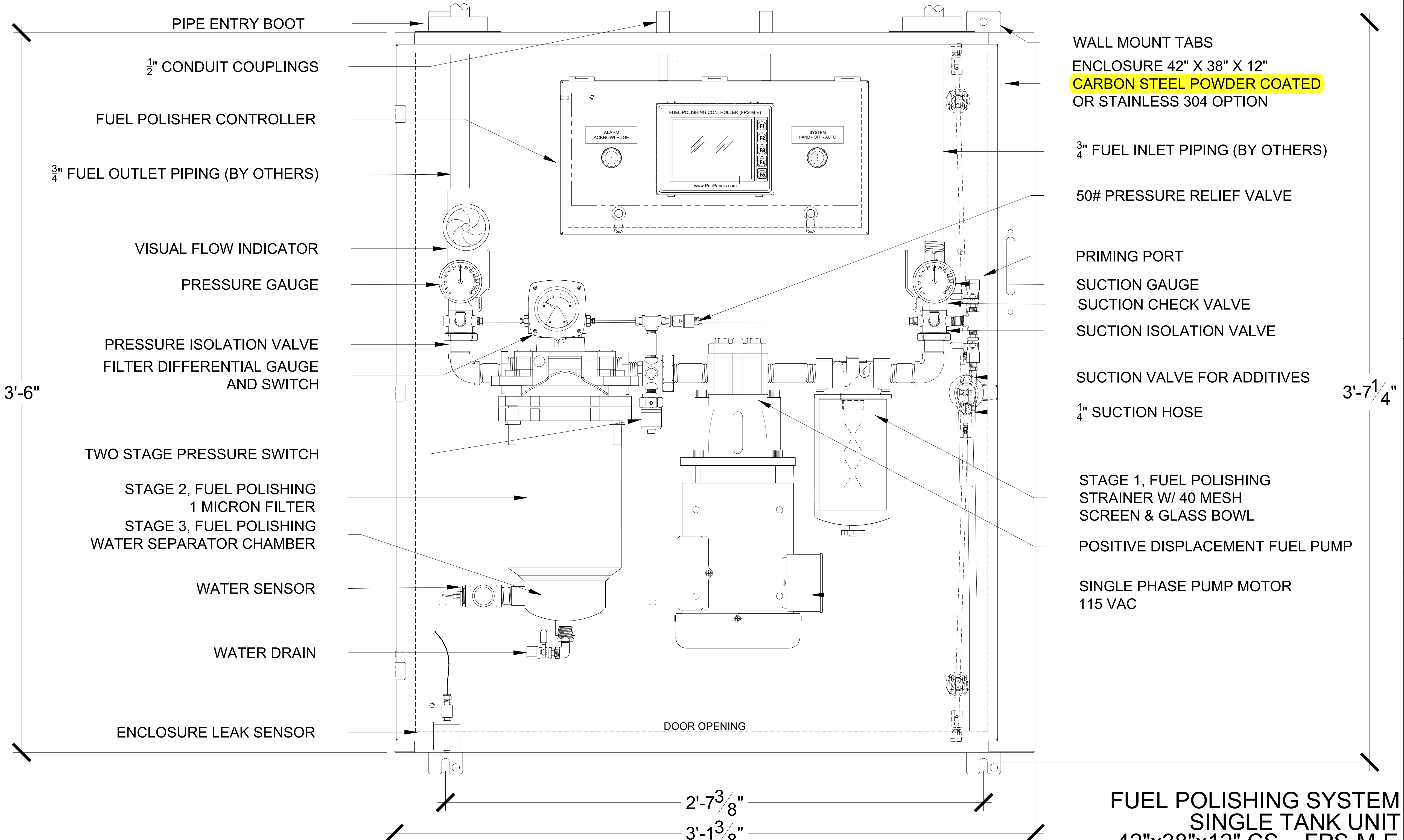
F1 (HOME)	PRESS TO RETURN TO THE HOME SCREEN
F2 (NEXT)	GO TO THE NEXT AVAILABLE SCREEN
F3 (BACK)	GO BACK TO THE PREVIOUS SCREEN
F4 (ALARM)	GO TO THE ALARM SCREEN
F5 (MORE)	GO TO MANUAL RUN AND PROGRAMMING SCREENS

THESE BUTTONS ARE PASSWORD PROTECTED. THE STANDARD PASSWORD IS “123”. AFTER PRESSING THE BUTTON ENTER THE PASSWORD. IN THIS FPS-14 SYSTEM THERE ARE NO SETUP INFORMATION TO BE SETUP OR MODIFIED.

PRESS THE “AUTO FILTRATION BUTTON” TO GO TO THE AUTO FILTRATION PROGRAMMABLE SCHEDULE. PRESS THE “MANUAL START” BUTTON THE ENTER THE MANUAL RUN SCREEN.

FPS-M-E (MODELS)

MODEL	GPM	FUEL POLISHING STAGE 1	FUEL POLISHING STAGE 2	FUEL POLISHING STAGE 3	PUMP MAX PSI	PUMP MAX FEET FT OF HEAD	MOTOR HP/VAC
FPS-M-E-5	5	40 MESH	1 MICRON	WATER REMOVAL	50	115	0.5 / 115
FPS-M-E-7	7	40 MESH	1 MICRON	WATER REMOVAL	50	115	0.5 / 115
FPS-M-E-9	9	40 MESH	1 MICRON	WATER REMOVAL	50	115	0.5 / 115
FPS-M-E-12	12	40 MESH	1 MICRON	WATER REMOVAL	35	81	0.5 / 115
FPS-M-E-15	15	40 MESH	1 MICRON	WATER REMOVAL	34	78	0.5 / 115



FUEL POLISHING SYSTEM
SINGLE TANK UNIT
42"x38"x12" CS FPS-M-E

General Notes:

NOTES

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Location & Contact

Washington DC (headquarters):
620 Herndon Parkway Suite 120
Herndon VA 20170
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New York
1141 River Road
Selkirk, NY 12158
Phone: 518.635.4343

Project Name and Address:
P20-0642 CORE 8698 OLYMPIC NATIONAL PARK

PROJECT

SafeSite fuel system controls

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Rev:003.001	
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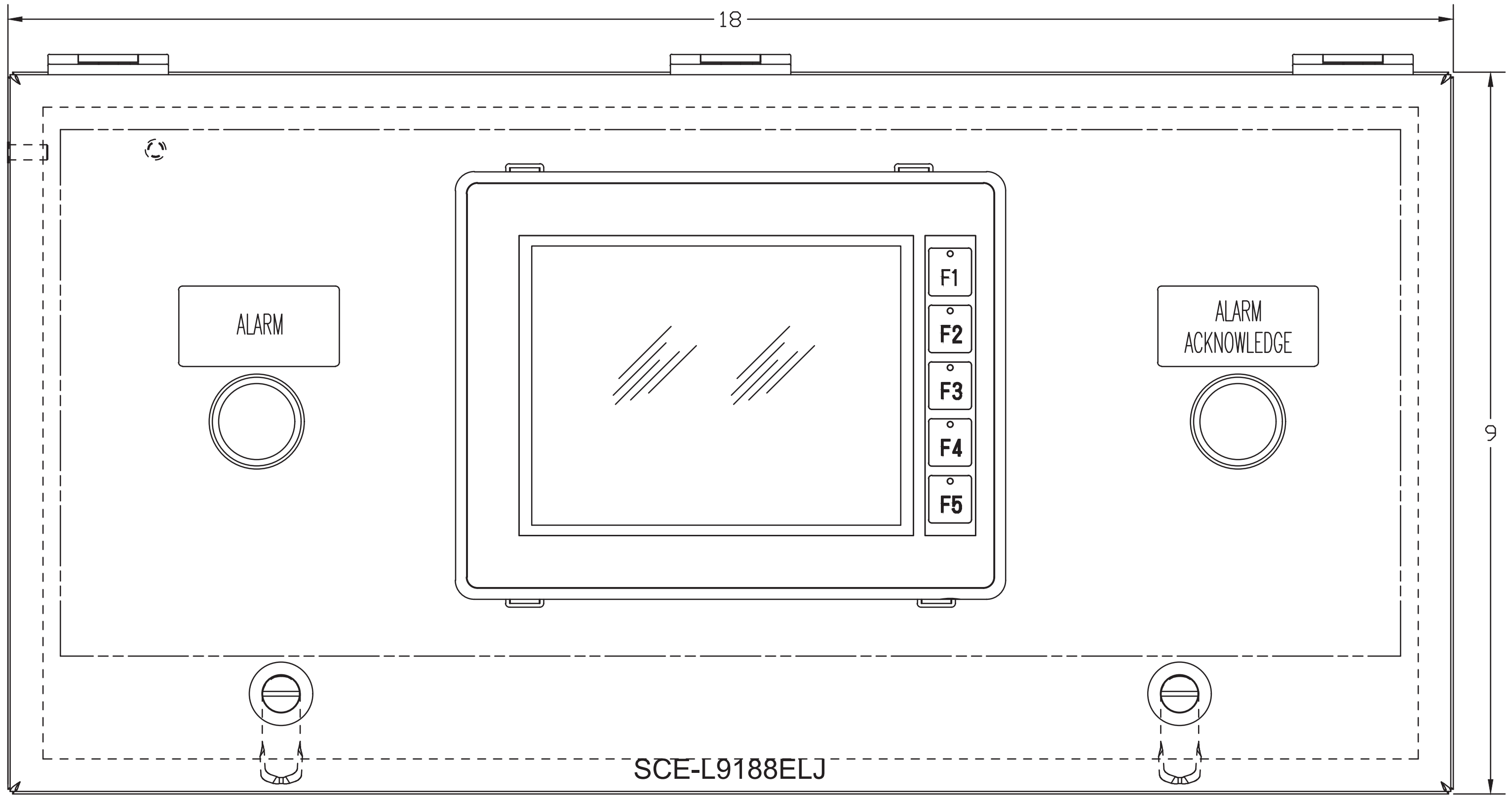
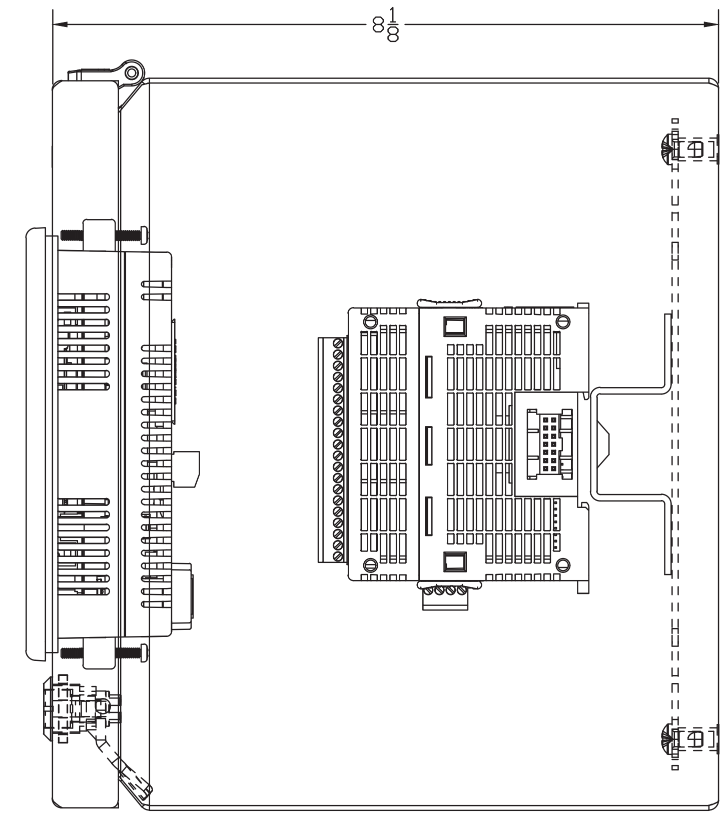
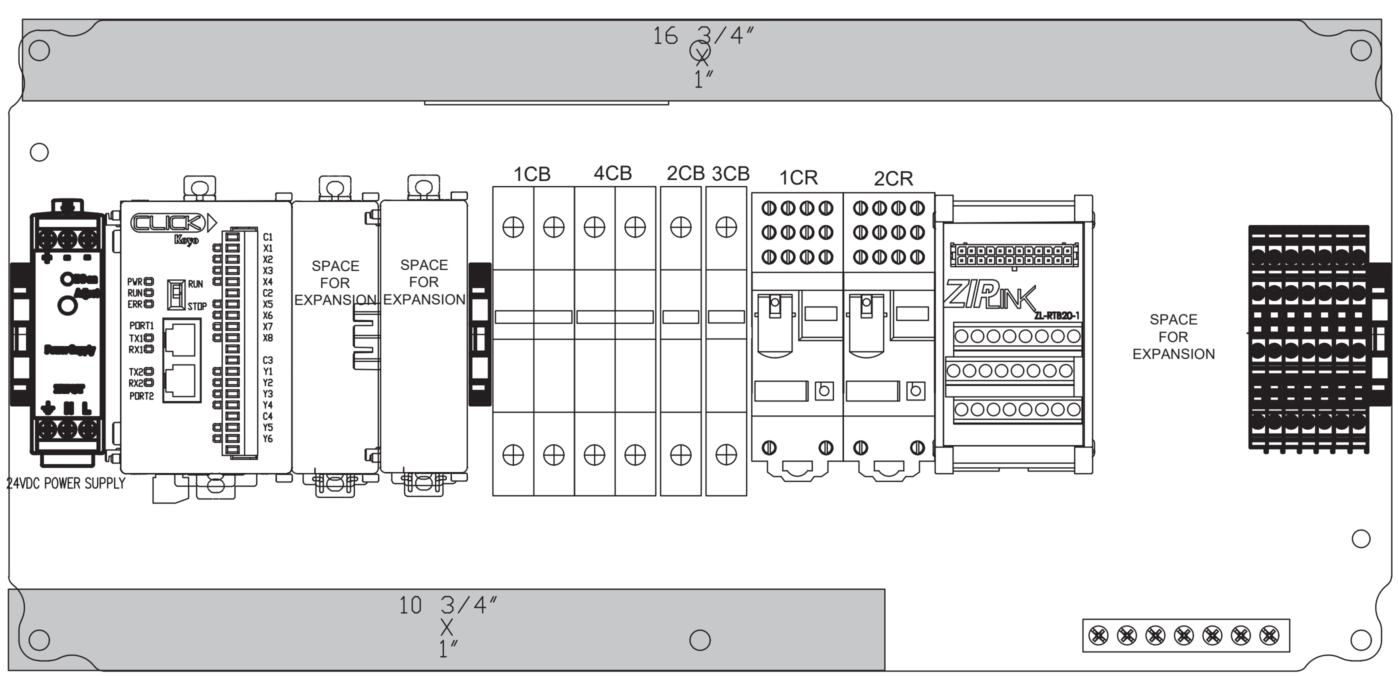


FRONT VIEW



RIGHT SIDE VIEW



SUBPANEL FRONT VIEW

General Notes:

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620 Herndon Parkway Suite 120
Herndon VA 20170
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1141 River Road
Selkirk, NY 12158
Phone: 518.635.4343

Project Name and Address:
LAKESIDE PETROLEUM SERVICE
EQUIPMENT STANDARD

FUEL POLISHING SYSTEM (FPS-1P)

SafeSite fuel system controls

CORE ENGINEERED SOLUTIONS
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(VA) 703.563.0320

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Date: 05/11/20	Sheet #
Rev: 000	E01
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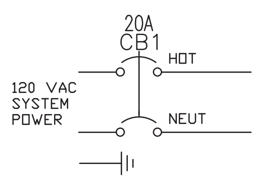
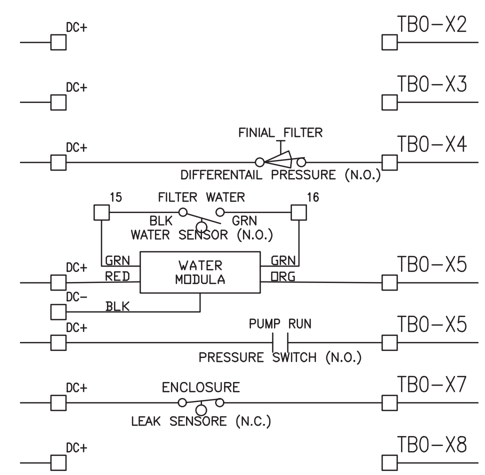
FIELD INSTALLATION DIAGRAMS

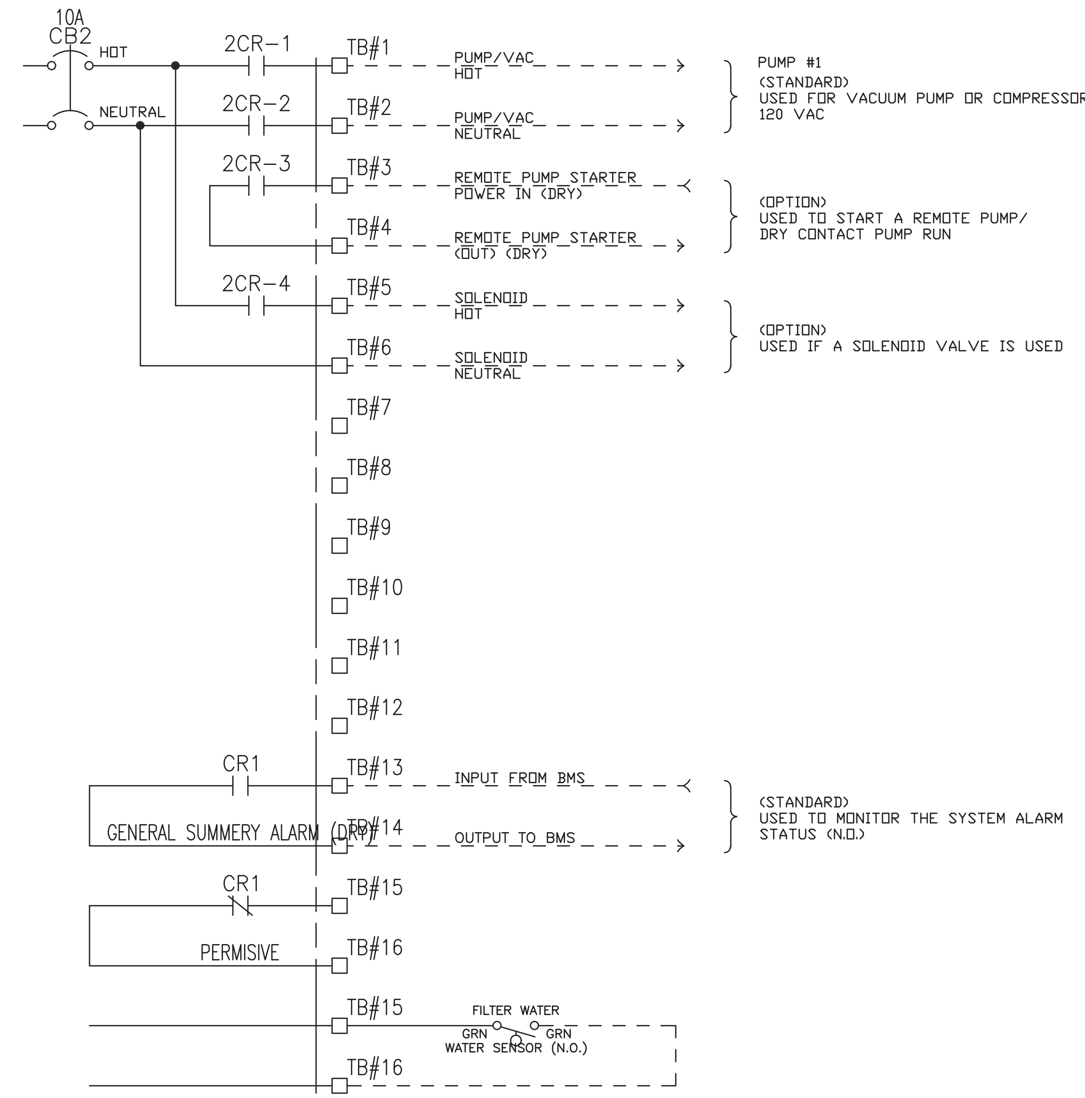
INCOMING POWER FIELD WIRING



INPUT FIELD WIRING



OUTPUT FIELD WIRING



FPS-1P

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LAKESIDE PETROLEUM SERVICE
EQUIPMENT STANDARD

FUEL POLISHING SYSTEM (FPS-1P)

SafeSite
fuel system controls

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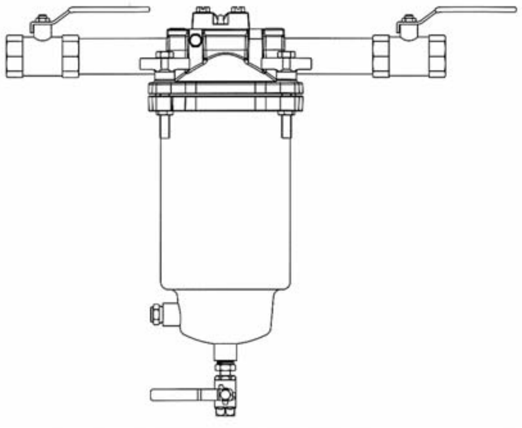
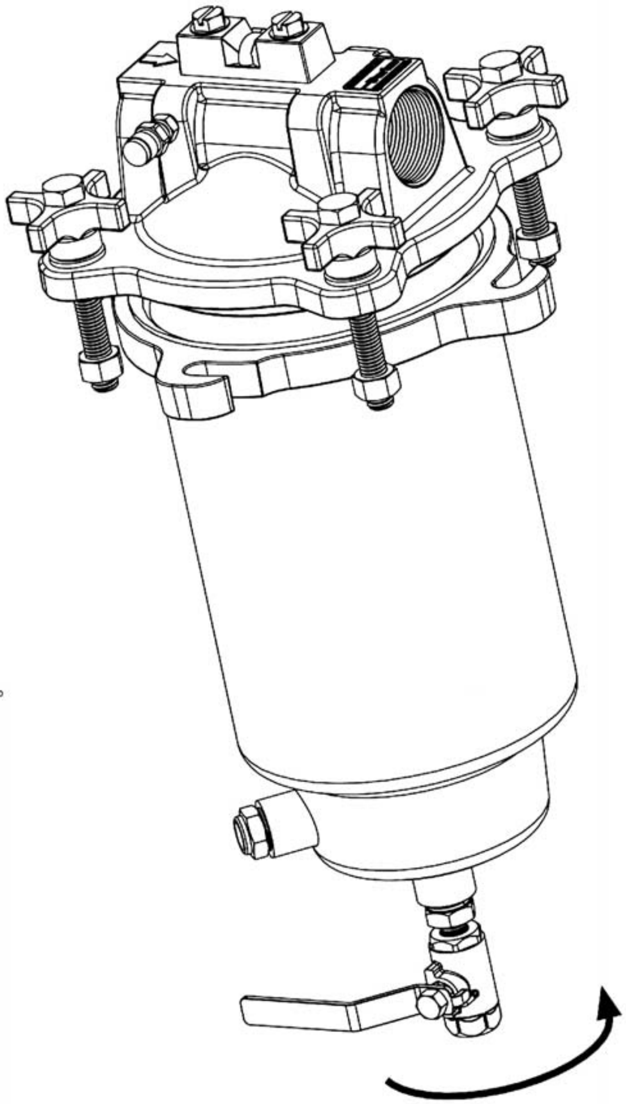
Drawing:FPS-1P_r000.dwg	

Racor FBO Filter Vessel Installation, Operation and Service

- Aviation Fuel Trucks
- Aviation Fuel Cabinets
- Diesel Fuel Dispensing
- Marine Fuel Docks
- High-Flow Diesel Engine Filtration





Offer Of Sale

The items described in this document and other documents or descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any such item, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgements, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 12 months from date of shipment from Parker Hannifin Corporation. The warranty period for pumps and motors is specifically limited to 90 days from date of purchase. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISLCAIMED.**

NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.

5. Limitation of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part of Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carries or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

Hydrocarbon Filtration FBO-10 and FBO-14 Series Housing and Cartridges

INDEX

MAXIMUM FLOW RATES

	Maximum Flow Rates				Clean Dry	Change
FBO-10	**Flow Range**	**Diesel**	**Jet Fuel**	**Gasoline**	**Delta P**	**Delta P**
Prefilter	5-40 GPM	20	40	50	**	20 PSID
Filter Separator	5-35 GPM	18	35	45	**	15 PSID
Absorber	5-25 GPM	18	35	45	**	30 PSID
FB0-14	**Flow Range**	**Diesel**	**Jet Fuel**	**Gasoline**	**Delta P**	**Delta P**
Prefilter	10-60 GPM	30	60	75	**	20 PSID
Filter Separator	10-50 GPM	25	50	65	**	15 PSID
Absorber	10-37 GPM	26	55	70	**	30 PSID

**** Varies With Fluid and Flow Rate**

ELEMENT APPLICATIONS

	Micron Rating	FBO-10	FBO-14
		6 X 10 Element	6 X 14 Element
Filter Separator	1	FBO-60327	FBO-60336
	5	FBO-60328	FBO-60337
	10	FBO-60353	FBO-60356
	25	FBO-60329	FBO-60338
Prefilter	1	FBO-60330	FBO-60339
	5	FBO-60331	FBO-60340
	10	FBO-60356	FBO-60357
	25	FBO-60332	FBO-60341
Absorptive Filter	1	FBO-60333	FBO-60342
	5	FBO-60334	FBO-60343
	10	FBO-60355	FBO-60358
	25	FBO-60335	FBO-60344

Product Description, Installation, Operation and Service Instructions For Parker Hannifin Racor Division, Hydrocarbon Filtration FBO-10 & FBO-14 Series Housings and Cartridges

FBO SERIES PRODUCT DESCRIPTION

Racor Hydrocarbon Filtration's new FBO-10 and FBO-14 filter assemblies are designed to meet the toughest hydrocarbon refueling conditions and give maintenance personnel ease of filter changeouts.

The FBO assembly can flow 25 gpm/95 lpm or up to 60 gpm/230 lpm depending on the unit, cartridges installed and the fuels being filtered.

FBO SERIES APPLICATIONS

The FBO assembly can be used on mobile refuelers or installed in refueling cabinets.

The unit can also be used for diesel fuel dispensing pumps or as an engine primary fuel filter/water separator.

FBO FEATURES

The assembly features a *"locking ring collar,"* that attaches the filter housing to the aluminum die-cast filter head with four bolts.

The slotted *"locking ring collar"* allows maintenance personnel to hand loosen the four collar bolts, rotate and lower the bowl assembly for cartridge changeouts.

With a new cartridge installed, simply raise the bowl and rotate into position on the locking ring and hand tighten evenly.

CLOSURE HARDWARE

The closure hardware consists of stainless steel nuts, bolts and washers with metal hand knobs for ease of maintenance.

No V-Band Clamps are used. This allows one person to easily change the filter cartridge.

APPLICATIONS

Jet Fuel
Aviation Gas
Diesel Fuel
Gasoline
Kerosene
JP4, JP5, JP8

INSTALLATIONS

Aviation Fuel Trucks
Aviation Fueling Cabinets
Diesel Fuel Dispensing System
Marine Fuel Docks
Fuel Systems on Large Diesel Engines

STANDARD DESIGN FEATURES

Die-cast Aluminum Head
Steel Filter Bowl Assembly
Powder Coated Components
"Locking Ring Collar," No Clamps
1 1/2" NPT Inlet and Outlet
150 psi @ 240° F Maximum Design Pressure
Manual Drain Valve
Manual Vent Valve

OPTIONAL ACCESSORIES

Water Sight Glass or Electronic Water Probe
Delta P Indicator.

Cartridge Options

(1, 5, 10, 25 micron)

FP Prefilters
OCP Coalescers
FW Water Absorbing

Installation, Operation and Service Instructions

INSTALLATION

1. Remove the housing protectors from the inlet and outlet connections.

2. Make certain that connections are free of any debris.

> **CAUTION:**
> **Be sure to correctly identify the inlet and outlet connections to avoid piping the unit backwards.** ***The unit will not perform properly if connections are reversed.***

3. Provide shut-off valves in the inlet and outlet piping as close to the unit as possible. *This is necessary for isolating the unit from the system when cartridge replacement is necessary. (See Illustration on page 4).*

4. Connect the housing into the piping system with a minimum number of turns and fittings, especially on the inlet side.

5. For installations on fuel dispensing pump, connect the fuel delivery hose directly to the outlet connection.

6. Provide room for the housing to clear the cartridge during change-out. (*A 2 inch base clearance is required).*

7. We recommend installation of a differential pressure gauge so the differential pressure across the housing can be monitored. This allows accurate determination of when the cartridge should be changed.

   Part numbers 72694 or 72783 are differential pressure gauges specifically designed to be used on FBO-10 and FBO-14.

8. For ***Absorptive Cartridges*** used in aviation fuel or diesel fuel service, ***ALWAYS*** install a differential pressure gauge or other means of determining the differential pressure.

   See Maximum Flow Rates Chart for applicable flow rates on page ii, before page 1.

> **CAUTION:**
> **On systems where pressures can exceed 75 psi, a pressure bypass around the pump *must be installed* to protect the cartridge and system from a high pressure shock or sudden cartridge seal-off due to a slug of water in the product.**

OPERATION AND SERVICE

Open Vent & Drain Valves Each Day

It is recommended that the vent and drain valves be opened once each day to permit the escape of entrapped air and accumulated water.

Limited Maintenance Required

Since there are no moving parts, maintenance is limited to an occasional cartridge replacement, requiring only a 2 inch (51mm) base clearance.

Maintenance Guidelines For:

Inspection of Head Gasket and Cartridge and Seal Gasket Change-Out

1. The *head gasket* should be carefully inspected for signs of damage or deterioration each time the housing is opened.

2. Each Parker Element Replacement Kit contains a *housing seal gasket*. It is recommended that the seal gasket *be replaced at every cartridge changeout.*

3. Replace the seal gasket if it shows any signs of wear.

4. We recommend the seal gasket be lubricated with petroleum jelly or oil prior to installation.

> **CAUTION:**
> **Use only non-sparking tools when performing any maintenance or service work on this equipment.**

Cartridge Replacement Procedures

Frequency of Cartridge Element Replacement

The frequency of cartridge element replacement is dependent upon the following conditions:

For Aviation Fuel Service

Replace the cartridge when the differential pressure across the housing exceeds 15 psi; red indication on the DP gauge; after one year of service; or when there is a significant reduction in flow through the housing, whichever occurs first.

For All Other Applications

Replace the cartridge when the differential pressure exceeds 25 psi; red indication of DP gauge; after one year of service; when the flow is significantly reduced; or if the pressure has been steadily climbing then begins to decrease, whichever occurs first.

Cartridge Replacement Procedures

When any of the above noted conditions indicate that cartridge replacement is necessary, observe the following procedures.

1. Close the inlet and outlet isolation valves to isolate the filter from the system.
2. Open the drain valve on the housing bottom and allow all fluid to drain from the unit.
3. Open the vent valve on the cover of the housing and allow the unit to thoroughly vent before opening the cover.
4. Loosen the four (4) knobs attaching the head to the housing flange.
5. Remove the head gasket and discard.
6. Remove and discard the expended cartridge in a FIRE-SAFE place, in accordance with local and national regulations.
7. Flush the interior of the housing with clean, processed, filtered product or a suitable solvent. A nonmetallic bristle brush will help to remove caked-on debris. Rinse the housing and unit cover with a clean solvent and dry with soft, lint-free wiping cloths.

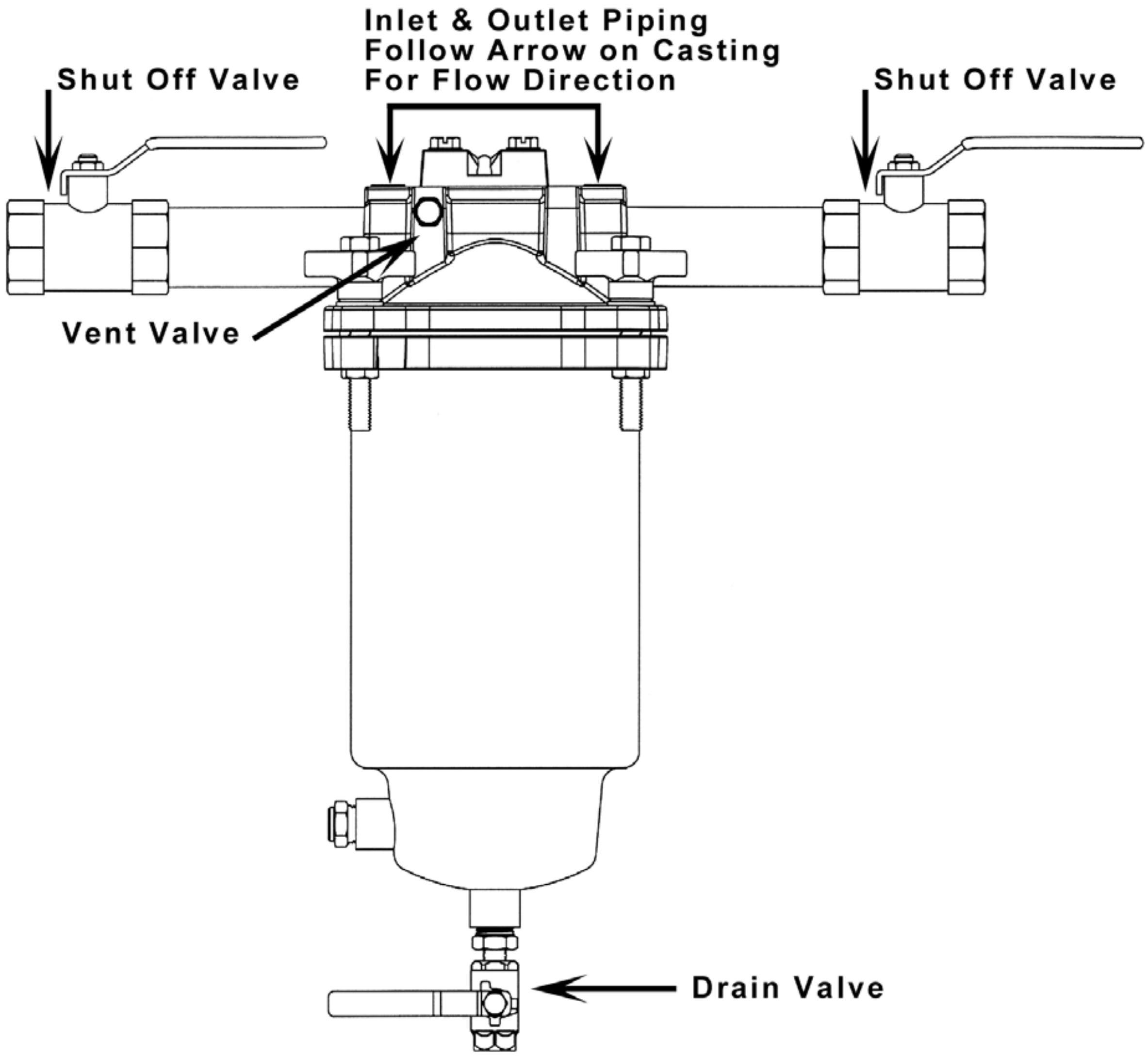
CAUTION:
Due to the toxic effects of some additives used in filtered fluids, care should be exercised in handling the expended cartridges and/or all internal parts that have been in contact with the filtered product.

8. Lightly lubricate new head gasket with Vaseline or Petroleum Jelly and position it on the head. If Vaseline is not available, lubricate the gasket with the fuel or oil that it will be used in.
9. Insert a new cartridge into the housing. Position housing (with cartridge) underneath filter head. Push/twist cartridge onto head spigot. The head "conical spring" will seat/seal the cartridge in the housing. *(See head/spring/cartridge installation instruction on page 5.)*
10. "Rotate" housing onto the collar bolts. Hand tighten knobs until head is "snug" to housing. *See Illustration on Page 5.*

NOTE:
A TORQUE WRENCH IS RECOMMENDED. TIGHTEN ALL COLLAR BOLTS TO 50 IN LBS.

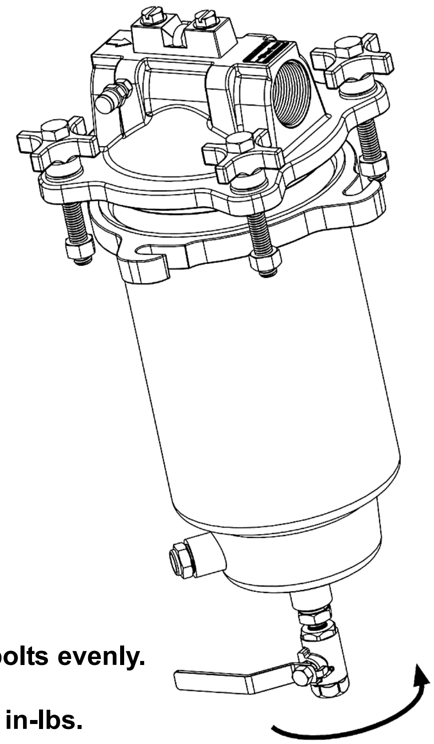
11. Close the drain plug or valve on the bottom of the housing.
12. SLOWLY open the inlet and outlet valves; allow the unit to fill completely.
13. Leave the vent valve on top of the unit open; to allow entrapped air to escape while filling.
14. When a small amount of fluid flows from the vent valve, close it tightly.
15. During the initial filling and after the above maintenance, and while unit is in operation, examine housing and all connections for leaks,including head/flange junction
16. Assure any and all leaks are identified and repaired before allowing fuel to flow through housing.

Illustration:
Typical Isolation Valve Layout



NOTE:
Valves should be installed on each side of the filter assembly, so the fuel flow can be shut off during element changeouts or filter assembly maintenance.

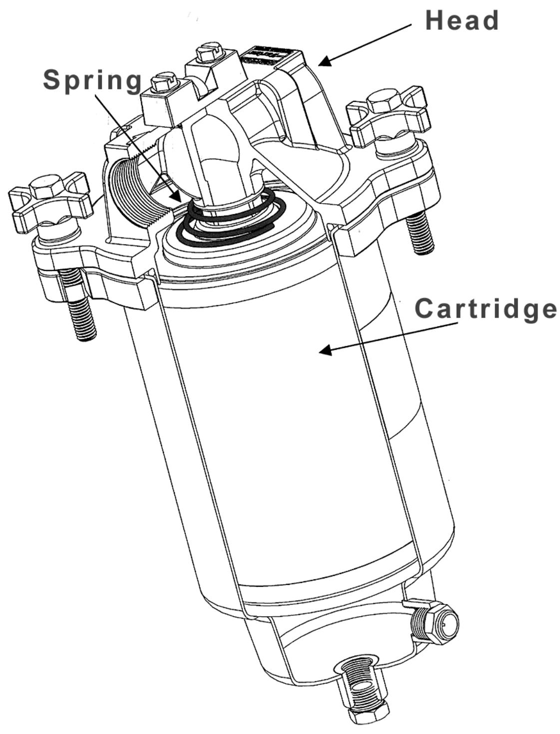
Illustration:
Housing to Head Assembly



NOTE:

1. **Hand tighten all four collar bolts evenly.**
2. **If a torque wrench is used;**
   torque each collar bolt to 50 in-lbs.

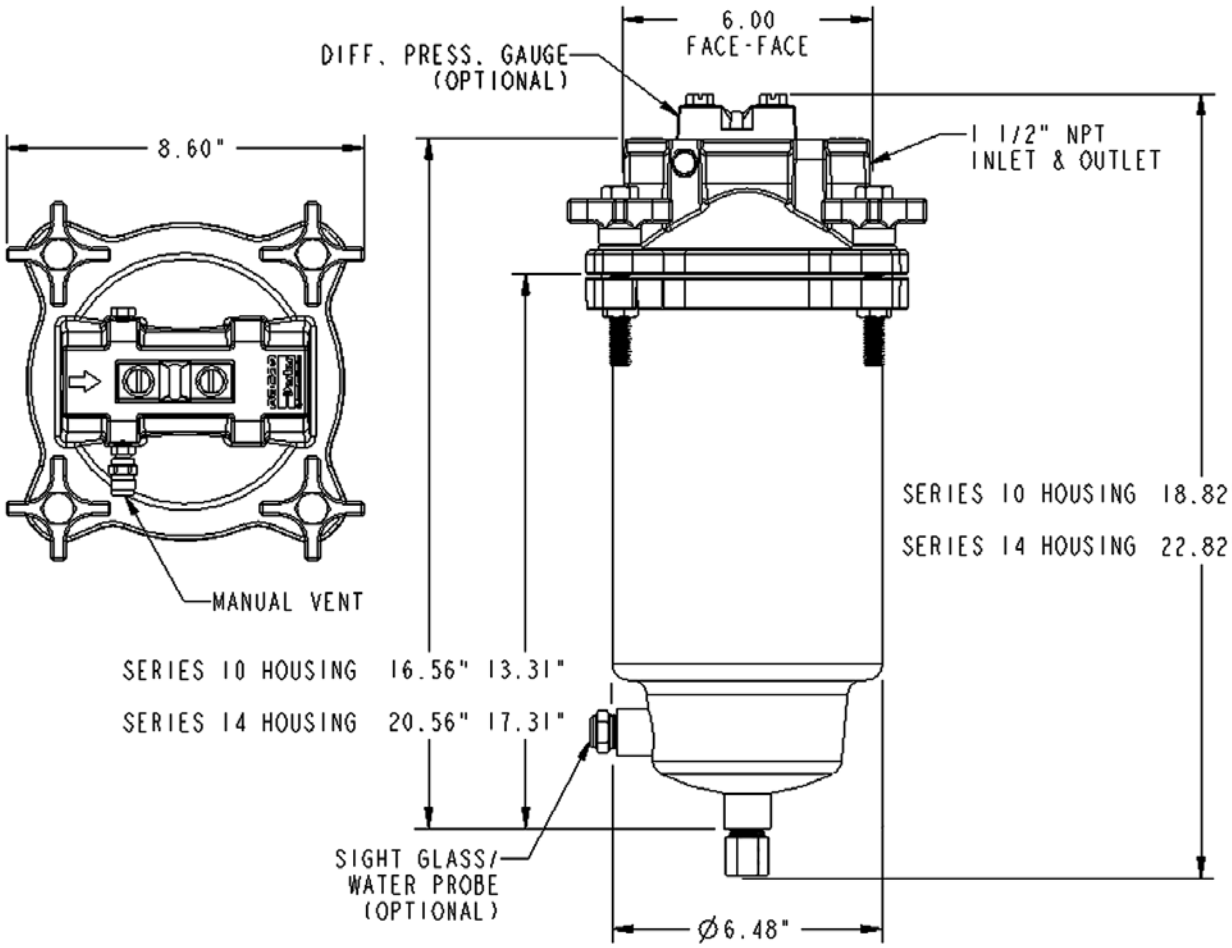
Illustration:
Head/Spring/Cartridge Installation



NOTE:

1. **Location of Spring**

Illustration and Spare Parts List



Spare Parts List

Description	Part Number	Quantity
½" Washer	71328	4
½" Hex Nut	71329	4
Spring	72368	1
Purge Valve	72695	1
O-Ring	72699	1
1/8" Pipe Plug	72700	1
½" Pipe Plug	72701	1
¼" Pet Cock	72702	1
½" – ¼" Bushing	72709	1
Handle Assembly (knob)	72712	4
Sight Glass	72710	1
DP Gauge 15 psid	72694	1
DP Gauge 30 psid	72783	1
Water Probe	RK 30880	1
Housing Assembly FBO-10	72805	1
Housing Assembly FBO-14	72806	1
Head, with DP Gauge Ports	72531	1
Head , without DP Gauge Ports	72718	1
¼" NPT Close Nipple	72812	1
¼" NPT Ball Valve	71943-.25	1

Also Available From Racor

Filter Vessels

Racor manufactures filter vessels with flow rates up to 5,000 gallons per minute. Those vessels include prefilters, vertical filter separators, horizontal filter separators, clay treaters and fuel monitors.

API/IP Qualified Elements

Racor currently produces coalescers and fuel monitors to API/IP qualifications. Qualification reports of each test are available by contacting Racor. These include applications for both vertical and horizontal filter separators and fuel monitor elements.

RVFS Filter Vessels

Racor RVFS filter vessels offer economical systems for flow rates up to 150 gallons per minute for aviation fuels and up to 75 gallons per minute for diesel fuels. RVFS units can be supplied in single units or as duplex systems, with optional electronic monitoring systems. These units are being used with high flow diesel engines as prefilters or as fuel dispensing systems for aviation fuels or diesel fuel.

Filter Elements

Racor manufactures a full range of API/IP coalescers, IP fuel monitors, prefilters, coalescers, separators, synthetic pleated media elements, clay bags and canisters, activated carbon cartridges, fuel monitors, water absorbing elements and spin-on filters, oily water separator elements, and natural gas coalescers.

For more information on Racor Hydrocarbon Filters ask for brochure #7537 or call (800) 451-7299.

Racor also offers a full line of mobile and marine fuel, oil, air and coolant filters for all gasoline, diesel fuel and natural gas powered engines.

For more information on mobile and marine products, call (800) 344-3286.

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TECHNICAL SERVICE MANUAL

INSTALLATION, START UP, TROUBLESHOOTING, PREVENTATIVE MAINTENANCE, DO'S & DON'TS

CONTENTS

INSTALLATION GENERAL COMMENTS

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.

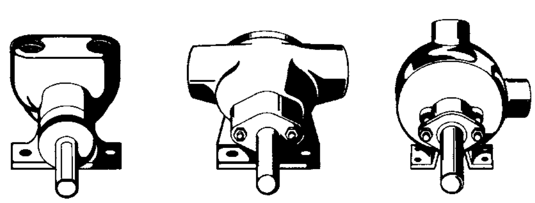


FIGURE 1

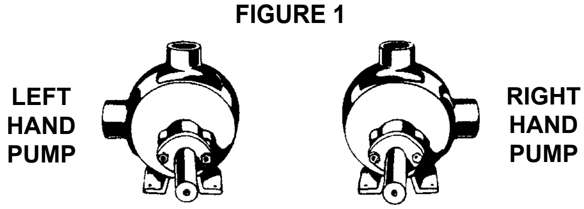


FIGURE 2

4. ***Suction/Discharge -*** shaft rotation will determine which port is suction and which is 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.

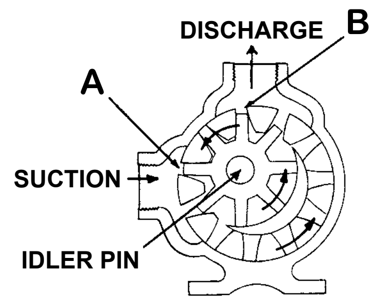


FIGURE 3

5. ***Pressure Protection -*** Viking pumps are positive displacement. 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 - pressure can build up until the motor stalls, the drive equipment fails, a pump part breaks or ruptures, or the piping bursts. Because of this, some form of pressure protection must be used with a positive displacement pump. This may be a relief valve mounted directly on the pump, an inline relief valve, a torque limiting device or a rupture disk.

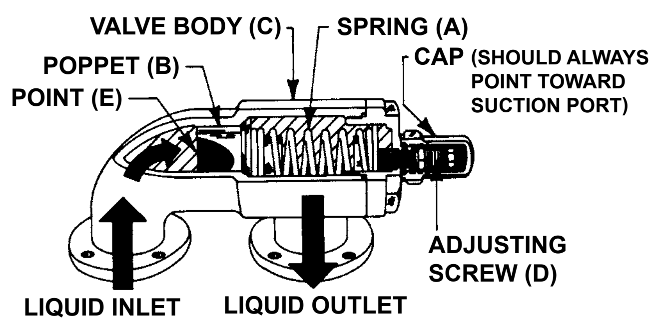


FIGURE 4
CUTAWAY OF VIKING INTERNAL PRESSURE RELIEF VALVE

The pressure 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 underside 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.

SAFETY INFORMATION AND INSTRUCTIONS

IMPROPER INSTALLATION, OPERATION OR MAINTENANCE OF PUMP MAY CAUSE SERIOUS INJURY OR DEATH AND/OR RESULT IN DAMAGE TO PUMP AND/OR OTHER EQUIPMENT. VIKING'S WARRANTY DOES NOT COVER FAILURE DUE TO IMPROPER INSTALLATION, OPERATION OR MAINTENANCE.

THIS INFORMATION MUST BE FULLY READ BEFORE BEGINNING INSTALLATION, OPERATION OR MAINTENANCE OF PUMP AND MUST BE KEPT WITH PUMP. PUMP MUST BE INSTALLED, OPERATED AND MAINTAINED ONLY BY SUITABLY TRAINED AND QUALIFIED PERSONS.

THE FOLLOWING SAFETY INSTRUCTIONS MUST BE FOLLOWED AND ADHERED TO AT ALL TIMES.

Symbol Legend :

⚠ **Danger -** Failure to follow the indicated instruction may result in serious injury or death.

WARNING **Warning -** In addition to possible serious injury or death, failure to follow the indicated instruction may cause damage to pump and/or other equipment.

⚠ **BEFORE** opening any liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) be sure that :

- Any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
- The pump drive system means (motor, turbine, engine, etc.) has been "locked out" or otherwise been made non-operational so that it cannot be started while work is being done on the pump.
- You know what material the pump has been handling, have obtained a material safety data sheet (MSDS) for the material, and understand and follow all precautions appropriate for the safe handling of the material.

⚠ **BEFORE** operating the pump, be sure all drive guards are in place.

⚠ **DO NOT** operate pump if the suction or discharge piping is not connected.

⚠ **DO NOT** place fingers into the pumping chamber or its connection ports or into any part of the drive train if there is **any possibility** of the pump shafts being rotated.

⚠ WARNING **DO NOT** exceed the pumps rated pressure, speed, and temperature, or change the system/duty parameters from those the pump was originally supplied, without confirming its suitability for the new service.

⚠ WARNING **BEFORE** operating the pump, be sure that:

- It is clean and free from debris
- all valves in the suction and discharge pipelines are fully opened.
- All piping connected to the pump is fully supported and correctly aligned with the pump.
- Pump rotation is correct for the desired direction of flow.

WARNING **INSTALL** pressure gauges/sensors next to the pump suction and discharge connections to monitor pressures.

⚠ WARNING **USE** extreme caution when lifting the pump. Suitable lifting devices should be used when appropriate. Lifting eyes installed on the pump must be used **only** to lift the pump, **not** the pump with drive and/or base plate. If the pump is mounted on a base plate, the base plate must be used for all lifting purposes. If slings are used for lifting, they must be safely and securely attached. For weight of the pump alone (which does not include the drive and/or base plate) refer to the Viking Pump product catalog.

⚠ **DO NOT** attempt to dismantle a pressure relief valve that has not had the spring pressure relieved or is mounted on a pump that is operating.

⚠ **AVOID** contact with hot areas of the pump and/or drive. Certain operating conditions, temperature control devices (jackets, heat-tracing, etc.), improper installation, improper operation, and improper maintenance can all cause high temperatures on the pump and/or drive.

⚠ WARNING **THE PUMP** must be provided with pressure protection. This may be provided through a relief valve mounted directly on the pump, an in-line pressure relief valve, a torque limiting device, or a rupture disk. If pump rotation may be reversed during operation, pressure protection must be provided on ***both*** sides of pump. Relief valve adjusting screw caps must always point towards suction side of the pump. If pump rotation is reversed, position of the relief valve must be changed. Pressure relief valves cannot be used to control pump flow or regulate discharge pressure. For additional information, refer to Viking Pump's Technical Service Manual TSM 000 and Engineering Service Bulletin ESB-31.

⚠ WARNING **THE PUMP** must be installed in a matter that allows safe access for routine maintenance and for inspection during operation to check for leakage and monitor pump operation.

CAUTION !

Internal type relief valves mounted on Viking pumps should always have the cap or bonnet pointed toward the suction side of the pump. Return-to-tank-type relief valves should always be mounted on the discharge side of the pump. If pump rotation is 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 rotation is reversed, e.g., *using one pump to fill a tank and then by use of a reversing switch or other means changing the rotation to permit the same pump to circulate the liquid through a heater or to load out)* **then pressure protection must be provided on both sides of the pump for both rotations. This may be a combination of relief valves, torque limiting devices or rupture disks.**

CAUTION !

Pumps or systems without relief valves should have some form of pressure protection, e.g. torque limiting devices or rupture disks.

Viking pumps can be furnished with either an internal pressure 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 Figures 5A and 5B.** An inline 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 should also be as short and large as possible.

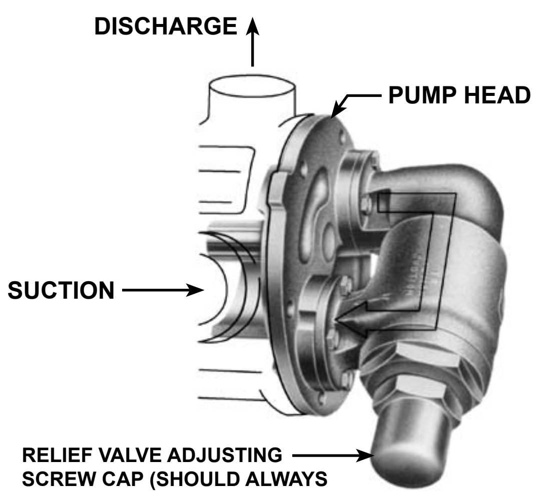


FIGURE 5A
INTERNAL PRESSURE RELIEF VALVE

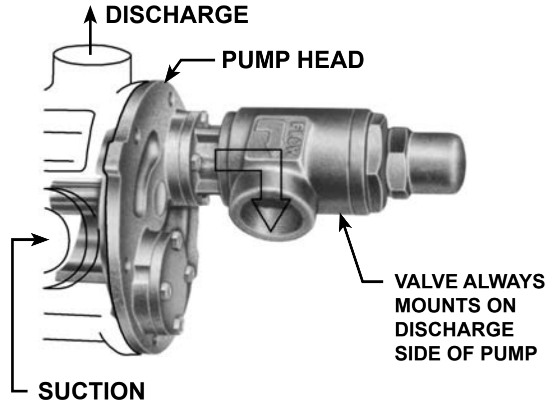


FIGURE 5B
RETURN-TO-TANK PRESSURE RELIEF VALVE

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

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 relief valve.**

The pressure at which either the return-to-tank or internal relief valve bypasses can be changed by turning the adjusting screw. Do not back the adjusting screw all the way out. Stop when spring tension is off the screw (the screw starts to turn 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 solid 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. 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 aligned at the time they were assembled. During shipping and mounting the alignment is often disturbed. **BE SURE TO RECHECK ALIGNMENT AFTER THE PUMP UNIT IS INSTALLED!**

1. Check pump ports to be sure they are square and in the proper position; shim or move the pump as required. Do not force piping to line up with the ports.

2. If the pump is driven by a flexible coupling(s) either direct connected to the motor or through a reducer, 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, page 4.**

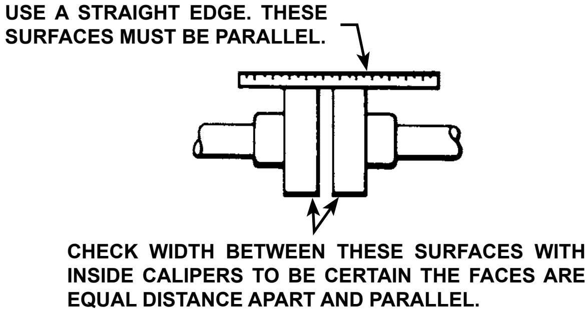
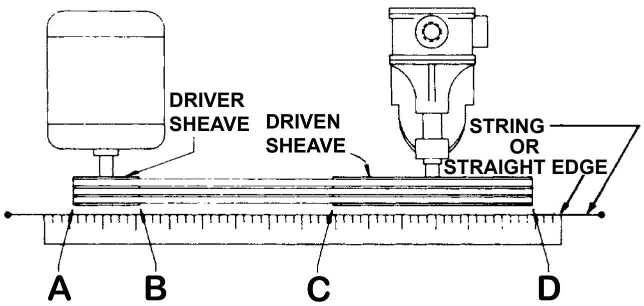


FIGURE 6

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.**



WHEN SHEAVES ARE PROPERLY ALIGNED, ALL POINTS A, B, C, D WILL TOUCH STRING OR STRAIGHT EDGE.

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 the pump to reach operating temperature, then recheck alignment.

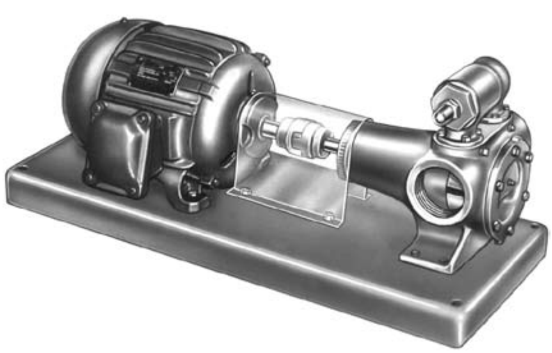


FIGURE 7
INTERNAL PRESSURE RELIEF VALVE

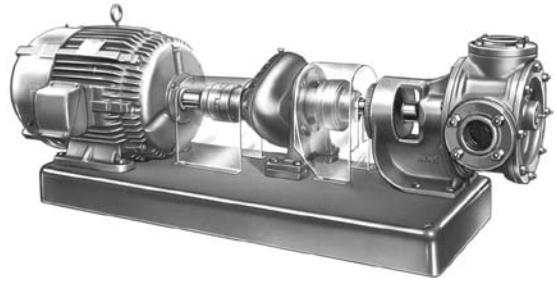


FIGURE 8
INTERNAL PRESSURE RELIEF VALVE

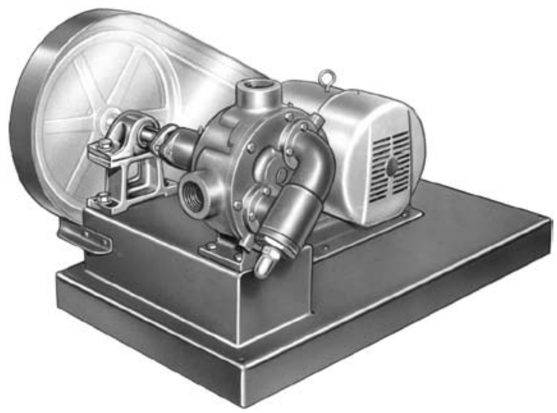


FIGURE 9
INTERNAL PRESSURE RELIEF VALVE

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 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 10.5.** 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.

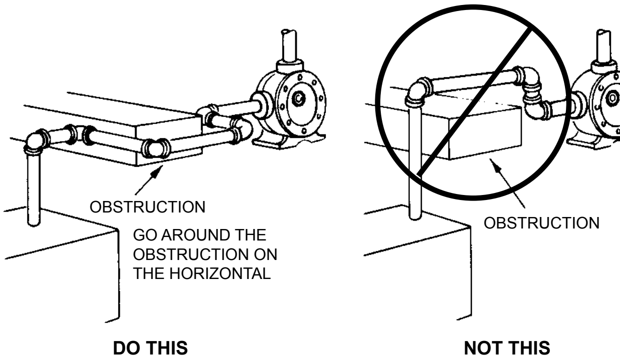


FIGURE 10

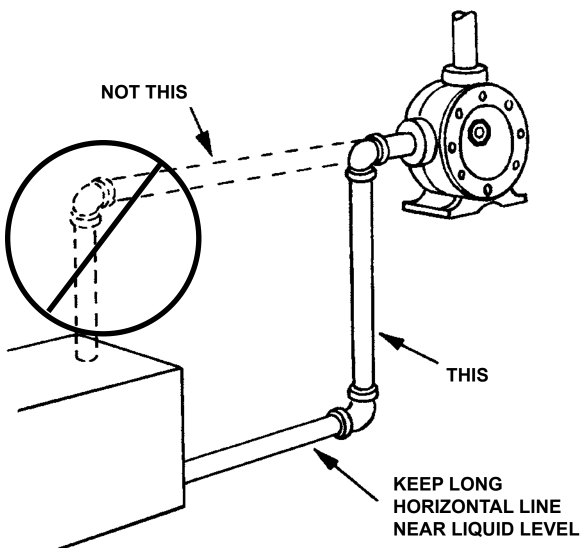


FIGURE 11

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. For additional information, **refer to TSM640.**
9. If the pump is not equipped with a relief valve, consideration should be given to mounting one in the discharge line. See discussion on 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 sealer 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 the 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:
    - **a).** When handling a cold liquid such as refrigeration ammonia that can warm up to ambient temperatures when the pump is shut off or
    - **b).** 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. **MAKE SURE THE PUMP DRIVER IS LOCKED OUT OR CANNOT BE ENERGIZED BEFORE DOING THIS.**
5. Jog motor to be sure it is turning in the right direction; see discussion on pump rotation under **“Installation - General Comments”** item 4 in this manual.
6. Check any relief valves to be sure they are installed correctly. See discussion on relief valves 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. **See Engineering Service Bulletin ESB-515.**
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 may damage 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 Troubleshooting in this manual and try again. If it still does not pump, contact your Viking representative.

RAPID WEAR

CAUSE		EVIDENCE	POSSIBLE SOLUTION
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, pitting or metal appears to be “eaten” away.	Check the Viking General Catalog Liquid List for materials of construction recommendation. Consider weather 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 weather 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 (discoloration).	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 you 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 grease fittings 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.

TROUBLESHOOTING

A Viking pump that 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 insufficient liquid above the end of the suction pipe.
   - **c)** Vibrating from cavitation, misalignment, or damage 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. Too much 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. Too much 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. **SEE CHART, PAGE 7.**

PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of your pump and reduce the overall cost of ownership.

A) Lubrication - Grease all grease fittings 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 NLGI #2 grease for normal applications. For hot or cold applications use appropriate grease. **See Engineering Service Bulletin ESB-515.**

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.

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 eliminate 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 pump is to be stored, or not used for six months or more, pump must be drained and a light coat of non-detergent SAE 30 weight oil must be applied to all internal pump parts. Lubricate fittings and apply grease to pump shaft extension. Viking suggests rotating pump shaft by hand one complete revolution every 30 days to circulate the oil. Retighten all gasketed joints before using the pump.

DO'S & 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 pressure 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 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 over-speed shutdown in case the pump starts to act as a turbine and over-speeds the drive.
8. Don't operate the pump with all of the liquid bypassing through a pump mounted internal type 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 result in a heat build-up in the pump, which could cause hazardous conditions or happenings.

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! Serious injury may result.
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.
9. Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

VIKING PUMP

IDEX CORPORATION

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, FOB. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

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