



# HP Series Trans-Portable Pumps

## Installation, Operation and Service Maintenance Manual

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## NOTICE !

Class1 cannot assume responsibility for product failure resulting from improper maintenance or operation. Class1 is responsible only to the limits stated in the product warranty. Product specifications contained in this manual are subject to change without notice.

All Class1 products are quality components -- ruggedly designed, accurately machined, precision inspected, carefully assembled and thoroughly tested. In order to maintain the high quality of your unit, and to keep it in a ready condition, it is important to follow the instructions on care and operation. Proper use and good preventive maintenance will lengthen the life of your unit.

**ALWAYS INCLUDE THE UNIT SERIAL NUMBER  
IN YOUR CORRESPONDENCE.**

| ECO NO | REV | CHANGE FROM                   | BY  | DATE       | APVD | <div><br/><br/>Certificate Number: IMS - 0011</div> <div><b>Class 1</b><br/>A Unit of IDEX Corporation<br/>Ocala, FL 34475 USA</div> |     |            |                                                                      |
|--------|-----|-------------------------------|-----|------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------|----------------------------------------------------------------------|
| 0000   | F   | Series Upgrade to Latest Rev. | LwH | 12/31/2006 |      |                                                                                                                                                                                                                                                                                                              |     |            |                                                                      |
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# 1 Safety Precautions



## IMPORTANT !

CLASS1 HP-SERIES (HP-75, HP100, HP-200, HP300 AND HP400) PORTABLE PUMPING SYSTEMS ARE DESIGNED FOR OPTIMUM SAFETY OF ITS OPERATORS. FOR ADDED PROTECTION, PLEASE FOLLOW THE SAFETY GUIDELINES LISTED IN THIS SECTION AND ADHERE TO ALL WARNING, DANGER, CAUTION AND IMPORTANT NOTES FOUND WITHIN THIS MANUAL.

ALL SUPPLIED DOCUMENTATION (ENGINE, CLASS1 PUMP MANUALS, ETC.) MUST BE CAREFULLY READ, UNDERSTOOD AND ADHERED TO STRICTLY BY ALL INSTALLERS AND OPERATORS BEFORE ATTEMPTING TO INSTALL OR OPERATE ANY HP SERIES PORTABLE PUMPING SYSTEM.

WHEN DEVELOPING DEPARTMENTAL APPARATUS OPERATING PROCEDURES, INCORPORATE THE WARNINGS AND CAUTIONS AS WRITTEN.

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## NOTICE !

THE PROCEDURES IN THIS MANUAL ARE GENERAL OPERATING PROCEDURES. THEY DO NOT REPLACE THE PROCEDURES, POLICIES OR GUIDELINES ESTABLISHED BY THE AUTHORITY HAVING JURISDICTION, NOR DO THEY REPLACE THE RECOMMENDATIONS AND PROCEDURES PROVIDED IN THE APPARATUS MANUFACTURER'S MANUAL.

REFER TO THE PROCEDURES PROVIDED BY THE AUTHORITY HAVING JURISDICTION FOR UNIT LAYOUT AND CONNECTION OF HOSES, VALVES AND DRAIN COCKS.

ALL FASTENERS ON THE CLASS1 HP PORTABLE SERIES ASSEMBLIES ARE SELECTED FOR THEIR SPECIFIC APPLICATION. CLASS1 DOES NOT RECOMMEND REPLACING FASTENERS WITH ANYTHING OTHER THAN CLASS1 PART NUMBERS PROVIDED. REPLACING WITH A WEAKER ALTERNATIVE POSES A SERIOUS SAFETY RISK.

ALL FASTENERS MUST BE INSTALLED WITH A LOCKING ANAEROBIC ADHESIVE / SEALANT, SUCH AS LOCTITE® #242, #246 OR EQUIVALENT.

ALSO REVIEW THE SAFETY INFORMATION FOUND IN THE ENGINE MANUFACTURER'S OPERATING AND MAINTENANCE MANUAL / OWNERS MANUAL, PROVIDED WITH THE SYSTEM.

## 1.1 DEFINITIONS



### **DANGER !**

**DANGER** - Immediate hazard which WILL result in severe personal injury or death if the danger is ignored.



### **WARNING !**

**WARNING** - Hazards or unsafe practices which COULD result in severe personal injury or death if the warning is ignored.



### **CAUTION !**

**CAUTION** - Hazards or unsafe practices which COULD result in minor or moderate personal injury if the caution is ignored.



### **NOTICE !**

**NOTICE** - Practices which could result in damage to the apparatus or other property.



Carbon Monoxide Poisoning Hazard



Corrosive Hazard



Electrical Shock Hazard



Eye Protection required when operating equipment



Flammable Fuel Hazard



Hearing Protection required when operating equipment



Hot Surfaces Hazard

## 1.2 GENERAL

**Read all instructions, including the Engine Manufacturer's Operating and Maintenance Manual / Owners Manual, thoroughly before beginning any installation, operation or service process.**

- ☐ The installer / operator is responsible for observing all instructions and safety precautions in his or her daily routine as dictated by regional safety ordinances or departmental procedures.
- ☐ **Fluids** - To meet various shipping regulations, ALL fluids within the engine, battery (if applicable), gearbox and pump assemblies are drained prior to shipping from the factory.

At installation and before operation, ALL fluids must be added to the appropriate levels. See Section 5.2 "Post Operation" on page 50.

- ☐ Use care when removing the HP Portable Series assembly from its packaging to prevent personal injury and/or damage to the unit. Save all packaging until you are certain everything is correct.
- ☐ DO NOT operate an HP series pump when the unit is being carried.
- ☐ Exercise care when transporting the unit by motor vehicle; it should be securely fastened down. If the tank contains fuel, the unit must be stored and transported in the "horizontal" position only.
- ☐ When mounting the HP series portable on a skid, truck, trailer or other movable equipment, it is preferred to have the resting points under the skid frame as close as possible under the frame cross-members. This prevents undue strain on the frame and engine.
- ☐ DO NOT operate equipment when mentally or physically fatigued.
- ☐ DO NOT run the engine in a closed-in area. Proper ventilation for engine cooling and engine exhaust MUST BE provided.
- ☐ If an exhaust extension is required to vent gases to the outside, it is important to construct the exhaust extension to prevent excessive exhaust back pressure.



**WARNING !**

**EXHAUST GASES CONTAIN CARBON MONOXIDE, WHICH IS AN ODORLESS AND DEADLY POISON. PROPER EXHAUST VENTILATION MUST BE PROVIDED TO PREVENT THE ACCUMULATION OF EXHAUST GASES.**



- ❑ The exhaust system components may smoke during the initial break-in period. This smoking should stop after the pump is run several times.
- ❑ Be careful not to touch the exterior of a HOT engine, especially the muffler and the surrounding area. The engine is hot enough to be painful or cause burns / injury.
- ❑ DO NOT permanently remove or alter any protective feature, guard or insulating devices, or attempt to operate the unit when these guards / covers are removed.



Doing so voids the Class1 warranty. Also see heading “Express Warranty” on page 105.

- ❑ Any of the preceding could affect system capacity and/or safe operation of the system and is a serious safety violation which could cause personal injury or could affect safe operation of the unit.

**WARNING!**



**NO MODIFICATIONS MAY BE MADE TO A CLASS1 HP SERIES PORTABLE UNIT WITHOUT PRIOR WRITTEN PERMISSION FROM:**

**Class1**

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- ❑ Rotating parts can cause injury. Be extremely careful that NO part of your body (head, feet, arms, legs, fingers, hair, etc.) is in an area of rotating parts where you could be subject to injury.
- ❑ Make sure proper personal protective equipment is used when operating or servicing the equipment.



**WARNING!**

**BE SURE TO WEAR SAFETY GLASSES WHEN REMOVING AND/OR INSTALLING FORCE (PRESS) FITTED PARTS. WEAR PROTECTIVE, HEAT-RESISTANT GLOVES WHEN HANDLING PARTS THAT ARE HOT OR REQUIRE HEATING FOR INSTALLATION AND/OR REMOVAL. FAILURE TO COMPLY MAY RESULT IN SERIOUS EYE OR HAND INJURY.**

**DO NOT OVERHEAT PARTS CONSTRUCTED OF BRONZE (E.G. IMPELLER). OVERHEATING (PART TURNS RED OR BLUE) CAN WEAKEN THE PART AND IT MUST THEN BE REPLACED.**

- ☐ **Nozzle selection – Class 1 does not recommend any specific type or brand of nozzle for use with the HP series system.**

Each fire department must conduct its own evaluation to ensure an appropriate nozzle choice for the various types of hazards they expect to encounter. Each fire department must develop associated operational procedures and guidelines. Class 1 does not recommend or claim suitability or fitness for any given nozzle brand or style.

**WARNING !**

**ONCE A NOZZLE HAS BEEN SELECTED IT IS IMPERATIVE TO PROVIDE AMPLE TRAINING IN THE USE OF THE NOZZLE. OPEN NOZZLES SLOWLY AND MAKE SURE THE NOZZLE IS SECURED AGAINST REACTION FORCE.**



- ☐ Check engine fuel level BEFORE initial start-up each day. Be sure to leave room in the tank for expansion of the fuel.
- ☐ Wear hearing protection when operating the unit. DO NOT operate the engine without a muffler. Inspect periodically and replace as needed.
- ☐ DO NOT run an HP series pump for more than forty-five (45) seconds without suction established. If a pump is operated without water for extended periods, or without discharging water, it could overheat. This can damage the mechanical seal, impeller or the drive mechanism.
- ☐ If leakage from the drain hole in the pump head is noticed or suspected, the mechanical seal must be inspected and/or replaced.
- ☐ Keep equipment, i.e., engine controls and linkage, cylinder fins, muffler, etc. and surrounding area clean. Cluttered areas invite accidents and could effect engine operation. Remove all oil deposits from equipment and surrounding area. Accumulations of grease and oil may present a hazard.
- ☐ Do not operate engine with an accumulation of grass, leaves, dirt or other combustible material in the muffler area.

- ❑ All visitors should be kept at a safe distance from work area. Keep children away from equipment and discharge hose. DO NOT allow children to fold discharge hose.
- ❑ Prevent accidental starting by always removing the battery ground (negative —) wire (BLACK) or before working on the engine or the equipment driven by the engine.
- ❑ Maximum speed of the engine is factory set. DO NOT tamper with the governor springs, links or other parts to run at higher speeds. Excessive speed increases the hazard of personal injury and reduces engine life.
- ❑ Familiarize yourself with all controls, learn how to STOP the engine quickly in an emergency. See engine manufacturer's Operating and Maintenance Manual / Owners Manual.
- ❑ The HP series pump MUST BE primed before starting the engine. See heading "Priming" on page 44.
- ❑ When shutting OFF a gasoline engine, be sure it is completely STOPPED before leaving the work area.
- ❑ If the tank / fuel caddy is equipped with a closing vented cap, OPEN the cap vent when pumping.

CLOSE fuel tank cap vent when storing or transporting.

- ❑ Flush pump with fresh, clear water after pumping salt water or water containing sand.
- ❑ Allow the pumping unit to cool before transporting or storing. HOT engine parts present a hazard.
- ❑ When storing, keep unit away from sources of heat or flame. The storage area should have adequate ventilation to prevent the accumulation of fuel vapors. Take care not to store the unit against sharp edges as these may cause damage to various fuel lines or electrical cabling.
- ❑ Relieve all system pressure, then drain all water from the system before servicing the system.
- ❑ Before connecting any cord sets or wiring harnesses, inspect the seal washer in the connector. If the seal washer is missing or damaged, water can enter the connector causing corrosion. This could result in possible system failure.
- ❑ The pump and engine assembly are vibration isolation mounted. When making permanent connection to the suction or discharge fittings DO NOT use hard piping. A short length of flexible piping is required to prevent vibration damage to the pump and engine.
- ❑ DO NOT use petroleum solvents, such as kerosene, to clean a cartridge. They may cause deterioration. DO NOT oil a cartridge or use pressurized air to clean or dry the cartridge.



## 1.3 FUEL SAFETY

- Carefully read and understand the “Engine Manufacturer's Operating and Maintenance / Owners Instructions” before attempting to operate, service or disassemble the engine or any of its parts. Also see Section 4 “Operation” on page 43.



### WARNING !

#### POSITIVELY NO SMOKING !!

- **Gasoline is a highly combustible fuel.** The improper use, handling or storage of gasoline can be dangerous. Prevent accidents by following these safety recommendations, plus those furnished by your regional safety ordinances or departmental procedures:
  - Use gasoline as a fuel, NEVER as a cleaning fluid.
  - Use only an approved container to hold or store gasoline. NEVER store gasoline in familiar containers, such as milk containers or soap bottles.
  - Store gasoline in a cool location, out of reach of children. NEVER store gasoline near heat sources, open flame or sources using a pilot light or other devices that can create a spark.
  - DO NOT refuel with the engine running. Add fuel to a COOL engine only. Spilled fuel on a hot engine or muffler may cause a fire or an explosion. Fill fuel tank out-of-doors and wipe up any spills immediately.
  - Make sure all fuel lines and connectors are secure.
  - Provide a fire extinguisher when working with gasoline. Be sure the extinguisher is in operating condition; check the pressure gauge or indicator. Be familiar with its proper use.

Consult your local fire department for the correct type of extinguisher for your application. Extinguishers rated ABC by the National Protection Association are appropriate for most applications.
  - For proper handling, storing and transporting of fuel, follow fuel tank manufacturer's instructions sheet and/or instructions printer on the tank.
  - NEVER store unit in vertical position with fuel in the tank.
- Do not operate the engine when an odor of gasoline is present or other explosive conditions exist.
- Sparking can occur if a wire terminal does not fit firmly on the spark plug. Reform terminal if necessary.

- ❑ Do not check for a spark with the spark plug or wire removed. Use an approved tester.
- ❑ Do not crank the engine with the spark plug removed. If the engine is “flooded,” place throttle in FAST position and crank until the engine starts. See Section 4.1 “Startup” on page 43.

## 1.4 BATTERY SAFETY

The battery contains concentrated sulfuric acid which can cause severe chemical burns. When the battery is charging, it releases hydrogen, a colorless, odorless and highly explosive gas which can be ignited by a spark. Eliminate all sparks or flames from the charging area.

### WARNING !



- ❑ Always assume the battery is emitting hydrogen and employ proper safety precautions.
- ❑ Do not smoke, use an open flame, or create arcs or sparks near the battery.
- ❑ Consult the label on your battery for information on cell-type, ampere-hour capacity, charge rate and normal full-charge voltage.
- ❑ Packaged with every battery are specific instructions for battery safety, care and use, and a Material Safety Data Sheet (MSDS). Read these documents thoroughly before performing any service to the battery.
- ❑ Always disconnect the battery before performing any system maintenance and be sure to wear protective clothing and safety glasses when working with battery acid or the battery in general.
- ❑ Neutralize acid spills immediately with Bicarbonate of Soda! If acid contacts the skin or eyes, wash with water immediately and seek medical help at once.
- ❑ Never place a tool or any metal object on top of the battery where it could possibly touch battery terminals causing a short or serious electrical shock.
- ❑ Use caution when changing battery connectors to ensure that the polarity is not reversed. Always connect the BLACK wire “last” and to the NEGATIVE (—) terminal; the RED wire to the POSITIVE (+) terminal.
- ❑ Keep vent plugs in place and clean at all times
- ❑ When replacing this battery, use the same type battery as specified on the rating nameplate.
- ❑ Be sure to install and retighten all battery restraints.





## 2 Overview

### 2.1 HP SERIES

**Figure 2-1: HP Series Portable Pumping Units**

The Class1 **HP Series Portable Pumps** fulfill many types of in-service fire fighting applications. The pumps are available in configurations providing a wide range of pressures and flows to suit user requirements in a lightweight, portable unit. (See Figure 2-1: “HP Series Portable Pumping Units.”)

The HP series portables are capable pumping water from draft, relay or hydrant and can deliver discharge pressures from 50 PSI (3.5 BAR) up to 300 PSI (21 BAR) and flow from 100 GPM (379 LPM), up to 550 GPM (2,082 LPM). For a unit overview, see heading, 2.4 “Pumping System Overview” beginning on page 26.

HP Series portables are available in five (5) separate models:

- **HP75:** Wildland and attack pump - High pressure, Medium volume
- **HP100:** Wildland and attack pump - High pressure, Medium volume
- **HP200:** Wildland and attack pump - Medium pressure, medium volume

- **HP300:** Transfer and Supply, Tank Refueling; Low pressure forfeiting with multiple lines - Medium low pressure, Medium high volume
- **HP400:** Transfer and Supply, Tank Refueling - Low pressure, high volume

Each pump configuration includes pump ends made of strong corrosion resistant aluminum alloy, held together with a stainless steel strap. The aluminum parts of the discharge valves are treated with a hard anodizing process to increase corrosion resistance and durability. The pump engine (see heading, “Engine” beginning on page 20.) is air cooled and offers enclosed high-strength thermoplastic covers for quiet operation.

**NOTICE !**



**PERFORMANCE OF AN HP SERIES PORTABLE PUMP MEETS OR EXCEEDS NFPA 1921 REQUIREMENTS. FOR COMPLETE NFPA 1921 COMPLIANCE, THE PUMPING UNITS MUST BE MARKED WITH SPECIFIC LABELS. CONSULT FACTORY IF THESE LABELS ARE REQUIRED.**

### “Premium” Model

The Model **HP** series Premium pumps are light weight, compact units. The pumping unit is mounted on a molded plastic fuel tank, which is an integral part of the pump base and includes an aluminum skid plate on the bottom to provide for extra puncture protection. Four (4) carry handles are included for two (2) man portability. The unit also includes high-strength thermoplastic covers for quiet operation. Also see Figure 2-1: “HP Series Portable Pumping Units” on page 17.

### “T” Model

The Model **HPT** series Trans-Portable pumps are light weight, compact units. The pumping unit is mounted on a steel skid base and includes four (4) handles for two (2) man portability. A remote three (3) gallon (12 liter) fuel tank allows the pump to run for about two (2) hours under normal operating conditions. Also see Figure 2-1: “HP Series Portable Pumping Units” on page 17.

## “W” Model

The Model HPW series Trans-Portable pumps offer a sturdy wraparound steel frame with four (4) carry handles for two (2) man portability. The wrap-around frame protects the pump, engine and fuel system from damage caused by normal handling. Also included is an integral base frame fuel tank. Also see Figure 2-1: “HP Series Portable Pumping Units” on page 17.

## “X” Model

The Model HPX series pumps are available without plastic covers, carry handles or support frame and with or without a base fuel tank. The “X” series can be permanently mounted to the apparatus frame. Also see Figure 2-1: “HP Series Portable Pumping Units” on page 17.

## Carry Handles

Each portable pump is equipped with four carry handles, either stationary or foldable (see Figure 2-2: “Foldable Carry Handles” below), dependent on model selected.

### Foldable Handles

Two positions are offer, other than the stowed position, to provide for increased mobility by two (2) people.

When not is use, the handles fold away (stowed) to prevent equipment or personnel from getting caught. The folded handles also provide a more compact pump that fits in a smaller storage compartment.

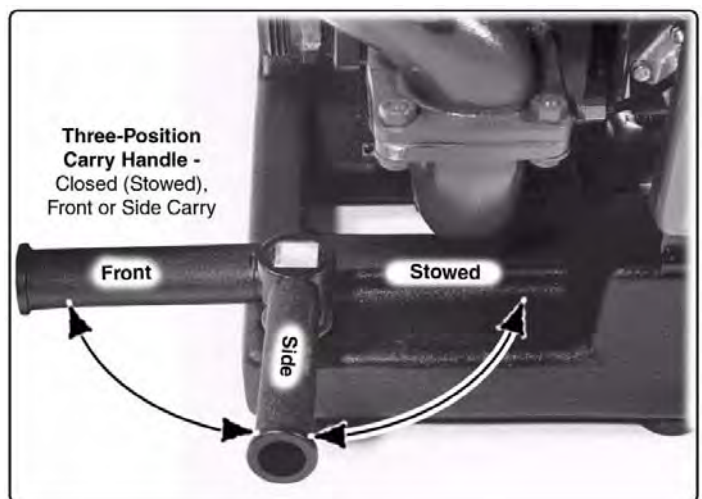


Figure 2-2: Foldable Carry Handles

## Engine

See separate engine manufacturer's Operation and Maintenance Manual / Owners Manual, located at the back of this manual, for more information.

**Note:** All engine related service and parts requests should be directed to the engine manufacturer.

- ❑ Air-cooled, horizontal shaft, V-Twin Overhead Valve.
- ❑ Produces eighteen (18) horse-power (13.4 kw.) at 4,000 RPM from its 34.75 cubic inch (570 cc.) displacement.
- ❑ Electric start with recoil backup to ensure starting under all circumstances.
- ❑ 16 Amp alternator.
- ❑ Emissions meet 1994 California Air Resources Board Standards (CARB).
- ❑ Oil capacity - approximately three (3) pints (1.4 liters).
- ❑ Cross-linked, polyethylene fuel tank - capacity of three (3) gallons (12 liters) for up to 12 hours running time, rated performance conditions.

**Note:** Under many operating conditions, longer running times can be obtained.

## Discharge Valve

The discharge valve swivels through 175° for ease of discharge hose connection. The valve permits the discharge to be directed as needed without changing the position of the pump. The valve is self-checking that automatically closes to form a positive seal when priming the pump.

## Electrical Quick-Disconnect

Each portable pump is provided with a marine grade quick-disconnect electrical socket. The socket is used to power an optional light mast for night time operations. It can also be used to connect a trickle charger to ensure the battery is charged and the pump is always in a ready state.

## Pump

### On all pumps -

- ☐ The engine crankshaft serves as the pump shaft with an enclosed-type silicon bronze impeller, mounted directly to the shaft.
- ☐ To protect against corrosion, a bronze sleeve, O-ring seal and a mechanical-type, self-lubricating and adjusting seal are used.
- ☐ The impeller is hydraulically sealed by a replaceable, patented floating bronze clearance ring, located in the suction of the aluminum volute.

### HP75

- ☐ Model **HP75 series** pump delivers discharge pressures from 50 PSI (3.5 BAR), up to 325 PSI (22 BAR) and flow rates from 15 GPM (57 LPM), up to 135 GPM (511 LPM).
- ☐ Suction inlet connection - female 2" NPT (51 mm)
- ☐ Discharge connection:
  - Model HPX and HPXB - 1-1/2" NPT (38 mm)
  - Model HPT and HPW - 1-1/2" screw-type valve

**Note:** Suction and discharge connection thread sizes are for standard units. Contact your Class1 sales representative for a full range of factory installed adapters to meet individual customer requirements.

- ☐ Priming - exhaust Venturi; 20" HG (508mm)
- ☐ Weight - 157 lbs. (71 kgs.) minimum, up to 194 lbs. (88 kgs.)

### HP100

- ☐ Model **HP100 series** pump delivers discharge pressures from 50 PSI (3.5 BAR), up to 285 PSI (20 BAR) and flow rates from 20 GPM (76 LPM), up to 150 GPM (568 LPM).
- ☐ Suction inlet connection - female 2" NPT (51 mm)
- ☐ Discharge connection:
  - Model HPX and HPXB - male, 1-1/2" NPT (38 mm)
  - Model HPT and HPW - male, 1-1/2" NST screw-type valve

**Note:** Suction and discharge connection thread sizes are for standard units.

Contact your Class1 sales representative for a full range of factory installed adapters to meet individual customer requirements.

- ❑ Priming - exhaust Venturi; 20" HG (508mm)
- ❑ Weight - 157 lbs. (71 kgs.) minimum, up to 194 lbs. (88 kgs.)

## HP200

- ❑ Model **HP200 series** pump delivers discharge pressures from 10 PSI (0.7 BAR), up to 190 PSI (13 BAR) and flow rates from 60 GPM (227 LPM), up to 245 GPM (927 LPM).
- ❑ Suction inlet connection - female 3" NPT (51 mm), 4" (102 mm) grooved coupling.
- ❑ Discharge connection:
  - Model HPX and HPXB - male, 2-1/2" NPT (64 mm)
  - Model HP Premium, HPT and HPW - male, 2-1/2" NST screw-type valve

**Note:** Suction and discharge connection thread sizes are for standard units. Contact your Class1 sales representative for a full range of factory installed adapters to meet individual customer requirements.

- ❑ Priming - exhaust Venturi; 20" HG (508mm)
- ❑ Weight - 145 lbs. (66 kgs.) minimum, up to 175 lbs. (79 kgs.)

## HP300

- ❑ Model **HP300 series** pump delivers discharge pressures from 25 PSI (1.7 BAR), up to 100 PSI (7 BAR) and flow rates from 150 GPM (568 LPM), up to 380 GPM (1,439 LPM).
  - ❑ Suction inlet connection - female 3" NPT (51 mm), 4" (102 mm) grooved coupling
  - ❑ Discharge connection - male, 2-1/2" NST (64 mm) screw-type valve
- Note:** Suction and discharge connection thread sizes are for standard units. Contact your Class1 sales representative for a full range of factory installed adapters to meet individual customer requirements.
- ❑ Priming - exhaust Venturi; 20" HG (508mm)
  - ❑ Weight - 140 lbs. (64 kgs.) minimum, up to 176 lbs. (80 kgs.)

## HP400

- Model **HP400 series** pump delivers discharge pressures from 10 PSI (0.7 BAR), up to 100 PSI (7 BAR) and flow rates from 90 GPM (341 LPM), up to 550 GPM (2,082 LPM).
  - Suction inlet connection - female 3" NPT (51 mm), 4" (102 mm) grooved coupling
  - Discharge connection -
    - Model HPX and HPXB - male, 3" NPT (76 mm)
    - Model HP Premium, HPT and HPW - two (2) male, 2-1/2" NST screw-type valve
- Note:** Suction and discharge connection thread sizes are for standard units. Contact your Class1 sales representative for a full range of factory installed adapters to meet individual customer requirements.
- Priming - exhaust Venturi; 20" HG (508mm)
  - Weight - 140 lbs. (64 kgs.) minimum, up to 185 lbs. (84 kgs.)

## Wraparound Frame option

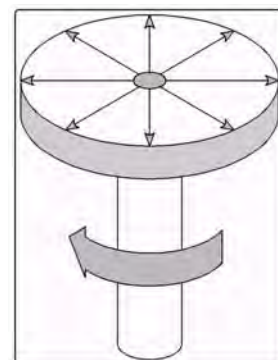
The wraparound frame option protects the pump, engine and fuel system from damage caused by normal handling. The frame also serves as a convenient means for transporting the unit over long distances.

## 2.2 PRINCIPLES OF OPERATION

### Centrifugal Force

Hale pumps are centrifugal pumps that operate on the principle of centrifugal force created by a rapidly spinning disk. (See Figure 2-3: "Centrifugal Force - Rotating Disk.")

As the disk rotates, it throws water from the center toward the outer circumference of the disk. The velocity at which the water travels directly relates to the diameter of the disk and the speed of rotation.



**Figure 2-3: Centrifugal Force - Rotating Disk**

When water is confined in a closed container, such as the volute (pump body), the velocity of the water is converted to pressure that rises to a level dependent on the speed of rotation.

Three interrelated factors regulate the performance of a centrifugal pump:

- **SPEED (RPM)** If the speed of rotation increases with flow held constant, fluid pressure increases.
- **PRESSURE** If pressure changes with speed held constant, the flow, measured in gallons or liters per minute (GPM/LPM), changes inversely; if pressure increases, flow decreases. Pressure is measured in pounds per square inch (PSI) or BAR.
- **FLOW** If the pressure is held constant, the flow increases with an increase in the speed of rotation. Flow is measured in the number of gallons of fluid per minute (GPM/LPM) that a pump can deliver when supplied from draft.

A centrifugal pump has the ability to fully utilize any positive suction inlet pressure, thus reducing the amount of work done by the pump. For example, if the required discharge pressure is 120 PSI (8.3 BAR) and the inlet pressure is 45 PSI (3.1 BAR), the pump must only produce the difference in pressure or 75 PSI (5.2 BAR).

This contributes to improved performance with reduced maintenance. Additionally, decreased maintenance is aided by centrifugal pumps having few moving parts.

As the impeller rotates, the water moving outward in the impeller creates reduced pressure, or a vacuum in the suction eye, allowing atmospheric pressure to push water into the pump impeller replacing the water discharged. Water enters the suction eye of the impeller. The rotating impeller vanes develop discharge pressure and via the “cutwater \*,” directs the water to the discharge opening.

*\* The “cutwater” is a wedge that divides the water between the volute (pump body) and the pump discharge.*

## 2.3 PUMP COMPONENTS

The Hale single-stage pump consists of:

- Volute (Pump Body)
- Impeller and Clearance Ring
- Mechanical Seal



## Volute, Pump Body

Water discharging from the impeller enters the volute. The volute is constructed from fine-grain cast iron (or bronze) and shaped so that its area increases from the cutwater to its full capacity at the volute throat.

This gradual increase in size maintains a constant average velocity through the volute. The volute is a single piece, and must be removed to service the impeller, clearance rings, and mechanical seal.

## Impeller

The impeller provides velocity to the water. Water enters the rotating impeller at the intake (or eye), and is confined by the shrouds and the vanes to build pressure. (See Figure 2-4: “Impeller Operation.”)

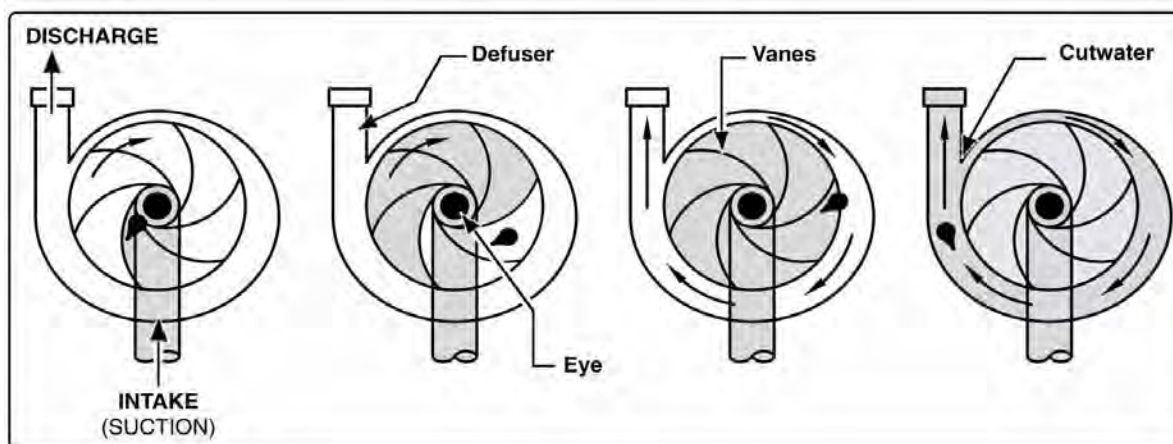


Figure 2-4: Impeller Operation

The vanes guide water from the inlet to the discharge and reduce the turbulence of the spinning water. Figure 2-4: “Impeller Operation” traces a drop of water from the intake of the impeller to the discharge outlet.

## Clearance Ring(s)

Clearance rings prevent pressurized water that is leaving the pump volute from returning to the intake of the impeller. They also prevent leakage, accomplished by limiting the radial clearance between the spinning impeller and the stationary clearance ring.

Typically, a clearance ring has a radial clearance of about 0.0075" (0.191 mm) or between 0.015" to 0.020" (0.381-0.508 mm) per side. Clearance rings are designed for replacement when wear limits cause the pump to exceed NFPA standards for satisfactory performance.

## Mechanical Seal

The "maintenance-free," mechanical seal is common to Class1 pumps. The stationary seat is in constant contact with a rotating seal ring to prevent leakage. The sealing diaphragm is made of a rubber elastomer specifically designed for high-temperature operations.

**Note:** Mechanical seals do not drip like other pump packing. A Class1 pump with a drip from the seal requires service.

### WARNING !



**IF A PUMP IS OPERATED WITHOUT WATER FOR EXTENDED PERIODS, OR WITHOUT DISCHARGING WATER, IT COULD OVERHEAT. THIS CAN DAMAGE THE MECHANICAL SEAL OR THE DRIVE MECHANISM.**

## 2.4 PUMPING SYSTEM OVERVIEW

- **Typical HP75 / HP100 Series Portable Pump Overview —**  
see Figure 2-5: "Typical HP75 / HP100 Series Portable Pump Overview" on page 27.
- **Typical HP Series Control Panel Layout —**  
see Figure 2-6: "Typical HP Series Control Panel Layout" on page 28.
- **Typical HPX Series Control Panel Layout —**  
see Figure 2-7: "Typical HPX Series Control Panel Layout" on page 28.
- **Typical HP75 / HP100 Pump and Gearbox Assembly —**  
see Figure 2-8: "Typical HP75 / HP100 Pump and Gearbox Assembly" on page 29.
- **Typical HP200 - HP400 Pump and Gearbox Assembly —**  
see Figure 2-9: "Typical HP200 / HP300 / HP400 Pump Assembly" on page 30.

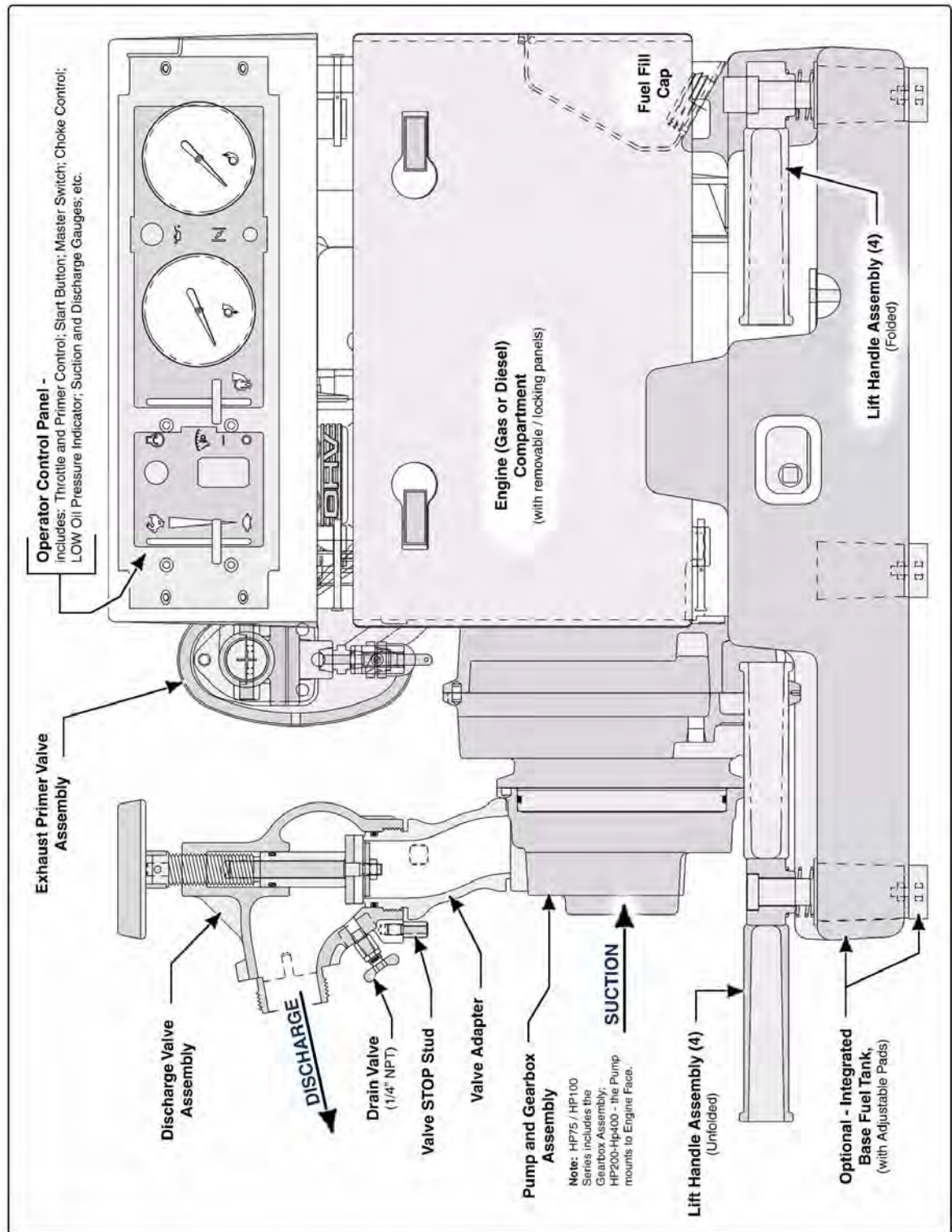


Figure 2-5: Typical HP75 / HP100 Series Portable Pump Overview

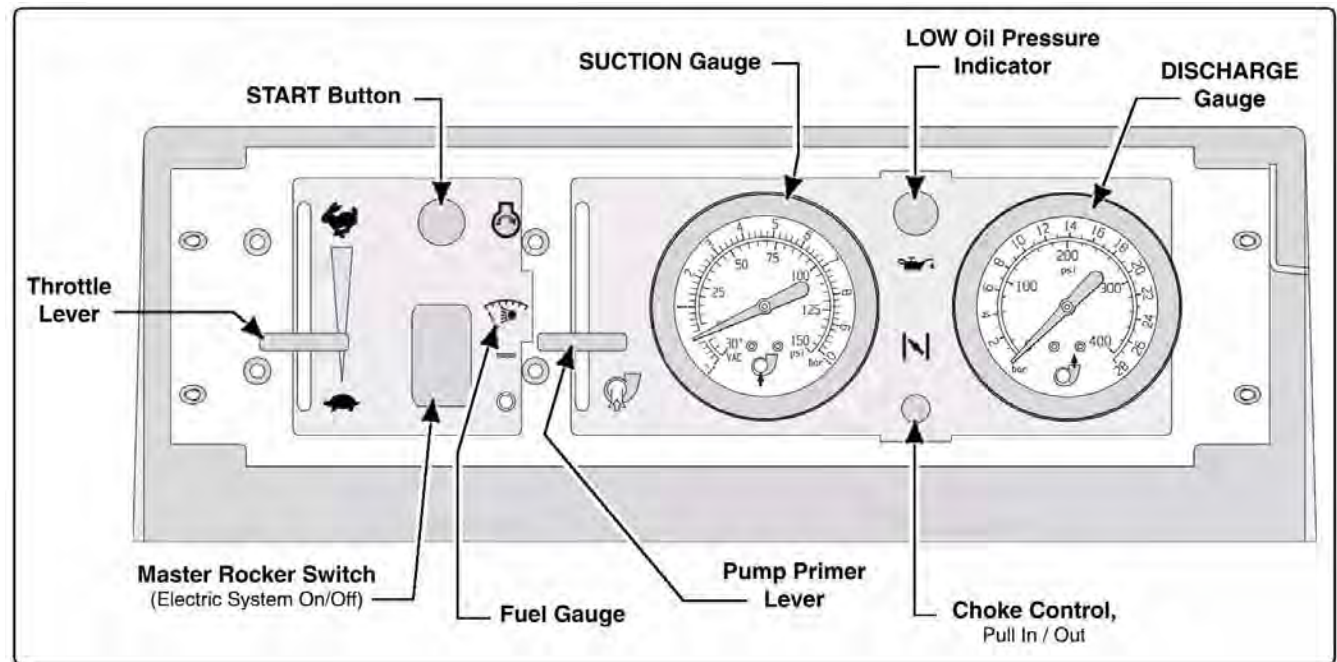


Figure 2-6: Typical HP Series Control Panel Layout

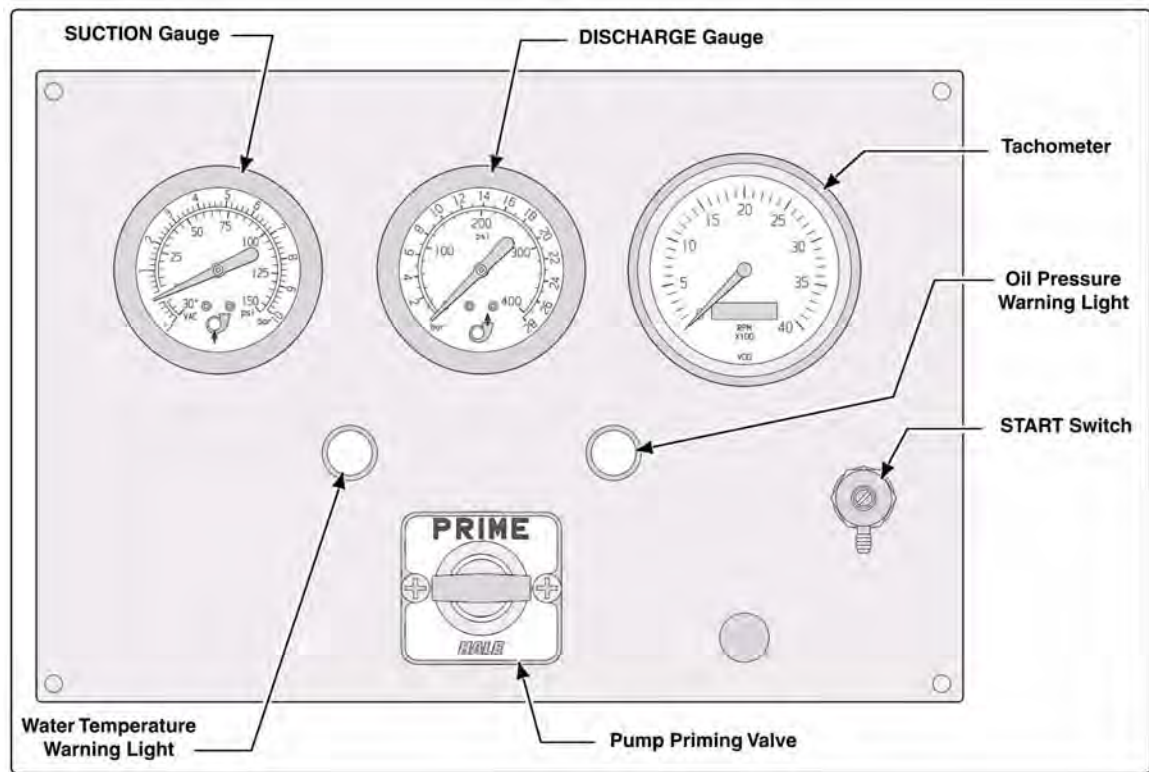


Figure 2-7: Typical HPX Series Control Panel Layout



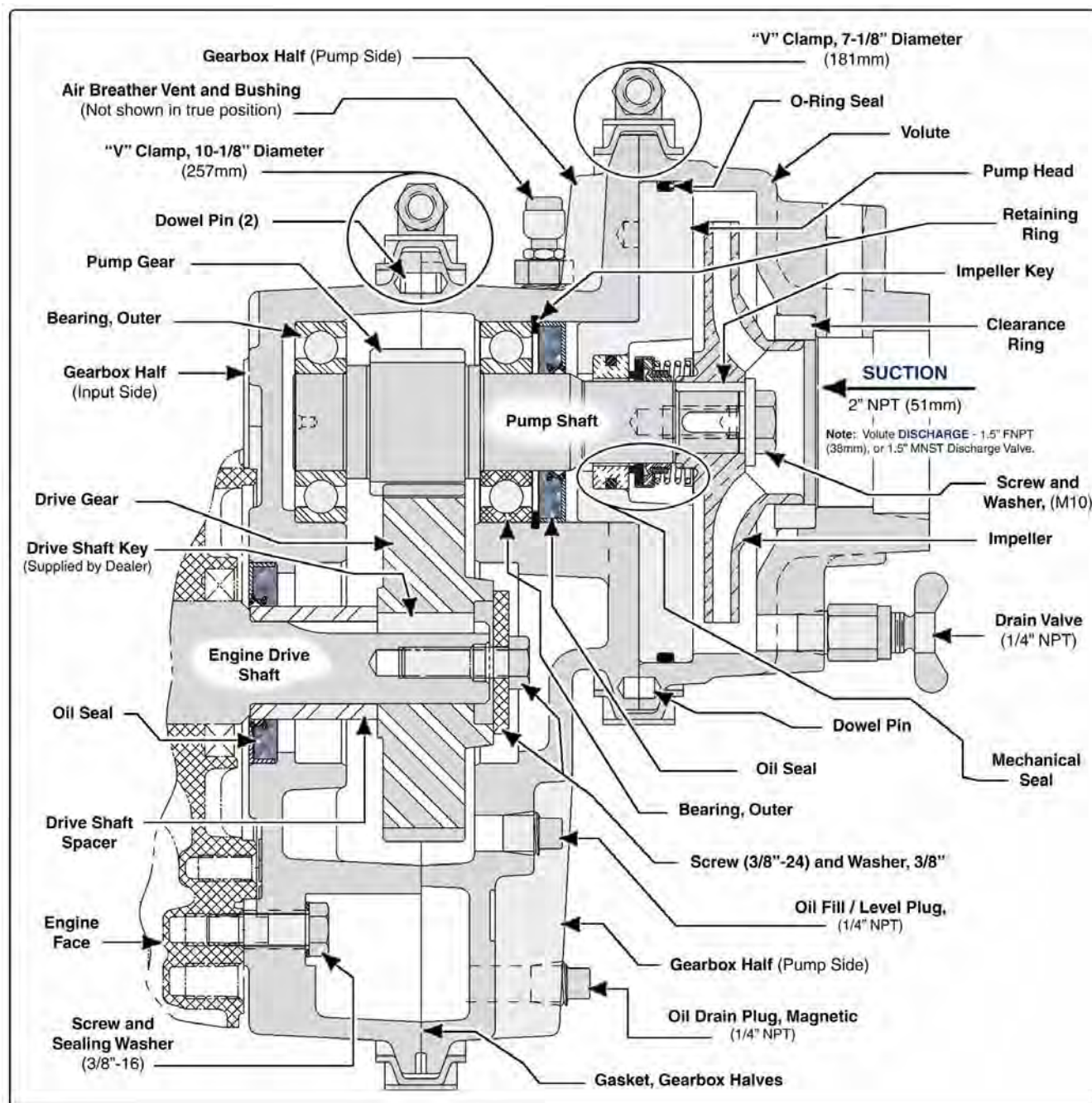


Figure 2-8: Typical HP75 / HP100 Pump and Gearbox Assembly

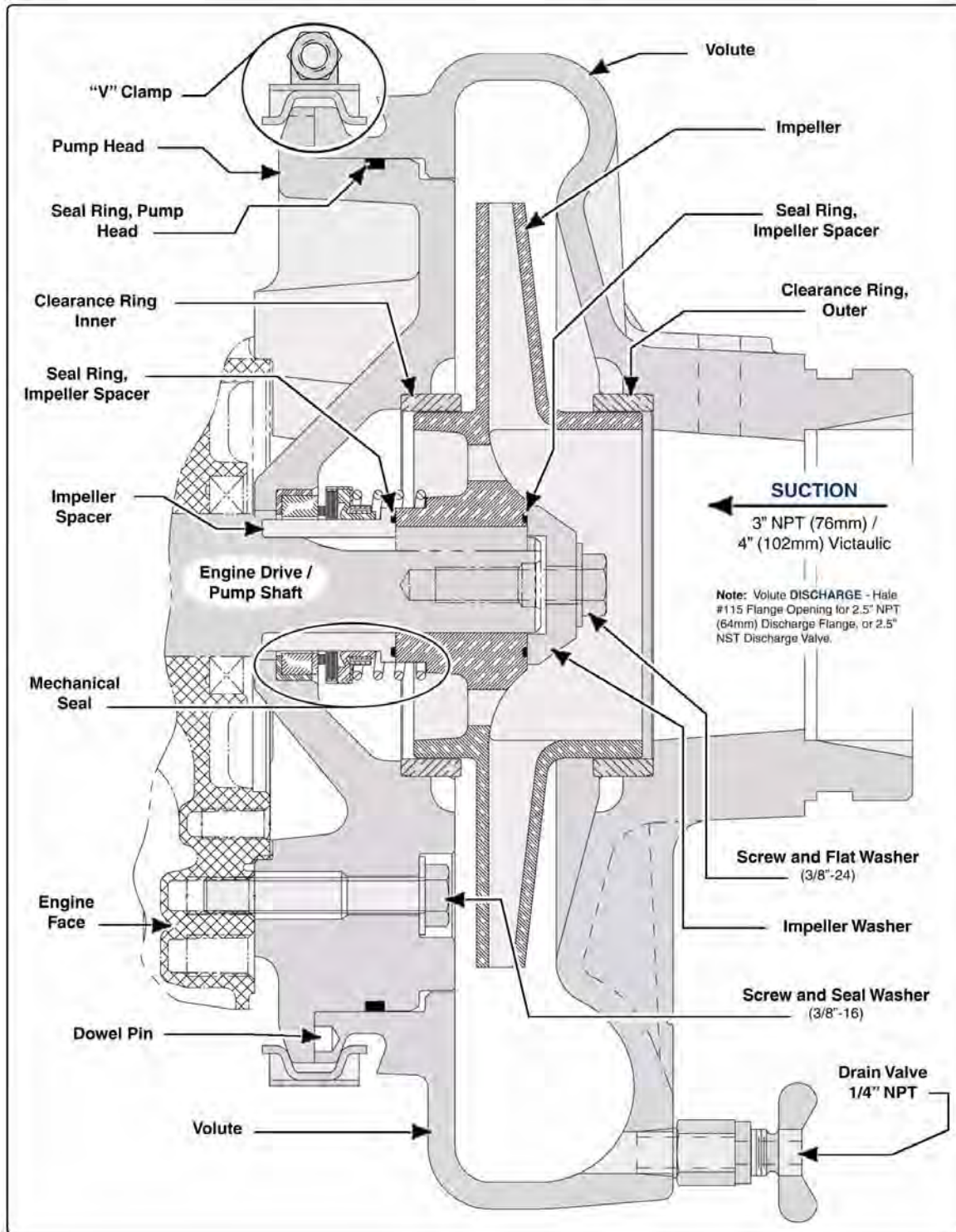


Figure 2-9: Typical HP200 / HP300 / HP400 Pump Assembly

## 3 Preparation and Installation

### 3.1 INSPECTION

Before shipping from the factory, each Class1 HP Series Portable Pump is inspected to make sure the unit you receive is in impeccable condition and equipped per your order. However, we recommend:

1. When unpacking the unit, do not discard the insulating materials or carton until you are sure everything is correct. After inspection proves satisfactory, discard all shipping material in accordance with your local / environmental policies.
2. Inspect the pump for any signs of physical damage during shipment, loose or missing parts, etc.
3. Verify that the portable pump configuration and options match your purchase order. Report any discrepancies to your distributor / dealer.
4. Note any apparent damage or missing parts on the bill of lading, and request the delivery agent to sign it.

Report damage to your distributor / dealer and the shipping company.

### 3.2 FLUID LEVELS

To meet various shipping regulations, ALL fluids within the engine, gearbox, fuel system, battery and pump are drained and tagged prior to shipping from the factory. Also see Section 5.2 "Post Operation" on page 50



#### **IMPORTANT !**

AT INSTALLATION AND BEFORE OPERATION, PROPER QUANTITIES AND GRADES OF FUEL AND OIL MUST BE ADDED TO THE APPROPRIATE LEVELS.

### 3.3 TRANSPORTING

**ALWAYS CARRY THE UNIT IN AN UPRIGHT POSITION AND “LEVEL” USING THE FOUR (4) HANDLES. ALSO SEE HEADING “CARRY HANDLES” ON PAGE 19.**



If the engine has been running, allow it to cool for at least fifteen (15) minutes before attempting to move it. A HOT engine and exhaust system can cause burns and ignite some materials.

Care must be taken not to drop or strike the engine or pump, as damage may result. When transporting the unit by motor vehicle, care should be taken to fasten the unit down securely. Follow the manufacturer's instructions for transporting a fuel caddy, when included.

### 3.4 INSTALLATION

A suitable location site should be chosen as near to the water source as possible for the HP series portable pump unit.

#### “X” Series Pumps

If your system is an HP “X” series pump, for installation instructions see heading ““X” Series Pump Dealer Installation” on page 34.

#### Battery Power

Connect the pump electrical system to a 12 volt battery to provide power to start the pump. The pump may be connected to the apparatus battery or a separate battery.

#### **WARNING !**



**THE BATTERY CONTAINS CONCENTRATED SULFURIC ACID WHICH CAN CAUSE SEVERE CHEMICAL BURNS.**

**WHEN THE BATTERY IS CHARGING, IT RELEASES HYDROGEN, A HIGHLY EXPLOSIVE GAS WHICH CAN BE IGNITED BY A SPARK. ALWAYS ASSUME THE BATTERY IS EMITTING HYDROGEN AND EMPLOY PROPER SAFETY PRECAUTIONS.**



**WARNING ! - continued**

SHORTING BATTERY TERMINALS CAN RELEASE ENORMOUS AMOUNTS OF ENERGY, CAUSING SPARKS OR FLAME, OR HEATING NEARBY COMPONENTS TO DANGEROUS TEMPERATURES.



DO NOT SMOKE, USE AN OPEN FLAME, OR CREATE ARCS OR SPARKS NEAR THE BATTERY.

ALWAYS CONNECT THE BLACK CABLE TO THE NEGATIVE (—) BATTERY TERMINAL LAST.

FOR BATTERY SAFETY INFORMATION, SEE PRECEDING HEADING “BATTERY SAFETY” ON PAGE 16. ALSO, PACKAGED WITH EVERY BATTERY IS SPECIFIC INSTRUCTIONS FOR BATTERY SAFETY, CARE AND USE, AND A MATERIAL SAFETY DATA SHEET (MSDS). READ THESE DOCUMENTS THOROUGHLY BEFORE PERFORMING ANY SERVICE TO THE BATTERY.

1. Open the top cover on the pump, if included.
2. Disassemble the battery brackets and remove the battery from its holder tray. (See Figure 3-1: “Battery Layout.”)

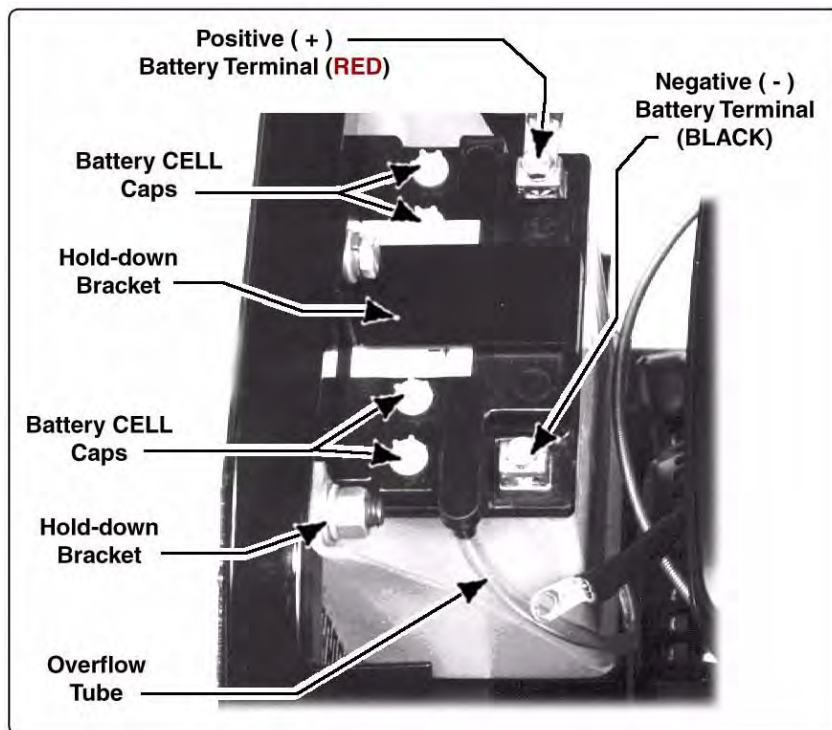


Figure 3-1: Battery Layout

The battery is a dry-charge battery and is shipped DRY.

3. Remove the battery cell caps. Fill each cell to the level indicator using dilute battery grade sulfuric acid. The electrolyte level may drop slightly because of absorption into the plates and separators. If it does, add more electrolyte to restore the level. (See Figure 3-1: "Battery Layout," on page 33.)
4. Install each battery cell cap and tighten.
5. Return the battery to its holder and install the hold-down brackets to clamp the battery in place.
6. Connect the battery cables to the appropriate terminal, making sure the polarity is not reversed and that the BLACK cable (negative — terminal) is connected "last."

**CAUTION !**



**ALWAYS CONNECT THE BLACK CABLE TO THE NEGATIVE (—) BATTERY TERMINAL LAST.**

7. Make sure the battery overflow tube is connected and directed down to the lowest point of the pump. (See Figure 3-1: "Battery Layout," on page 33.)

### **"X" Series Pump Dealer Installation**

1. Remove the mounting bolts and shock absorber feet from the four (4) corners of the pump. Retain the bolts and feet.
2. On the apparatus, mark the location of the mounting holes and drill 3/8" (9.5 mm) diameter holes in accordance with the mounting dimension drawing. (See Figure 3-2: "'X' Series Mounting Dimension Layout Drawing," on page 35.)
3. Place the pump in position over the mounting holes and secure using the original mounting bolts and hardware and the shock absorbing feet provided.
4. If access to the fuel tank fill cap is not provided, install an optional fill tube and vent extension as required.

**Note:** The fuel tank on the HP series pump is already vented; therefore, a vented fuel cap is not required.

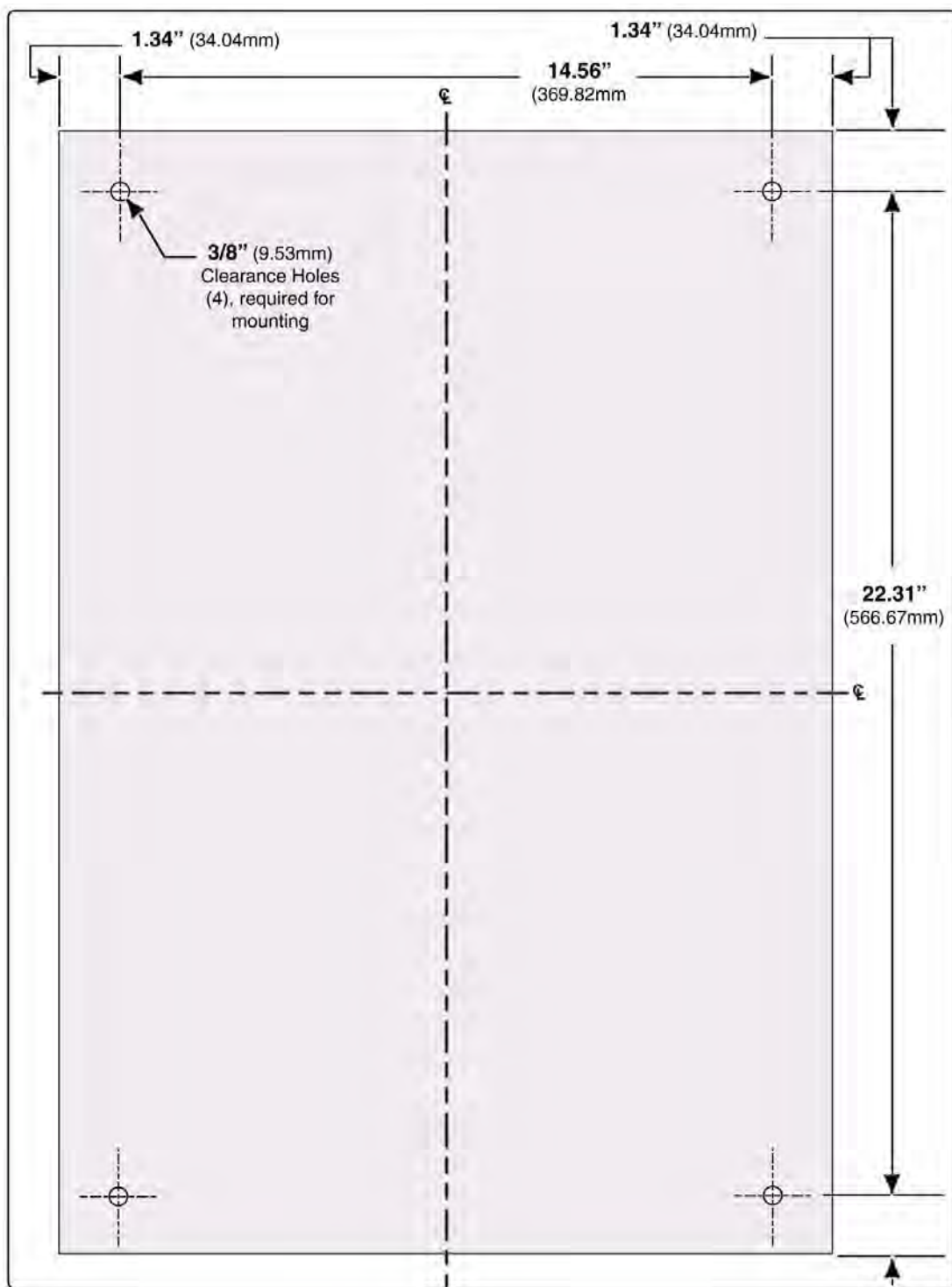
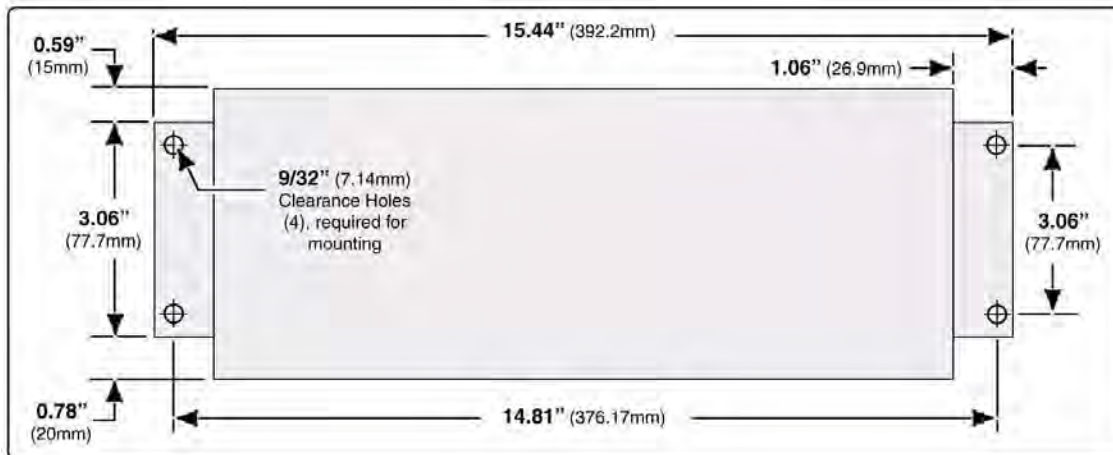


Figure 3-2: "X" Series Mounting Dimension Layout Drawing



**Figure 3-3: "X" Series Control Panel Dimension Layout**

5. Locate and install the control panel on the apparatus. A dimensional drawing is provided for mounting hole location. (See Figure 3-3: "'X" Series Control Panel Dimension Layout.")

**Note:** There could be excess cable after the connections are made. Loosely coil the excess cable and secure in place with tie wraps.

6. Make the electrical connection from the control panel to the pump with the jumper wires provided. Approximately 6' (2 meters) of wire and control cable is provided. If additional cable length is required, contact your distributor.
7. Connect the throttle lever and chock control to the engine. Secure in place with the clamps provided. Check that the controls work smoothly.

## Suction and Discharge Connection

### CAUTION !



THE PUMP AND ENGINE ASSEMBLY ARE VIBRATION ISOLATED. WHEN MAKING PERMANENT CONNECTIONS TO THE SUCTION OR DISCHARGE FITTINGS DO NOT USE HARD PIPING. A SHORT LENGTH OF FLEXIBLE PIPING IS REQUIRED TO PREVENT DAMAGE TO THE PUMP AND ENGINE.

DO NOT ATTACH REGULAR PIPE THREADED (NPSH / NPT) FITTINGS. THEY COULD PERMANENTLY DAMAGE THE MALE FIRE THREADS.

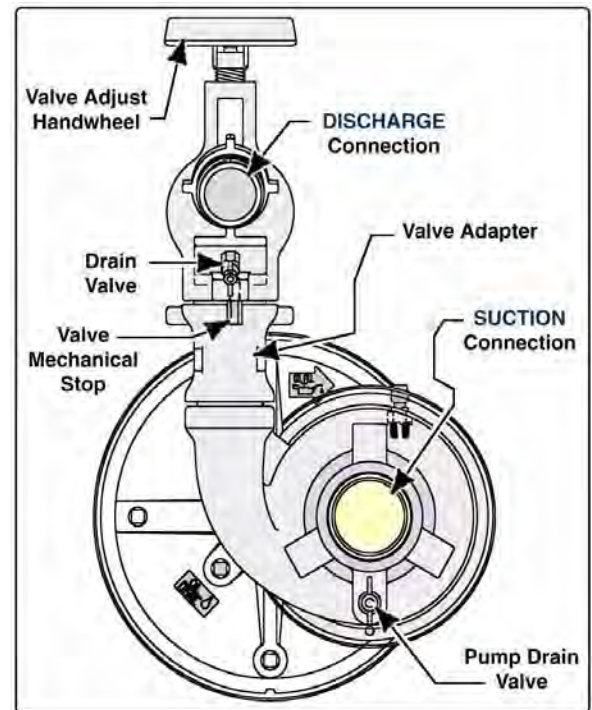
When making the piping connections, it may be necessary to rotate the pump volute to obtain proper alignment - see heading "Turning the Pump" on page 38.

## Suction

The suction (inlet) hose should be of a size, type and layout to avoid excessive friction loss. Ensure there are a minimum of restrictions, such as, bends, elbows and couplings. (See Figure 3-4: "Typical Suction / Discharge Connections.")

To protect the pump from debris, install a strainer in the suction line and make sure the line is not submerged in mud or silt on the bottom.

When operating from draft, the suction hose should slope continuously downward from the pump to the water source.



**Figure 3-4: Typical Suction / Discharge Connections**

## Discharge

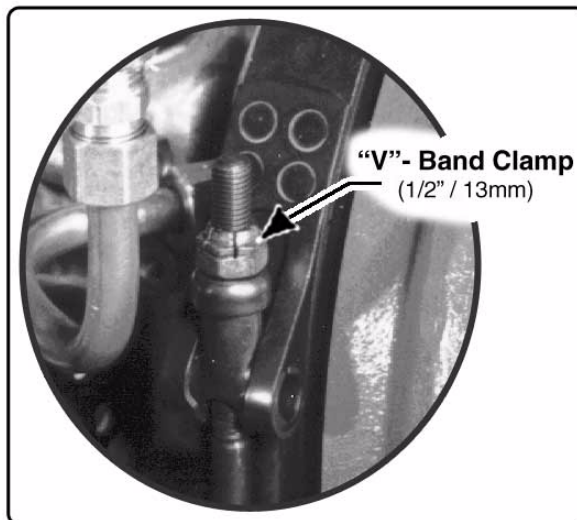
The discharge hose should be of a size, type and layout to avoid excessive friction loss. The volume and pressure of liquid to be pumped, the length of line, the number of elbows and fittings should be considered when selecting the proper size hose. (See Figure 3-4: "Typical Suction / Discharge Connections.")

Also see Section "Appendix D: Hose Friction Loss" on page 97.

The discharge tube has a threaded male connection to accept a 1-1/2" NST (NH) National Standard fire hose coupling and is located at the rear of the unit.

## Turning the Pump

1. Loosen and remove the “V” band clamp. (See Figure 3-5: “Volute “V”-Band Clamp,” on page 38.) Also see Figure 2-1: “HP Series Portable Pumping Units” on page 17.
2. Remove the volute from the pump body.
3. Locate and remove the positioning roll pin from the pump body. See Section 2.4 “Pumping System Overview,” on page 26.
4. Reinstall the volute to the pump body and install the “V”-band clamp.
5. Turn (rotate) the volute as needed and connect the discharge piping, then tighten and torque the “V”-band clamp enough to prevent leakage. (See Table 7-1: “Typical Torque Values Chart,” on page 69.)

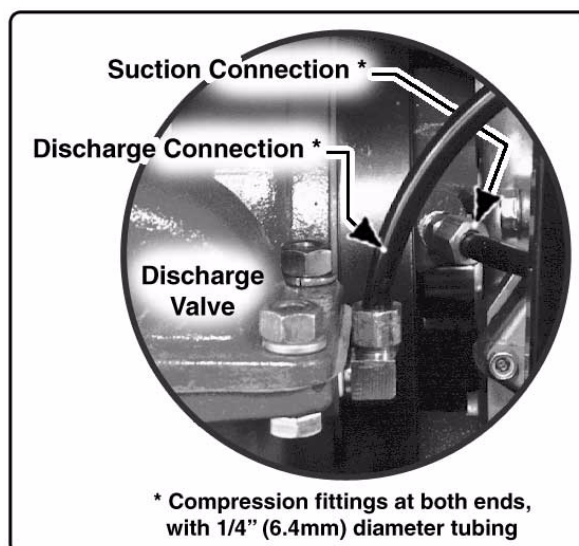


**Figure 3-5: Volute “V”- Band Clamp**

## Gauges

Connect the 1/4" (6.4 mm) diameter tubing, provided with the pump, to the compression fittings for the suction and discharge gauges. (See Figure 3-6: “Suction / Discharge Gauge Tubing Connections.”)

If longer tubing is needed, make sure the tubing is rated at the maximum operating pressure of the pump.



**Figure 3-6: Suction / Discharge Gauge Tubing Connections**



## Exhaust Primer Cable

Connect the exhaust priming lever cable to the exhaust primer. (See Figure 3-7: "Exhaust Primer Connect.")

Make sure the cable clamp is also installed and tight, without crimping the cable.

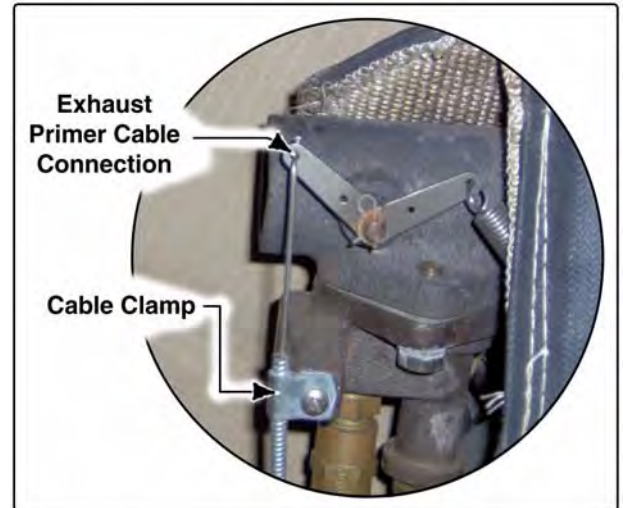


Figure 3-7: Exhaust Primer Connect

## 3.5 FUEL SYSTEM

Before checking and/or servicing the fuel system, see preceding heading "Fuel Safety" on page 15.

Use clean, fresh, regular unleaded gasoline with a minimum rating of 85 octane. Fresh fuel prevents gum from forming in the fuel system or on essential carburetor parts. Purchase fuel in quantities that can be used within thirty (30) days.

For additional information, see the engine manufacturer's operating and maintenance manual provided with the unit.



### CAUTION !

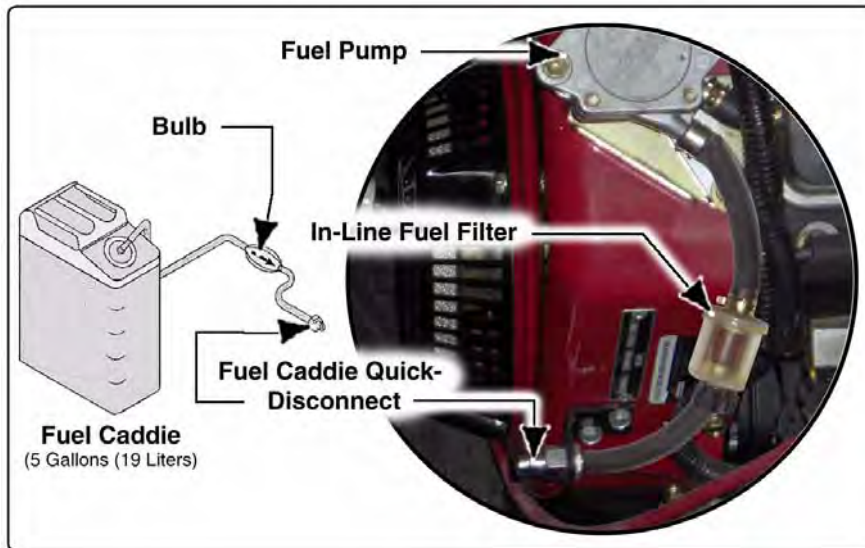
**SOME FUELS CALLED OXYGENATED OR REFORMULATED FUELS, ARE FUELS BLENDED WITH ALCOHOLS OR ETHERS. EXCESSIVE AMOUNTS OF THESE BLENDS CAN DAMAGE THE FUEL SYSTEM OR CAUSE PERFORMANCE PROBLEMS. IF ANY UNDESIRABLE OPERATING SYMPTOMS OCCUR, USE GASOLINE WITH A LOWER PERCENTAGE OF ALCOHOL OR ETHER, 10% OR LESS.**

**DO NOT MIX OIL WITH GASOLINE.**

## Adding Fuel

1. Turn the engine OFF and let engine cool at least two (2) minutes before removing the fuel cap.

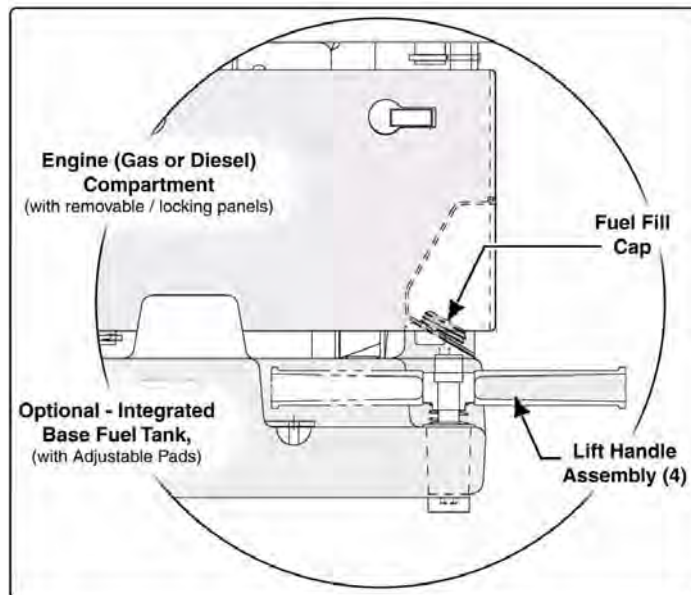




**Figure 3-8: Typical Fuel Caddie Quick-Disconnect**

2. Ensure the pump is LEVEL to prevent overfilling or spilling fuel.
3. If a fuel caddie is required, connect the caddie fuel line to the quick-disconnect on the engine. (See Figure 3-8: "Typical Fuel Caddie Quick-Disconnect.")
4. If the fuel tank is provided, remove the fuel cap to check the fuel level. (See Figure 3-9: "Typical Fuel Cap.")
5. Fill the tank to approximately 1-1/2" (38 mm) below top of the neck to allow for fuel expansion.

DO NOT fill the fuel tank to the point of overflowing. The tank is designed to provide sufficient expansion space when filled properly.



**Figure 3-9: Typical Fuel Cap**

6. Use clean, lead-free (unleaded) gasoline. The engine operates satisfactorily on any gasoline intended for automotive use. A minimum of eighty-five (85) octane is recommended.
7. Leaded gasoline may be used if unleaded (or lead-free) is not available.

**Note:** Using gasoline which contains alcohol, such as gasohol is not recommended. If gasoline with alcohol must be used, it **MUST NOT** contain more than ten percent (10%) Methanol and **MUST** be removed from the engine during storage.

### 3.6 GEARBOX OIL (HP100 SERIES)

Incorrect oil types or amounts of oil result in unnecessary high oil temperature and possible wear or damage. Change the oil every twelve (12) months, depending on pump usage.

To meet various shipping regulations, oil is drained from the gearbox prior to shipping from the factory. At installation and before operating the first time, oil must be added to the appropriate level.

#### To Fill or Check Oil Level

1. Gearbox capacity is approximately 1.5 quarts (1.4 liters) - see heading "Appendix C1: Lube and Sealant Specifications" on page 95.
2. Remove the oil LEVEL and FILL plugs. (See Figure 3-10: "Gearbox Oil Change Plugs.")

Have clean disposable shop rags and oil dry handy to confine any spills.

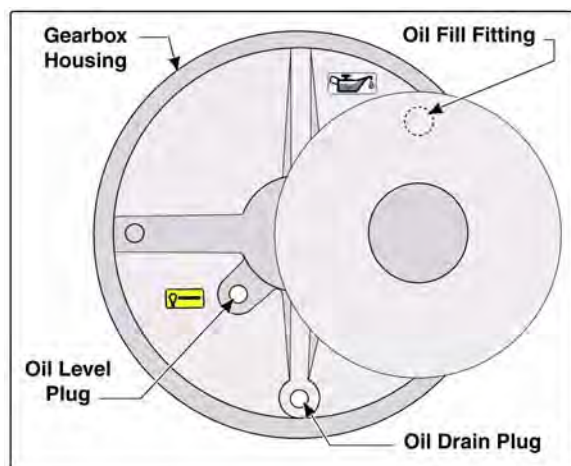


Figure 3-10: Gearbox Oil Change Plugs

3. If oil trickles from the oil LEVEL plug, there is sufficient oil in the gearbox. (See Figure 3-10: "Gearbox Oil Change Plugs.")
4. If additional oil is required, place a funnel in the oil FILL port and add oil (SAE30W) until oil trickles from the LEVEL plug hole.

5. Using an appropriate sealant, reinstall both pipe plugs and clean any excess oil residue.

## 3.7 STORAGE

### WARNING !



**TO PREVENT ACCIDENTAL STARTING, BEFORE PLACING THE UNIT IN STORAGE OR BEFORE WORKING ON THE ENGINE OR PUMP, ALWAYS DISCONNECT THE NEGATIVE (—) WIRE (BLACK) FROM THE BATTERY TERMINAL.**

### Engine and Fuel System

For engine storage instructions, see separate Engine Operation and Maintenance Manual, heading “Engine Manual” listed on page 107.

### Pump

1. With suction and discharge hose connected and placed in clean water, start the pump and run fresh water to flush the system. Run the pump for about two (2) minutes to ensure clean water has circulated through the pump.
2. Switch the pump to OFF and disconnect the suction and discharge line. Drain hoses and place in proper storage area.
3. Thoroughly drain water from the pump body by opening all drain valves. Once all water is drained, close the valves.
4. With the pump running, spray into the pump discharge tube using either a white lithium or silicone type lubricant. Also place the nozzle of the spray lubricant down through the suction port and spray into and around the suction bore of the pump volute. This treatment coats the inside of the pump and tends to prevent the clearance ring and impeller hub from sticking due to corrosion.
5. Spray the threads of the discharge tube with either a white lithium or silicone type lubricant.
6. Return the pump to its storage compartment and secure in place.

## 4 Operation



### IMPORTANT !

THE PROCEDURES IN THIS SECTION ARE GENERAL OPERATING PROCEDURES. NOT ALL PROCEDURES IN THIS SECTION MAY APPLY TO YOUR SPECIFIC OPERATIONAL REQUIREMENTS. REFER TO ONLY THOSE SECTIONS WHICH APPLY TO YOUR OPERATIONAL REQUIREMENTS.

THESE PROCEDURES DO NOT REPLACE THE PROCEDURES, POLICIES OR GUIDELINES ESTABLISHED BY THE AUTHORITY HAVING JURISDICTION.

ALWAYS REFER TO THE PROCEDURES PROVIDED BY THE AUTHORITY HAVING JURISDICTION FOR OPERATING PROCEDURES, SETTING WHEEL CHOCKS, AS WELL AS LAYOUT AND CONNECTION OF HOSES, VALVES AND DRAIN COCKS. ALL VALVES, DRAIN COCKS AND CAPS SHOULD BE CLOSED.

THOROUGHLY REVIEW THE ENGINE OPERATING PROCEDURES FOUND IN THE ENGINE MANUFACTURER'S MANUAL / OWNERS MANUAL, PROVIDED WITH THE SYSTEM.

### 4.1 STARTUP



#### WARNING !

**DO NOT OPERATE THE ENGINE IN AN ENCLOSED AREA! PROPER VENTILATION FOR ENGINE COOLING AND ENGINE EXHAUST MUST BE PROVIDED.**

**EXHAUST GASES CONTAIN CARBON MONOXIDE, WHICH IS AN ODORLESS AND DEADLY POISON. PROPER EXHAUST VENTILATION MUST BE PROVIDED TO PREVENT THE ACCUMULATION OF EXHAUST GASES.**

**IF AN EXHAUST EXTENSION IS REQUIRED TO VENT GASES TO THE OUTSIDE, IT IS IMPORTANT TO CONSTRUCT THE EXHAUST EXTENSION TO PREVENT EXCESSIVE EXHAUST BACK PRESSURE.**

**DO NOT REFUEL THE HP SERIES PUMP WITH THE ENGINE RUNNING. REFILL FUEL CONTAINERS OR TANK OUT-OF-DOORS, AWAY FROM ANY SOURCE OF IGNITION AND CLEAN UP ANY SPILLS IMMEDIATELY.**

1. Choose a suitable location as near to the source of water as possible to place the HP series portable pump.

2. **Skid unit only** - Connect the fuel caddy to the fuel line quick-disconnect on the engine base - see Figure 3-8: "Typical Fuel Caddy Quick-Disconnect" on page 40.

Open the air vent on the fuel caddy cap, then squeeze and release the priming bulb until resistance is felt, indicating the engine fuel line is full. Continued action pumps fuel past the check valve, flooding the carburetor.

3. Make sure all pump drains and discharge valves are CLOSED.
4. Set the throttle lever upward to the FAST position (  ).
5. CLOSE the choke (  ).

**Note:** A warm engine requires LESS choking than a COLD engine. When starting a warm engine little or no chock is required.

6. Set the ignition switch to ON (—) and check that the oil light is ON.

This indicates the battery is good and the pump is ready to start. If the oil light is not ON, check the battery connections and ground connections. It may be necessary to start the pump using the recoil starter if the oil light does not energize. See "Recoil Starting" on page 45.

7. Start the engine by pressing and holding the START push button pressed until the engine starts (or turn the starter key-switch to START and release when the engine starts).

When the engine starts, slowly open the choke (  ).

If the engine does not start using the electric starter, the recoil starter must be used - see heading "Recoil Starting" on page 45.

#### Notes:

Use SHORT starting cycles of only several seconds to avoid overworking the starter. Prolonged cranking (more than fifteen [15] seconds) can damage the starter motor. If the engine does not start in fifteen (15) seconds, release the starter button and allow the starter to cool for two (2) minutes before starting again.

The exhaust system components may smoke during the initial break-in period. This smoking stops after the pump is run a few times.

## Priming

8. Hold the primer lever down (  ) to prime the pump and establish suction.

Monitor the suction and discharge gauges to determine when suction is established, then release the primer lever (  ) making sure the lever returns to the UP position.

**WARNING !**

**DO NOT RUN THE PUMP FROM MORE THAN FORTY-FIVE (45) SECONDS WITHOUT SUCTION ESTABLISHED. IF PRIMING IS NOT ACHIEVED IN 45 SECONDS, STOP AND LOOK FOR CAUSES, SUCH AS LEAKS, BLOCKED SUCTION HOSE, ETC. THE PUMP'S MECHANICAL SEAL AND CLEARANCE RING REQUIRE WATER FOR COOLING AND LUBRICATION.**

9. Once suction is established, as indicated by the gauges, OPEN the pump discharge valve.
10. Adjust the throttle (  ) to obtain the desired discharge pressure on the discharge gauge.

**IMPORTANT !**

WHEN OPERATING FROM DRAFT, ESPECIALLY ON HIGH LIFTS, DO NOT INCREASE ENGINE SPEED WITHOUT A CORRESPONDING INCREASE IN PUMP PRESSURE. IF THE ENGINE SPEED INCREASES WITH NO FURTHER INCREASE IN FLOW OR PRESSURE, REDUCE THE THROTTLE SETTING UNTIL THE PRESSURE OR FLOW DECREASES SLIGHTLY AND OPERATE AT THAT POINT.

11. The pump is now ready for use.
12. Discharge conditions at the nozzle are determined by:
  - ☐ Length of hose.
  - ☐ Type of hose.
  - ☐ Elbows and fittings used.
13. If necessary, increase the throttle setting and/or reduce nozzle size to compensate for pressure losses.

**Recoil Starting**

- ☐ Open the pump cover on the instrument panel side of the pump, if applicable.

- ❑ Place your foot on the frame or skid to prevent movement. Pull the start handle cord slowly at first to bleed off some compression; then, pull with quick short strokes. Repeat as necessary until the engine starts.
- ❑ When the engine starts, slowly OPEN the choke (  ).
- ❑ Set the engine throttle (  ) to the desired operating point.

## 4.2 SHUT DOWN

### IMPORTANT !



IF SEA WATER, DIRTY WATER OR ALKALINE WATER HAS BEEN USED, FLUSH THE PUMP WITH CLEAN WATER FOR ABOUT TWO (2) MINUTES BEFORE SHUTTING DOWN.

1. CLOSE the discharge nozzle.
2. Move the throttle (  ) to the SLOW position.
3. CLOSE the pump discharge valve.
4. Set the ignition switch to the OFF (  ) position.

**Note:** The engine should be shut-down immediately after returning to SLOW.

5. Disconnect the fuel caddy quick-disconnect coupling and/or CLOSE the fuel cap vent, if applicable.
6. Restart the engine, with water flowing through the pump, and allow to IDLE until it STOPS from lack of fuel.
7. Allow suction and discharge lines to drain, then disconnect hoses.

### CAUTION !



**BE CAREFUL NOT TO TOUCH THE EXTERIOR OF THE ENGINE, ESPECIALLY THE MUFFLER AND THE SURROUNDING AREA. THE ENGINE IS HOT ENOUGH TO CAUSE INJURY.**

8. Disconnect the discharge hose and drain the pump by tilting the inlet end of the pump downward (especially important in freezing weather).
9. Replace all caps to prevent thread damage.



# Maintenance Schedule Check List

## Recommended Maintenance Intervals

To prolong pump life (limit “downtime”) and ensure reliable operation, perform the following maintenance schedule on a regular basis.

**Note:** For detailed engine maintenance scheduling, also see the Engine Manufacturer’s Operation and Maintenance Manual provided with your system.

| Recommended Procedures                                                                                                                                               | 8 Hours<br>/ Daily | 25 Hours<br>/ Weekly | 50 Hours<br>/ Monthly | 100 Hours<br>/ Yearly | Yearly |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------|-----------------------|-----------------------|--------|
| <b>ENGINE Maintenance</b> (Also see Engine Manufacturer’s Manual)                                                                                                    |                    |                      |                       |                       |        |
| <b>Check Engine Oil Level.</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual / Owners Manual provided.)                                             | ●                  |                      |                       |                       |        |
| <b>Change Engine Oil * (See Note 1)</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual provided.)                                                    |                    |                      | ●                     |                       |        |
| <b>Change Engine Oil Filter.</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual / Owners Manual provided.)                                           |                    |                      |                       | ●                     |        |
| <b>Clean Foam Air Cleaner. Pre-Cleaner. (See Note 2)</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual / Owners Manual provided.)                   |                    | ●                    |                       |                       |        |
| <b>Service Air Cleaner Cartridge. (See Note 2)</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual / Owners Manual provided.)                         |                    |                      |                       | ●                     |        |
| <b>Clean Cooling System. (See Note 2)</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual / Owners Manual provided.)                                  |                    |                      |                       | ●                     |        |
| <b>Clean Debris Guard. (See Note 2)</b><br>See Engine Manufacturer’s Operation and Maintenance Manual provided.                                                      | ●                  |                      |                       |                       |        |
| <b>Inspect Spark Arrester.</b><br>See Chapter 5, heading “Spark Arrestor Screen” on page 55.                                                                         |                    |                      |                       | ●                     |        |
| <b>Replace In-Line Fuel Filter</b><br>(See Engine Manufacturer’s Operation and Maintenance Manual / Owners Manual provided.)<br><i>Chart continued on next page.</i> |                    |                      |                       |                       | ●      |

**Chart M-1: Recommended Maintenance Schedule**

|                                                                                                                              |   |  |   |   |   |
|------------------------------------------------------------------------------------------------------------------------------|---|--|---|---|---|
| <b>Replace Spark Plug.</b><br>See Chapter 5, heading "Spark Plug" on page 57.                                                |   |  |   | ● |   |
| <b>Check Valve Clearance.</b><br>(See Engine Manufacturer's Operation and Maintenance Manual / Owners Manual provided.)      |   |  |   |   | ● |
| <b>Battery</b><br>See Chapter 5, heading "Battery Hydrometer Testing" on page 53.                                            |   |  |   |   | ● |
| <b>PUMP Maintenance</b>                                                                                                      |   |  |   |   |   |
| <b>Check Pump Gearbox Oil Level.</b><br>(Also see Note 3)<br>See Chapter 3, heading "Gearbox Oil (HP100 Series)" on page 41. | ● |  |   |   |   |
| <b>Change Gearbox Oil. (See Note 3)</b><br>See Chapter 5, heading "Replace Gearbox Oil" on page 50.                          |   |  | ● |   |   |
| <b>Clean Exhaust Primer Valve</b><br>See Chapter 5, heading "Exhaust Primer" on page 53.                                     |   |  |   | ● |   |
| <b>Leak Test Pump System</b><br>See Chapter 5, heading "Leak Test" on page 55.                                               |   |  |   |   | ● |
| <b>* Change oil after "first" eight (8) hours of operation.</b>                                                              |   |  |   |   |   |
| <b>Note 1: Change oil every 25 hours when operating under heavy load or in high ambient temperatures.</b>                    |   |  |   |   |   |
| <b>Note 2: Clean more often under dusty conditions or when airborne debris is present.</b>                                   |   |  |   |   |   |
| <b>Note 3: HP100 Model Pump ONLY.</b>                                                                                        |   |  |   |   |   |

**Chart M-1: Recommended Maintenance Schedule**



## Class1

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## 5 Preventive Maintenance

### 5.1 OVERVIEW

The following procedures are for normal use and conditions. Extreme conditions may indicate a need for increased maintenance. The procedures in this section identify measures needed to ensure lengthened pump life and continuing dependability. Always follow local maintenance and test procedures.



#### **WARNING !**

**BEFORE PERFORMING ANY MAINTENANCE ROUTINE, COMPLETELY REVIEW THE SAFETY SECTION OF THIS MANUAL, BEGINNING ON PAGE 9.**

**ALSO REVIEW THE ENGINE MANUFACTURER'S MANUAL / OWNERS MANUAL FOR ENGINE MAINTENANCE PROCEDURES.**

**TO PREVENT ACCIDENTAL STARTING, BEFORE SERVICING THE ENGINE OR PUMP, ALWAYS DISCONNECT THE NEGATIVE (—) WIRE (BLACK) FROM THE BATTERY TERMINAL.**

### Engine

For engine related preventive maintenance procedures, see the separate engine manufacturer's Operation and Maintenance Manual / Owners Manual provided with each system.

Items to check:

- ☐ Engine starting / stopping procedures
- ☐ Checking, adding and changing oil
- ☐ Changing oil and air filters
- ☐ Spark plug, check and/or replacement
- ☐ Spark arrestor screen — clean or replacement
- ☐ Fuel requirements and adding fuel

If required, separate Engine Service Repair Manuals are available from the engine manufacturer by contacting the engine manufacturer directly.

**All engine related service and parts requests should first be directed to the engine manufacturer. If additional information is needed, contact Class1 Customer Service at telephone number: 352-629-5020.**

## 5.2 POST OPERATION

1. Inspect the suction and discharge hose rubber washers and washers in the tube caps. Remove foreign matter from under these washers. Replace leaking, worn, damaged, or dry parts. *Leaks must be repaired before operating the unit !*
2. Remove any debris, i.e., dirt, leaves, grass, etc., that may have collected in the suction screen inlet. The suction screen may require more or less service depending on operating conditions. Also see heading "Intake Strainers" on page 55.
3. Verify that all discharge valves, drain valves, etc. are CLOSED. Also tighten suction caps.
4. Make sure the gearbox oil is full to the correct level - see heading "Replace Gearbox Oil" on page 50.

Also ensure that the engine has the proper amount oil and coolant. See separate engine operation and maintenance manual provided.

## 5.3 REPLACE GEARBOX OIL

For HP100 series pump gearbox capacity and oil type - see heading "Appendix C1: Lube and Sealant Specifications" on page 95. Also review heading "WARNING !" on page 49.



1. Place the pumping unit on a level surface allowing access to the gearbox housing oil plugs. (See Figure 5-1: "Gearbox Oil FILL/LEVEL Plugs," on page 51.)
2. Remove the Oil FILL and DRAIN (magnetic) plugs and drain the HP100 series pump gearbox oil into a suitable container. For container size based on gearbox capacity, see "Appendix C1: Lube and Sealant Specifications" on page 95. Have clean disposable shop rags and oil dry handy.
3. Examine the oil for contamination (e.g., water – turns the oil a milky color or settles to the bottom). Also see Section 6 Troubleshooting, heading "Water/Moisture in Pump Gearbox." on page 65.

4. Properly dispose of the used oil in accordance with your local environmental ordinances.

Inspect the magnetic drain plug. If metal filings are present, repair or replace gearbox components as necessary. See Section 7b "HP75 / HP100 Gearbox" on page 81. Also clean the drain plug (magnetic).

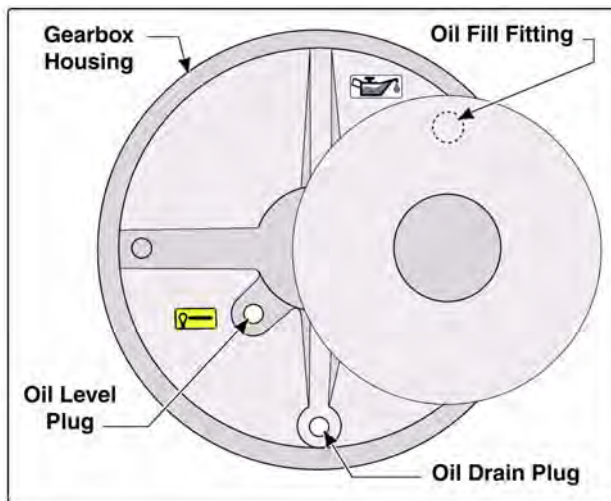


Figure 5-1: Gearbox Oil FILL/LEVEL Plugs

5. Reinstall the DRAIN (magnetic) plug, using suitable thread sealant.
6. Fill the gearbox (approximately 1.5 quarts / 1.4 liters) with an approved gear oil (SAE30W) until oil just begins trickling from the oil LEVEL plug opening. For gearbox capacity, see "Appendix C1: Lube and Sealant Specifications" on page 95.
7. Reinstall all pipe plugs using an appropriate thread sealant - see heading "Loctite Sealant" on page 96.

## Check / Fill Engine Fluids

To meet various shipping regulations, oil and water / antifreeze are drained from the engine crankcase and radiator prior to shipping from the factory. The battery is also drained. At installation and before operating the first time, oil, water / antifreeze, etc. must be added to the appropriate levels.

Refer to the engine manufacturer's operation and maintenance manuals provided with this system for FILL procedures, fluid capacities and types.

## 5.4 EXTREME CONDITIONS

Extreme conditions occur when the pump has been operated during freezing weather or as a result of pumping from a water source that contains material that is harmful to the pump if not purged.

## During Freezing Weather

In freezing weather, drain the pump, throttle tubing and discharge lines after each use as follows:

1. Open all discharge and suction valves, remove suction tube caps and discharge valve caps.
2. Open pump body drain cocks.
3. After the pump is completely drained, replace all caps and close all valves.

## Salt Water, Contaminated Water, etc.

Flush the pump and suction hoses by using fresh, clean water from a CLEAN water source. Refer to company / department procedures for flushing the pump.

## 5.5 GENERAL MAINTENANCE

### Anode Check

Also see Figure 5-2: "Hale Anode."

Hale offers two types of anodes (consumables):

- ❑ Zinc anode - recommended for all pumps where corrosion is an issue, including brackish or salt water exposure. Zinc anodes should be inspected every twelve (12) months.
- ❑ Magnesium anode - available if the pump already uses zinc anodes and galvanic corrosion is still a concern.

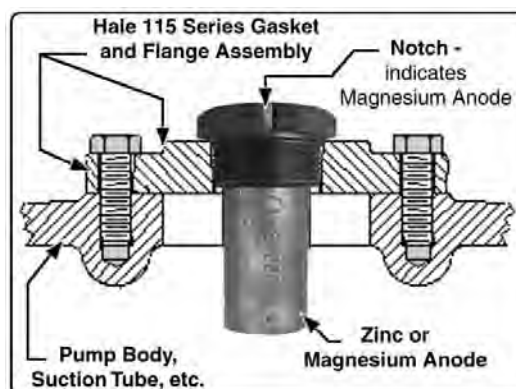


Figure 5-2: Hale Anode

Magnesium anodes, which are consumed at a faster rate, should be inspected ever three (3) or four (4) months. Magnesium anodes contain a notch in the hex head for identification.

Replace anodes when over 75% of the metal has been consumed. Performance of the anode life varies with water quality and pH. Anodes conform to MIL Spec. A180001.

## Battery Hydrometer Testing

1. Disconnect the negative (—) and positive (+) cables from the battery terminals. Always remove the negative (—) battery terminal first.
2. Using a hydrometer, check the specific gravity of each cell. All cells should have a specific gravity of 1.250 with no more than a 0.50 variation between any two cells.

If the specific gravity is LESS than 1.225 or varies by more than 0.50 between any two cells, replace the battery.

3. Connect the battery terminals to a load test instrument and place the battery under a simulated starting load. The meter should read approximately nine (9) volts or more when the simulated load is applied.

If the meter does not read 9 volts, replace the battery.



### IMPORTANT !

DISPOSE OF THE USED BATTERY IN ACCORDANCE WITH YOUR LOCAL ENVIRONMENTAL ORDINANCES.

4. Reconnect the battery to the system, always connecting the negative (—) terminal last. Also see Figure 3-1: “Battery Layout” on page 33.

## Exhaust Primer

The exhaust primer should be cleaned after one hundred (100) hours of operation or when pump priming appears sluggish.



Also review heading “WARNING !” on page 49.

1. Place the HP system on a clean, level work surface and provide access to the exhaust primer.
2. Disconnect the negative (—) battery terminal to prevent accidental system starting.



3. Unsnap and remove muffler heat shield.
4. Disconnect the primer cable from the actuating lever at the butterfly. (See Figure 5-3: "Exhaust Primer Service.") Also see Figure 3-7: "Exhaust Primer Connect" on page 39.
5. Remove the hex head screw and hardware that hold the exhaust valve assembly to the muffler.
6. Secure the assembly on a clean work surface with the ejector body facing up.
7. Remove the hex screws and separate the ejector body from the exhaust valve body.
8. Remove the check valve ball from the ejector body. Using a wire brush and tip cleaners, carefully remove carbon deposits from the ejector nozzle and check valve assembly.
9. Insert the check valve ball into the ejector body and reassemble by following the proceeding steps in reverse order.

**Figure 5-3: Exhaust Primer Service**

### Installation Notes

- ☐ Always install "new" gaskets
- ☐ Use proper thread sealant on all screws
- ☐ Make sure priming lever on instrument panel moves freely.  
If lever does not move freely, the cable may be dirty or damage. Clean and/or replace accordingly.
- ☐ Replace heat shield on the muffler and snap closed.

### Hoses Fittings and Tubes

1. Clean and check all hoses, fittings and tubes for signs of cracking, kinks, stripped threads or leaking seals, deterioration, etc.

2. Hoses should have uniform bends. If any are kinked or collapsed or feel soft in areas, they should be replaced.
3. Fittings and clamps should be tight, but not over tightened. Use thread sealant, such as Loctite #242 Medium Strength Threadlock (or equivalent). For pipe threads, apply Loctite teflon pipe sealant (or equivalent).

## **Intake Strainers**

Check and clean any debris from the intake strainer. Flush the pump, if required, using departmental / company procedures. Repair or replace any damaged strainers.

## **Leak Test**

A leak test of the pumping system must be performed yearly. The test is to be conducted at the pumps working pressure. Always follow your local / departmental test procedures.

## **Pipe Threads, Discharge**

Lubricate the discharge threads with a light coat of a good grade, lithium base grease.

## **Pump**

Except for draining the casing during freezing weather, the pump requires only an occasional cleaning.

## **Spark Arrestor Screen**

The engine muffler is equipped with a spark arrestor screen assembly. The screen must be inspected for deterioration, clogging, or other damage every fifty (50) hours of operation, or monthly, whichever occurs first.

**WARNING !**



**TO PREVENT ACCIDENTAL STARTING, BEFORE SERVICING THE ENGINE OR PUMP, ALWAYS DISCONNECT THE NEGATIVE (—) WIRE FROM THE BATTERY TERMINAL.**

**MAKE SURE THE MUFFLER AND PUMP HAVE COOLED BEFORE BEGINNING ANY SERVICE.**

**Note:** For Honda engine systems, see the engine manufacturer's Owner's Manual for detailed service instruction for Spark Arrestor.

1. Remove the heat shield from the muffler assembly to expose the exhaust primer assembly. (See Figure 5-4: "Spark Arrestor Servicing.")
2. Disconnect the negative (—) battery cable (BLACK).
3. Disconnect the primer tubing and cable.
4. Remove the three (3) bolts and hardware that mount the exhaust primer to the muffler. (See Figure 5-4: "Spark Arrestor Servicing," on page 56.)
5. Remove the exhaust primer assembly and gasket.
6. Remove the spark arrestor screen and gasket from the muffler. (See Figure 5-5: "Spark Arrestor Screen.")
7. Clean the screen assembly with a stiff wire brush. Inspect the screen for any damage or deterioration. Replace accordingly.
8. Install by following the proceeding steps in the reverse, remembering to:

**Figure 5-4: Spark Arrestor Servicing**

**Figure 5-5: Spark Arrestor Screen**

- Use "new" gaskets

- ☐ Torque the three bolts accordingly - see Table 7-1: "Typical Torque Values Chart" on page 69.
- ☐ Re-install the muffler heat shield.

## Spark Plug

1. A fouled, dirty or carboned spark plug causes hard starting and poor engine performance. Clean the spark plug using fine emery paper or wire brush and washing with a commercial solvent.



### CAUTION !

**DO NOT BLAST CLEAN THE SPARK PLUG. BLASTING MATERIAL COULD LODGE IN RECESSES OF THE PLUG AND EVENTUALLY WORK LOOSE, PERMANENTLY DAMAGING THE ALUMINUM BORE.**

2. Re-gap the plug to 0.030" (0.76 mm) (See Figure 5-6: "Re-Gap Spark Plug.")
3. For replacement, use:
  - ☐ Autocraft #3924
  - ☐ Champion #RC12YC

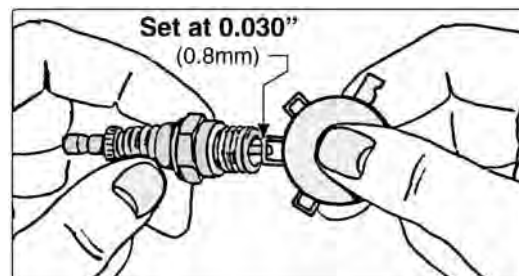


Figure 5-6: Re-Gap Spark Plug

## Valve Maintenance

Properly functioning valves are integral to the operation of the pump. Refer to the separate valve manual for proper valve maintenance procedures.

For example, lubricate all moving parts of the suction, discharge, hose drain, and multi-drain valves and valve linkage with a good grade, lithium base grease. For recommended grease, see "Appendix C1: Lube and Sealant Specifications" on page 95.

## Verify All Gauges are in Working Order

If your unit includes gauges, suction, discharge, etc., ensure they are functioning properly. Defective gauges must be removed from service and repaired and/or replaced.

## **Worn Clearance Ring(s) and Impeller Hub**

Clearance rings limit the internal bypass of water from the discharge side of the pump back to suction. The radial clearance between the impeller hub and the clearance rings is only a few thousandths of an inch when new. In clear water, the clearance rings continue to effectively seal for many years of operation.

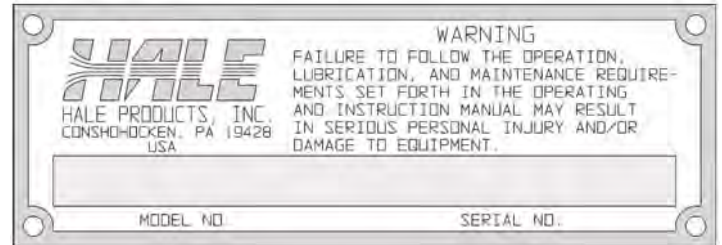
In dirty or sandy water, the impeller hub and clearance rings wear faster. The more wear, the greater the bypass and lower pump performance.

It should not be necessary to replace clearance rings until a loss in pump performance is noticed during the annual test. For clearance ring and impeller service, see heading “Pump Repair” on page 72.

Often, replacing the clearance rings reduces the bypass and restores the pump to near original performance. A complete restoration requires that the impeller also be replaced. See Section 7b “HP75 / HP100 Gearbox” on page 81 for maintenance and repair information if pump disassembly is required.

## 6 Troubleshooting

Table 6-2 lists conditions, possible causes and suggested corrective action measures. Before calling Class1 or your Class1 authorized parts service center for assistance, eliminate problem causes using the following table.



**Figure 6-1: Sample, Serial Nameplate**

If you cannot correct a problem, please have the following information prior to calling the Class1 Customer Service for assistance. Contact Customer Service at telephone number: **352-629-5020**.

- HP model and serial numbers - see Figure 6-1: “Sample, Serial Nameplate” on page 59. For your convenience, fill in the information on the nameplate above.
- Observed symptoms and under what conditions the symptoms occur

**Note:** The serial and model numbers are found on the engine identification plate attached to the engine.

| Condition                            | Possible Cause                                                                                                                                                                                                                                                                                                                   | Suggested Corrective Action                                                                                                                                                                                                                                                                                      |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENGINE TROUBLESHOOTING</b>        |                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                  |
| <b>Starter handle will not pull.</b> |                                                                                                                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Place the HP portable unit on a level surface.</li> <li>See Section 4 Operation, heading “Recoil Starting” on page 45.</li> <li>If condition persists, disassemble pump from engine to isolate the defective part.</li> <li>Repair and/or replace accordingly.</li> </ul> |
|                                      | <div style="text-align: center;"> <b>WARNING !</b><br/> <b>RAPID RETRACTION OF STARTER CORD (KICKBACK) WILL PULL HAND AND ARM TOWARD ENGINE FASTER THAN YOU CAN LET GO. BROKEN BONES, FRACTURES, BRUISES OR SPRAINS COULD RESULT. WHEN STARTING ENGINE, PULL CORD SLOWLY UNTIL RESISTANCE IS FELT, THEN PULL RAPIDLY.</b> </div> |                                                                                                                                                                                                                                                                                                                  |
| <b>Engine will not start.</b>        | Battery discharged<br><br><i>Chart continued on next page.</i>                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Recharge battery and hydrometer test.</li> <li>See Section 5 Preventive Maintenance, heading “Battery Hydrometer Testing” on page 53.</li> </ul>                                                                                                                          |

**Figure 6-2: Troubleshooting Chart**

| Condition                                 | Possible Cause                                                                                                                                                                                                                                                                                                                                                                                                                                                | Suggested Corrective Action                                                                                                                                                                                                                                                                            |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENGINE TROUBLESHOOTING - continued</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                        |
| <b>Engine will not start - continued.</b> | Fuse burned out, if included.                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>• Replace fuse.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                            |
|                                           | No fuel in tank.                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>• Fill tank. See Section "Adding Fuel" on page 39.</li> </ul>                                                                                                                                                                                                   |
|                                           | Bad fuel — engine stored without treating or draining gasoline, or refueled with bad gasoline (possible water in fuel).                                                                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• Drain fuel tank and carburetor and refuel with fresh, clean gasoline.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> <li>• Also see Section 3 Preparation, heading "Adding Fuel" on page 39.</li> </ul>       |
|                                           | LOW engine oil level.                                                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Add oil.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                 |
|                                           | LOW gearbox oil level.                                                                                                                                                                                                                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>• Add oil.</li> <li>• See Section 3, heading 3.6 "Gearbox Oil (HP100 Series)" on page 41.</li> </ul>                                                                                                                                                            |
|                                           | <div style="text-align: center;">  <b>CAUTION !</b>  </div> <p><b>THE ENGINE IS SHIPPED FROM THE FACTORY WITHOUT OIL. IF YOU START THE ENGINE WITHOUT OIL THE ENGINE WILL BE DAMAGED BEYOND REPAIR AND IS NOT COVERED BY WARRANTY. SEE SECTION 3.2 "FLUID LEVELS" ON PAGE 31.</b></p> |                                                                                                                                                                                                                                                                                                        |
|                                           | Gasoline shut-off valve closed.                                                                                                                                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• Open shut-off valve and start engine.</li> </ul>                                                                                                                                                                                                              |
|                                           | Engine switch OFF.                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• Turn engine switch ON and restart.</li> <li>• Also see Section 4 Preventive Maintenance, heading "Startup" on page 43.</li> </ul>                                                                                                                             |
|                                           | Fuel line or fuel filter clogged.                                                                                                                                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>• Clean fuel line and replace fuel filter. See engine manufacturer's operation and maintenance manual / Owner's Manual provided.</li> <li>• Also check fuel lines, tank cap and fittings for leaks or cracks - repair and/or replace accordingly.</li> </ul>    |
|                                           | Engine flooded.                                                                                                                                                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• Set the choke (if equipped) to OPEN / RUN position.</li> <li>• Continue to pull starter handle. See Section 4 Operation, heading "Recoil Starting" on page 45.</li> <li>• Also see Section 4 Preventive Maintenance, heading "Startup" on page 43.</li> </ul> |
|                                           | Spark plug shorted or faulty.                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>• Install new spark plug. See Section 5 Preventive Maintenance, heading "Spark Plug" on page 57.</li> </ul>                                                                                                                                                     |
| <i>Chart continued on next page.</i>      |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                        |

**Figure 6-2: Troubleshooting Chart**



| Condition                                     | Possible Cause                                              | Suggested Corrective Action                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENGINE TROUBLESHOOTING - continued</b>     |                                                             |                                                                                                                                                                                                                                                                                                                                                          |
| <b>Engine will not start - continued.</b>     | Spark plug broken (cracked porcelain or electrodes broken). | <ul style="list-style-type: none"> <li>• Install new spark plug. See Section 5 Preventive Maintenance, heading "Spark Plug" on page 57.</li> <li>• See engine manufacturer's operation and maintenance manual / Owner's Manual provided.</li> </ul>                                                                                                      |
|                                               | Engine over or under choked.                                | <ul style="list-style-type: none"> <li>• If over choked, or flooded - see "Engine flooded." on page 60.</li> <li>• If under choked, move the lever to the closed position and crank the engine two or three times.</li> </ul>                                                                                                                            |
|                                               | Malfunctioning carburetor, ignition or sticking valves.     | <ul style="list-style-type: none"> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> <li>• All engine related service and parts requests should first be directed to the engine manufacturer. If additional information is needed, contact Class1 Customer Service at telephone number: 352-629-5020.</li> </ul> |
| <b>Engine misses runs rough or is smoking</b> | Dirt in fuel line or carburetor.                            | <ul style="list-style-type: none"> <li>• Clean carburetor and fuel line.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                            |
|                                               | Carburetor out of adjustment.                               | <ul style="list-style-type: none"> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                                                                       |
|                                               | Defective spark plug or gap setting.                        | <ul style="list-style-type: none"> <li>• Clean and/or replace spark plug.</li> <li>• Set gap at 0.30" (0.8 mm).</li> <li>• See Section 5 Preventive Maintenance, heading "Spark Plug" on page 57.</li> </ul>                                                                                                                                             |
|                                               | Dirty air cleaner.                                          | <ul style="list-style-type: none"> <li>• Clean or replace air filter.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                               |
| <b>Engine lacks power.</b>                    | Air cleaner clogged.                                        | <ul style="list-style-type: none"> <li>• Clean or replace air filter.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                               |
|                                               | Carburetor out of adjustment.                               | <ul style="list-style-type: none"> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                                                                       |
|                                               | Muffler clogged.                                            | <ul style="list-style-type: none"> <li>• Clean carbon from muffler / spark arrestor screen.</li> <li>• See Section 5 Preventive Maintenance, heading "Spark Arrestor Screen" on page 55.</li> </ul>                                                                                                                                                      |
|                                               | Clogged exhaust ports.                                      | <ul style="list-style-type: none"> <li>• Remove muffler and clean carbon deposits — see "Muffler clogged." on page 61.</li> </ul>                                                                                                                                                                                                                        |

*Chart continued on next page.*

**Figure 6-2: Troubleshooting Chart**

| Condition                                  | Possible Cause                                               | Suggested Corrective Action                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENGINE TROUBLESHOOTING - continued</b>  |                                                              |                                                                                                                                                                                                                                                                                                                                              |
| <b>Engine lacks power - continued.</b>     | Poor compression.                                            | <ul style="list-style-type: none"> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> <li>• Contact factory or nearest Class1 dealer for service.</li> </ul>                                                                                                                                          |
|                                            | Low engine oil.                                              | <ul style="list-style-type: none"> <li>• Add oil.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                                       |
| <b>Engine overheats.</b>                   | Low gearbox oil.                                             | <ul style="list-style-type: none"> <li>• Add oil.</li> <li>• Also see Section 3 Preparation, heading "To Fill or Check Oil Level" on page 41.</li> </ul>                                                                                                                                                                                     |
|                                            | Air flow obstructed.                                         | <ul style="list-style-type: none"> <li>• Clean flywheel, cylinder fins and screen.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                      |
|                                            |                                                              |                                                                                                                                                                                                                                                                                                                                              |
| <b>Engine noisy or knocking.</b>           | Loose flywheel.                                              | <ul style="list-style-type: none"> <li>• Tighten and torque flywheel nut.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                               |
|                                            | Incorrect spark plug installed (wrong heat range for plug).  | <ul style="list-style-type: none"> <li>• Install correct type spark plug.</li> <li>• Clean and/or replace spark plug.</li> <li>• Set gap at 0.30" (0.8 mm).</li> <li>• See Section 5 Preventive Maintenance, heading "Spark Plug" on page 57.</li> </ul>                                                                                     |
|                                            | Worn bearings, piston rings or cylinder walls.               | <ul style="list-style-type: none"> <li>• All engine related service and parts requests should first be directed to the engine manufacturer. If additional information is needed, contact Class1 Customer Service at telephone number: 352-629-5020.</li> </ul>                                                                               |
|                                            | Bent fan housing.                                            | <ul style="list-style-type: none"> <li>• Remove fan housing - repair and/or replace.</li> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                    |
| <b>Engine "stalls" under load.</b>         | Carburetor main adjustment too "lean."                       | <ul style="list-style-type: none"> <li>• See Engine Manufacturer's Operation and Maintenance / Owner's Manual provided.</li> </ul>                                                                                                                                                                                                           |
|                                            | Engine is overheating.                                       | <ul style="list-style-type: none"> <li>• See previous heading "Engine overheats." on page 62.</li> </ul>                                                                                                                                                                                                                                     |
| <b>PUMP and GEARBOX TROUBLESHOOTING</b>    |                                                              |                                                                                                                                                                                                                                                                                                                                              |
| <b>Pump Loses Prime or Will Not Prime.</b> | Inoperative priming system or possible clogged priming pump. | <p><b>Note:</b> Using lubricant on the vanes and vane slots during disassembly and cleaning eventually causes a gummy residue to develop, rendering the system inoperative. <b>DO NOT LUBRICATE VANES AND VANE SLOTS.</b></p> <p><b>Note:</b> For units equipped with separate priming pump.</p> <p><i>Chart continued on next page.</i></p> |

Figure 6-2: Troubleshooting Chart

| Condition                                              | Possible Cause                                                                                                                                                                                                                                                                                                                                                                                                  | Suggested Corrective Action                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PUMP and GEARBOX TROUBLESHOOTING - continued</b>    |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                  |
| <b>Pump Loses Prime or Will Not Prime - continued.</b> | Discharge not closed.                                                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>The discharge must be closed with either a discharge valve, shut-off nozzle or by pinching the discharge hose (use a pinch clamp if available).</li> </ul>                                                                                                                                |
|                                                        | Suction lifts too high.                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>DO NOT attempt lifts exceeding 22' (6.7 meters) except at low elevation.</li> </ul>                                                                                                                                                                                                       |
|                                                        | Blocked or restricted suction strainer.                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Remove obstruction from suction hose strainer.</li> <li>Thoroughly clean strainer screen.</li> </ul>                                                                                                                                                                                      |
|                                                        | Suction connections.                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>Clean and tighten all suction connections.</li> <li>Check suction hose and hose gaskets for possible defects - repair and/or replace.</li> </ul>                                                                                                                                          |
|                                                        | Air trapped in suction line.                                                                                                                                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Avoid placing any part of the suction hose higher than the suction intake.</li> <li>Suction hose should be laid out with continuous decline to fluid supply.</li> <li>If trap in hose is unavoidable, repeated priming may be needed to eliminate air pockets in suction hose.</li> </ul> |
|                                                        | Insufficient priming (unsteady stream is discharged).                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Proper priming procedures should be followed.</li> <li>Do not release the primer control before assuring a complete prime.</li> <li>Open the discharge valve slowly during completion of prime to ensure complete prime.</li> </ul>                                                       |
|                                                        | <div style="text-align: center;">  <b>NOTICE !</b>  </div> <p><b>DO NOT RUN THE PRIMER OVER FORTY-FIVE (45) SECONDS. IF PRIME IS NOT ACHIEVED WITHIN 45 SECONDS, STOP AND LOOK FOR CAUSES (AIR LEAKS OR BLOCKED SUCTION HOSES).</b></p> |                                                                                                                                                                                                                                                                                                                                  |
|                                                        | Pump pressure too low when nozzle is opened.                                                                                                                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Prime pump again and maintain higher pump pressure while opening the discharge valve slowly.</li> </ul>                                                                                                                                                                                   |
| <b>Insufficient Pump Capacity.</b>                     | Air leaks.                                                                                                                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Attempt to locate and correct air leaks.</li> <li>Audible detection of a leak is often possible.</li> </ul>                                                                                                                                                                               |
|                                                        | Insufficient engine power.                                                                                                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Engine power check may be required for peak engine and pump performance.</li> <li>See previous heading "Engine lacks power." on page 61.</li> </ul>                                                                                                                                       |
|                                                        | Suction hose diameter is too small for the volume being discharged.                                                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>Use larger suction hose.</li> <li>Shorten total length by removing one length at a time.</li> <li>Reduce volume of discharge.</li> </ul>                                                                                                                                                  |

*Chart continued on next page.*
**Figure 6-2: Troubleshooting Chart**

| Condition                                                        | Possible Cause                                    | Suggested Corrective Action                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PUMP and GEARBOX TROUBLESHOOTING - continued</b>              |                                                   |                                                                                                                                                                                                                                                                                                                                                               |
| <b>Insufficient Pump Capacity - continued.</b>                   | Restriction in suction line at strainer.          | <ul style="list-style-type: none"> <li>Remove any debris restricting entrance of water at the strainer.</li> <li>See Section 5 Preventive Maintenance, heading "Intake Strainers" on page 55.</li> </ul>                                                                                                                                                      |
|                                                                  | Air leaks.                                        | <ul style="list-style-type: none"> <li>See heading "Air leaks." under condition " Pump Loses Prime or Will Not Prime" on page 63.</li> </ul>                                                                                                                                                                                                                  |
|                                                                  | Partial collapse of the lining in a suction hose. | <ul style="list-style-type: none"> <li>Damage to the outer lining may allow air between the outer and inner linings causing a partial collapse.</li> <li>Replace hose and retest.</li> </ul>                                                                                                                                                                  |
| <b>Insufficient Pressure.</b>                                    | Insufficient engine power.                        | <ul style="list-style-type: none"> <li>See previous heading "Insufficient Pump Capacity." on page 63.</li> </ul>                                                                                                                                                                                                                                              |
| <b>Engine Speeds Too HIGH for Required Capacity or Pressure.</b> | Lift too high, suction hose too small.            | <ul style="list-style-type: none"> <li>Higher than normal lift (10 ft. / 3.1m) causes higher engine speeds, high vacuum and rough operation.</li> <li>Use larger suction hose.</li> </ul>                                                                                                                                                                     |
|                                                                  | Faulty suction hose.                              | <ul style="list-style-type: none"> <li>Inner lining of suction hose may collapse when drafting and is usually undetectable.</li> <li>Try a different suction hose on the same pump.</li> <li>Test for comparison against original hose.</li> </ul>                                                                                                            |
|                                                                  | Blockage at suction hose entry.                   | <ul style="list-style-type: none"> <li>Clean suction hose strainer of obstruction. See Section 5 Preventive Maintenance, heading "Intake Strainers" on page 55.</li> <li>Follow recommended practices for laying suction hose.</li> <li>Keep off the bottom of the fluid supply by at least 2' (0.6 meters) below the surface of the water source.</li> </ul> |
|                                                                  | Pump is approaching "Cavitation."                 | <ul style="list-style-type: none"> <li>Gate the discharge valves to allow pressure to increase. This reduces the flow.</li> <li>Reduce the throttle opening to the original pressure setting.</li> <li>See "Appendix F: Cavitation" on page 101.</li> </ul>                                                                                                   |
|                                                                  | Worn pump impeller(s) or clearance rings.         | <ul style="list-style-type: none"> <li>Repair and/or replace as needed.</li> <li>See heading "Repair" on page 67.</li> </ul>                                                                                                                                                                                                                                  |
|                                                                  | Impeller blockage.                                | <ul style="list-style-type: none"> <li>A blocked impeller can prevent loss of both capacity and pressure.</li> <li>Back flushing the pump from discharge to suction may free the blockage.</li> <li>Removing the pump body may be necessary - this is considered a major repair.</li> </ul>                                                                   |

*Chart continued on next page.*

**Figure 6-2: Troubleshooting Chart**

| Condition                                           | Possible Cause                                                       | Suggested Corrective Action                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PUMP and GEARBOX TROUBLESHOOTING - continued</b> |                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Cavitation</b><br>(Pump beginning to cavitate.)  | Discharging more water than the pump is taking in.                   | <ul style="list-style-type: none"> <li>• Increase the flow into the pump with more and/or larger intake lines.</li> <li>• Gate the discharge valves to reduce flow and maintain pressure.</li> </ul> <b>Note:</b> Also see "Appendix F: Cavitation" on page 101.                                                                                                                                            |
|                                                     | Air leak.                                                            | <ul style="list-style-type: none"> <li>• Locate and eliminate all air leaks.</li> <li>• See heading "Air leaks." on page 63.</li> </ul>                                                                                                                                                                                                                                                                     |
|                                                     | Drafting too high.                                                   | <ul style="list-style-type: none"> <li>• Verify that lift hose, hose friction, water temperature and other lift limiting factors are reduced or eliminated.</li> </ul>                                                                                                                                                                                                                                      |
|                                                     | Water temperature too high.                                          | <ul style="list-style-type: none"> <li>• Reduce volume discharge by lowering the RPM or gating the discharge valves.</li> </ul>                                                                                                                                                                                                                                                                             |
|                                                     | Suction hoses diameter is too small for the volume being discharged. | <ul style="list-style-type: none"> <li>• Use a large suction hose.</li> <li>• Shorten the total length by removing one length of hose.</li> <li>• Reduce volume of discharge.</li> </ul>                                                                                                                                                                                                                    |
|                                                     | Restriction in suction line at strainer.                             | <ul style="list-style-type: none"> <li>• Remove any debris restricting entrance of water at the strainer.</li> <li>• See heading "Intake Strainers" on page 55.</li> </ul>                                                                                                                                                                                                                                  |
| <b>Discharge Valves Are Difficult to Operate.</b>   | Lack of lubrication.                                                 | <ul style="list-style-type: none"> <li>• Recommended weekly lubrication of discharge and suction valve.</li> <li>• Use a good grade, petroleum based, silicone grease.               <ul style="list-style-type: none"> <li>• For Hale Products, SVS Valves, etc., use Never-Seez® White Food Grade with PTFE.</li> </ul> </li> <li>• Refer to separate valve manual for additional information.</li> </ul> |
|                                                     | Valve in need of more clearance for operation.                       | <ul style="list-style-type: none"> <li>• Multi-gasket design allows additional gaskets for more clearance and free operation.               <ul style="list-style-type: none"> <li>• <b>Note:</b> Adding too many gaskets to the valve eventually causes leakage.</li> </ul> </li> </ul>                                                                                                                    |
| <b>Water/Moisture in Pump Gearbox.</b>              | Leak coming from above the pump.                                     | <ul style="list-style-type: none"> <li>• Check all piping connections and tank overflow for possible spillage falling directly onto the pump gearbox.</li> <li>• Repair accordingly.</li> </ul>                                                                                                                                                                                                             |
|                                                     | Submerging the gearbox in water.                                     | <ul style="list-style-type: none"> <li>• Visually inspect the unit for external signs of water leakage.</li> <li>• Was the unit submerged in water? Does your unit include an air vent / breather where water can enter if submerged? If so, change oil.</li> <li>• Also see Section 4 Preventive Maintenance, heading "Replace Gearbox Oil" on page 50.</li> </ul>                                         |

*Chart continued on next page.*

**Figure 6-2: Troubleshooting Chart**

| Condition                                           | Possible Cause                       | Suggested Corrective Action                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PUMP and GEARBOX TROUBLESHOOTING - continued</b> |                                      |                                                                                                                                                                                                                                                                                                                                        |
| <b>Water/Moisture in Pump Gearbox - continued.</b>  | Normal condensation.                 | <ul style="list-style-type: none"> <li>Depending on area / region where unit is operated, normal condensation can develop over time.</li> <li>Periodic inspection and possibly more frequent oil changes are needed.</li> </ul>                                                                                                        |
|                                                     | Leaking oil seal or mechanical seal. | <ul style="list-style-type: none"> <li>Inspect the oil seals and replace as needed. If the oil seal checks OK, the mechanical seal may be leaking.</li> <li>There must be NO leaks at the mechanical seal. See Section 7a "Mechanical Seal Assembly" on page 77.</li> <li>Hydrostatic test the system to determine leakage.</li> </ul> |

### Figure 6-2: Troubleshooting Chart

## Notes

[illegible]

## 7 Repair

### 7.1 OVERVIEW

This section describes the removal, inspection, and reinstallation (as required for maintenance and repair) of the Class1 pump and gearbox components. Follow the disassembly instructions in the order in which they appear in this section. At any point in the disassembly process, the unit can be reassembled by following the instructions in the reverse.

Service should be performed by a trained and qualified service technician, or your authorized Class1 service representative. Be sure you have sufficient knowledge, experience and the proper tools.

*Wherever there is a requirement for new parts, it is recommended to use only CLass1 authorized replacement parts for optimum safety of the equipment and its operators and to limit "downtime."*

### 7.2 ENGINE ASSEMBLY

Servicing the engine of the HP Series Trans-Portable System is detailed in the engine manufacturer's Operation and Service Manual / Owner's Manual, provided with each system.

**All engine related service and parts requests should first be directed to the engine manufacturer. If additional information is needed, contact Class1 Customer Service at telephone number: 352-629-5020.**

### 7.3 GENERAL REPAIR GUIDELINES

#### Before You Begin...

For a parts breakdown and identification, see Section 8, heading "Drawing Package and" on page 107.



**READ ALL INSTRUCTIONS THOROUGHLY  
BEFORE BEGINNING ANY SERVICE REPAIR.**



## WARNINGS !



- **BEFORE PERFORMING ANY SERVICE MAINTENANCE OR REPAIR, COMPLETELY REVIEW THE SAFETY SECTION OF THIS MANUAL, BEGINNING ON PAGE 9.**
  - **ALSO REVIEW THE ENGINE MANUFACTURER'S MANUAL / OWNERS MANUAL FOR ENGINE MAINTENANCE PROCEDURES.**
  - **TO PREVENT ACCIDENTAL STARTING, BEFORE SERVICING THE ENGINE OR PUMP ALWAYS DISCONNECT THE NEGATIVE (—) WIRE (BLACK) FROM THE BATTERY TERMINAL.**
  - **BEFORE WORKING ON THE PUMP, DISCONNECT SUCTION AND DISCHARGE PIPING AND DRAIN THE PUMP.**
  - **THE PUMP AND GEARBOX ASSEMBLY (IF INCLUDED) CAN BE HEAVY AND BULKY. ADDING ACCESSORIES ALSO INCREASES THE WEIGHT. CHECK YOUR BILL OF LADING FOR THE APPROXIMATE WEIGHT. BE CERTAIN TO USE PROPER LIFTING SUPPORT DEVICES (I.E., OVERHEAD CRANE, JACK, CHAINS, STRAPS, ETC.) CAPABLE OF HANDLING THE LOAD WHEN REMOVING OR INSTALLING THE PUMP AND GEARBOX ASSEMBLY. EXERCISE CARE WHEN USING CHAINS TO PROTECT THE FINISHED SURFACES FROM SCRATCHES.**
  - **BE SURE TO WEAR SAFETY GLASSES WHEN REMOVING AND/OR INSTALLING FORCE (PRESS) FITTED PARTS. FAILURE TO COMPLY MAY RESULT IN SERIOUS EYE INJURY.**
  - **ALL FASTENERS ON THE PUMP AND GEARBOX ASSEMBLY ARE SELECTED FOR THEIR APPLICATION. CLASS1 DOES NOT RECOMMEND REPLACING FASTENERS WITH ANYTHING OTHER THAN CLASS1 PART NUMBERS PROVIDED. REPLACING WITH A WEAKER ALTERNATIVE POSES A SERIOUS SAFETY RISK.**
  - **ALL FASTENERS MUST BE INSTALLED WITH A LOCKING ANAEROBIC ADHESIVE/SEALANT, SUCH AS LOCTITE® #246 FOR GEARBOX AND #242 FOR PUMP.**
1. Place HP system out of service in accordance with your departmental procedures. Place the pumping unit on a level, stable work surface.
  2. Match mark, tag and/or note, or photograph the orientation of all mechanical and electrical components and connections to the pump and/or gearbox before disassembly. This aids in proper reassembly.
  3. Remove valve operators, discharge and suction piping and valves that interfere with pump removal.
- Have clean disposable shop rags and oil dry handy.

4. Disconnect cooling tubes from the water manifold and pump, air lines, electrical switches, etc. as required.
5. When required, use a Lithium-based grease with 1% to 3% Molybdenum Disulfate. For a listing, see "Appendix C1: Lube and Sealant Specifications" on page 95.
6. When replacing fasteners, use the proper nuts, bolts, and other hardware. Many are specifically rated; that is, SAE Grade 5 or higher. Unless otherwise specified, fasteners are Grade 5 SAE.

Also ensure screws/bolts are properly torqued. (See Table 7-1: "Typical Torque Values Chart.")

| Bolt Size<br>Lock Nut size | Material                                | Minimum Torque<br>Ft.-Lb. (N-m) |
|----------------------------|-----------------------------------------|---------------------------------|
| 5/16"18                    | Zinc-plated steel                       | 17 (23)                         |
| 5/16"18                    | Zinc-plated steel, with 360° nylon lock | 19 (26)                         |
| 5/16"18                    | Silicon bronze                          | 10.3 (14)                       |
| 3/8"16                     | Zinc-plated steel                       | 30 (41)                         |
| 3/8"16                     | Zinc-plated steel, with 360° nylon lock | 33 (45)                         |
| 3/8"16                     | Silicon bronze                          | 18 (24)                         |
| 7/16"14                    | Zinc-plated steel                       | 50 (68)                         |
| 7/16"14                    | Zinc-plated steel, with 360° nylon lock | 53 (72)                         |
| 7/16"14                    | Silicon bronze                          | 29 (39)                         |
| 5/8"-11                    | Zinc-plated steel                       | 150 (203)                       |
| 5/8"-11                    | Silicon bronze                          | 85 (115)                        |
| 3/4"-10                    | Zinc-plated steel, Grade 5              | 260 (353)                       |
| 3/4"-10                    | Zinc-plated steel, Grade 8              | 380 (515)                       |

**Table 7-1: Typical Torque Values Chart**

**Gearbox, if included** - Apply Loctite #246 High Temperature Removable Threadlock (or equivalent) to all bolts on the gearbox.

**Class1 Series Pump** - Apply Loctite #242 Medium Strength Threadlock (or equivalent) to all bolts on the Pump.

7. Before installing the mechanical seal, use alcohol swabs provided by Class1 to clean all grease or oil from the pump shaft and mechanical seal running faces. Apply a generous coating of Pac-Ease Rubber Lubricant Emulsion (or equivalent) on the rubber seal parts to ease installation.

**WARNING !**



**DO NOT TOUCH THE CARBON SEAL WHILE INSTALLING THE MECHANICAL SEAL. USE OF ANY OTHER LUBRICANT CAN DAMAGE THE MECHANICAL SEAL AND SEAT.**

8. Use a pusher or bearing installation tool when installing bearings and seals to avoid cocking them or marking their faces. Also review heading “Bearings” on page 71.
9. Before placing system into operation, the pump assembly must be tested and checked for leaks.

**Gearbox Assembly (HP75 and HP100)**

1. Drain oil from the gearbox. Also see Section 5 Preventive Maintenance, heading “Replace Gearbox Oil” on page 50.
2. Have clean disposable shop rags and oil dry handy and a suitable container to collect the fluid. For gearbox capacity, see “Appendix C1: Lube and Sealant Specifications” on page 95.
3. For gearbox disassembly, see heading “Gearbox” on page 76.

## **7.4 CLEANING AND INSPECTION GUIDELINES**

1. Inspect all components (bearings, seals, gears, etc.) for excessive or abnormal wear, i.e., pitting, scoring / scratches, cracks, splits, etc.

**IMPORTANT !**



**WHEN REASSEMBLING, ALL COMPONENTS MUST BE CLEAN AND FREE OF DEFECTS.**

2. Replace O-ring seals and gaskets whenever they are removed to avoid unnecessary downtime later.
3. Clean all gasket material from mating surfaces before installing a new gasket. Be careful not to score the machined surfaces.

Install new gaskets and apply a light coat of grease to the gasket to hold it in place. Where applicable, trim gaskets to match the contour of the matching part.

4. Lightly oil or grease the shaft, O-ring seals and lip seals with a coating of general-purpose grease before reinstalling, especially when parts are pressed-in.
5. For recommended cleaners, see "Appendix C1: Lube and Sealant Specifications" on page 95.
6. Replace any hardware that shows signs of excessive wear.

## Bearings

Bearings and other components should be cleaned using only recommended solvents.

Bearings must always be replaced in matching sets by manufacturer.



### IMPORTANT !

WHEN REPLACING TAPERED BEARINGS, IT IS IMPORTANT THAT YOU DO NOT INTERCHANGE BEARING MANUFACTURER'S COMPONENTS. THE BEARING RACE AND CONE MUST ALWAYS BE REPLACED IN MATCHING SETS, AS SUPPLIED BY THE MANUFACTURER.

## Tools Required

- ☐ Lifting gear-lever hoist or chain hoist, and short choker
- ☐ Ball peen hammer
- ☐ Center punch
- ☐ Drift punch
- ☐ Allen wrenches
- ☐ Strap wrench
- ☐ Snap ring pliers
- ☐ Pry bars (2)
- ☐ Ratchets and wrenches for disassembly
- ☐ Torque wrench capable of 40, 65, and 135 ft.-lbs. (54, 88, and 183 N-m)
- ☐ Pan (to collect drip oil)
- ☐ Disposable rags

- ❑ Oil dry
- ❑ Wedges
- ❑ Bearing puller
- ❑ Pusher tube (a small section of PVC tubing to fit over the shaft)
- ❑ N-06 or N-07 bearing nut socket or spanner wrench, available from:

**Whittet-Higgins** at [www.whittet-higgins.com](http://www.whittet-higgins.com) or,

35 Higginson Avenue

P O Box 8

Central Falls, RI 02863

Phone ..... (401) 728-0700

## 7.5 PUMP REPAIR

1. Review heading “Before You Begin...” on page 67. Also review heading “Cleaning and Inspection Guidelines” on page 70.
2. Match mark the volute and gearbox half to ensure proper re-alignment during reassembly.
3. Support the pump head (volute) using an overhead crane and strap to prevent injury and damage to the clearance ring(s) and impeller when the V-clamp is loosened. Exercise care when using chains to protect finished surfaces from scratches.
4. Remove the V-clamp securing the volute to the pump head (or pump side gearbox housing).
  - ❑ For volute vs. pump head disassembly, see Figure 2-9: “Typical HP200 / HP300 / HP400 Pump Assembly” on page 30.
  - ❑ For volute vs. gearbox disassembly, see Figure 2-8: “Typical HP75 / HP100 Pump and Gearbox Assembly” on page 29.
5. Separate the volute from the pump head being careful not to damage the impeller and clearance ring(s).

### IMPORTANT !



DO NOT DAMAGE THE BRASS CLEARANCE RINGS OR IMPELLER AS YOU SEPARATE THE VOLUTE FROM THE PUMP BODY. THE IMPELLER, CLEARANCE RING(S) AND MECHANICAL SEAL ASSEMBLY NEED NOT BE REMOVED.

6. Inspect the clearance ring(s), located in the volute (and pump head), for wear and replace accordingly - see heading "Clearance Ring(s)" on page 74.
7. To remove the clearance ring, see heading "Clearance Ring(s)" on page 74.
8. While holding the impeller with a strap wrench, remove the impeller screw and washer.
  - For **HP75 and HP100** gearbox units, impeller screw - 3/8"-24
  - For **HP200 - HP400** units, impeller screw - M10
9. Remove the impeller by placing hardwood wedges on each side of the impeller, between the impeller and the pump head. The wedges should bear against the impeller disk, directly behind the impeller vanes, to prevent damage. (See Figure 7-2: "Placing Edges for Impeller Removal.")

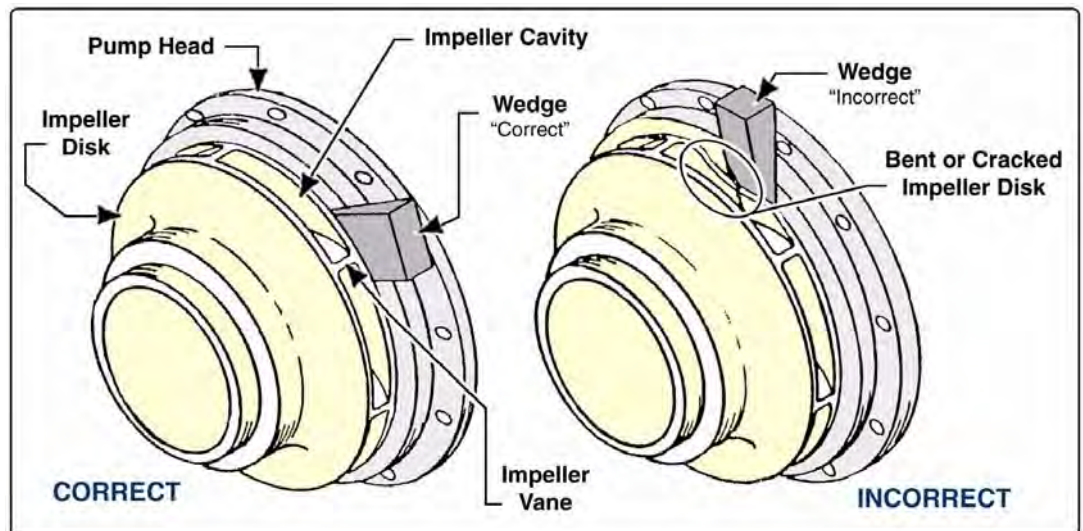


Figure 7-2: Placing Edges for Impeller Removal

10. Tap the end of the shaft with a soft headed mallet (rawhide, rubber, dead blow, etc.) while maintaining pressure with the wedges, until the impeller pops free.



### CAUTION !

**DO NOT STRIKE THE IMPELLER. IRREPARABLE DAMAGE COULD RESULT. MAKE CERTAIN THE WEDGES OR PULLER ARE PLACED AT THE IMPELLER VANES TO AVOID IRREPARABLE DAMAGE.**

11. Remove the impeller and impeller shaft key.
12. **HP200 - HP400 -**
  - Remove the mechanical seal assembly from the shaft. Also review heading “Mechanical Seal Assembly” on page 77.
  - Remove the impeller spacer
  - Remove the four (4) 3/8”-16 screws and sealing washers securing the pump head to the engine face.
13. **HP75 - HP100 -**
  - Remove the mechanical seal assembly from the shaft. Also review heading “Mechanical Seal Assembly” on page 77.
  - Remove the pump head from the pump shaft by pulling straight out. This exposes the oil seal for inspection and replacement - see heading “Pump Oil Seal (HP75 and HP100)” on page 76.
  - Remove the mechanical seal seat from within the pump head, see Figure 2-8: “Typical HP75 / HP100 Pump and Gearbox Assembly” on page 29.
  - To service the pump shaft assembly and gearbox assembly - see heading “Gearbox” on page 76.
14. Carefully clean and inspect all parts for excessive wear, chips, scoring or other damage. Replace all components that are worn, damaged, or pitted.

## Clearance Ring(s)

1. Inspect the clearance ring(s) for wear and replace accordingly - see heading “Worn Clearance Ring(s) and Impeller Hub” on page 58.
2. Clearance ring(s) are located -
  - **HP75 and HP100** - in the volute only
  - **HP200 through HP400** - one in the volute; one in the pump head

**Note:** Removing the clearance ring(s) renders it inoperative. It must be replaced. A usual good practice, if one ring requires replacement the other should be replaced as well. With the clearance installed, verify the impeller clearance - see heading “Worn Clearance Ring(s) and Impeller Hub” on page 58.



3. To remove the clearance ring(s), use a hammer and chisel to collapse the ring in the housing. Do not mar the sealing surface of the volute / pump head.

**WARNING !**

**BE SURE TO WEAR SAFETY GLASSES WHEN REMOVING AND/OR INSTALLING FORCE (PRESS) FITTED PARTS. FAILURE TO COMPLY MAY RESULT IN SERIOUS EYE INJURY.**

## Installation Notes

To install the volute, pump head and impeller, follow the preceding steps in the reverse order, paying attention to the following:

- Review preceding sections “Before You Begin...,” on page 67 and “Cleaning and Inspection Guidelines,” on page 70.
- Make sure a new O-ring is seated in its groove of the pump head and apply light coat of grease.
- Ensure the mechanical seal seat is properly seated within the pump head - see heading “Mechanical Seal Assembly” on page 77.
- If the clearance ring is removed, use a press to install it into the volute being careful not to crush or damage the ring (for HP75 and HP100 series).

Verify the inside diameter of the ring - see heading “Worn Clearance Ring(s) and Impeller Hub” on page 58.

- Align the dowel pin between the
  - **HP75 / HP100** — volute and engine face.
  - **HP200 - HP400** — pump head and gearbox pump side housing.
- **For HP200 - HP400**, apply a coating of Loctite, then insert the four (4) 3/8"-16 screws and seal washers to securing pump head to the engine face. Tighten and torque (to 40 ft. lbs. / 54 N-m) all screws in a criss-cross fashion to ensure an EVEN seal and torque accordingly. Also see Table 7-1: “Typical Torque Values Chart” on page 69.
- When installing the volute and pump head, DO NOT damage the clearance ring(s) or impeller.
- Ensure the V-clamp is properly seated around the volute / pump head and that the nut is accessible for future repairs before tightening.

- Test the pump per your departmental requirements before returning the system to operation.

## 7.6 PUMP OIL SEAL (HP75 AND HP100)

The oil seal, on HP75 and HP100 series pumps only, is exposed when the pump head is removed — see preceding heading “Pump Repair” beginning on page 72.

### To replace defective seal

1. Remove (pry out) the oil seal from the gearbox pump side housing half making sure not to damage the bore or shaft. Removing the seal renders it defective. To replace, order Hale p/n: 296-2720-00-0.
2. To install, make sure to install the oil seal with the spring side of the seal facing into the gearbox. (See Figure 2-8: “Typical HP75 / HP100 Pump and Gearbox Assembly” on page 29.)
3. Evenly press-in a new oil seal in the gearbox housing until flush against the bearing retaining ring. Lightly tap the seal around the edges to ensure an “even” seat.

## 7.7 GEARBOX

See Section 7b “HP75 / HP100 Gearbox” on page 81.

## 7a Mechanical Seal Assembly

(See Figure 7a-1: “Mechanical Seal Overview / Replacement.”)



### IMPORTANT !

IF WATER LEAKAGE FROM THE DRAIN HOLE IN THE VOLUTE IS NOTICED, THE IMPELLER MUST BE REMOVED AND THE MECHANICAL SEAL MUST BE INSPECTED.

### 7A.1 REMOVING THE SEAL

7. To expose the mechanical seal, remove the:
- Volute - see heading “Pump Repair” on page 72.
  - Impeller - see heading “Pump Repair” on page 72.

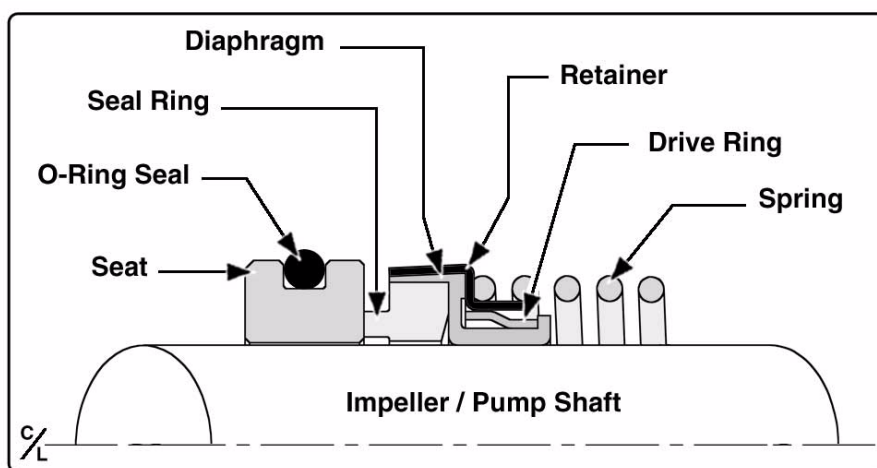


Figure 7a-1: Mechanical Seal Overview / Replacement



### CAUTION !

MECHANICAL SEALS ARE PRECISION ENGINEERED DEVICE. EXTREME CARE MUST BE TAKEN TO ENSURE THAT NO DAMAGE OCCURS TO THE MATING FACES.

**CAUTION ! - continued**



**ENSURE THAT THE FACES ARE ABSOLUTELY CLEAN THROUGHOUT THE ENTIRE INSTALLATION. SOLID FACES MUST BE CLEANED WITH AN APPROPRIATE DEGREASER AND A SOFT CLOTH.**

8. From within the volute and/or pump head, and using a hook-type tool, reach in and remove the:

- Mechanical seal spring
- Seal diaphragm and retainer
- Seal, stationary seat

(See Figure 7a-1: "Mechanical Seal Overview / Replacement" on page 77.)

Removing the mechanical seal renders it inoperative and it must be replaced.

9. After all components are removed, carefully inspect clearance rings and other parts for excessive wear or damage. Replace accordingly.

*It is recommended to always use Class1 genuine replacement parts for optimum safety of the equipment and its operators and to avoid unnecessary downtime.*

## 7A.2 INSTALLING SEAL

(See Figure 7a-1: "Mechanical Seal Overview / Replacement" on page 77.)

1. See **CAUTION !** warning beginning on page 77.
2. Clean the bore of the pump head using alcohol swabs. Solid running faces must be cleaned with alcohol wipes, supplied with the repair kit.

**WARNING !**



**OIL AND GREASE WILL DAMAGE THE MECHANICAL SEAL FACE. DO NOT TOUCH THE FACE OF THE MECHANICAL SEAL.**

**USE ONLY PAC-EASE RUBBER LUBRICANT EMULSION (OR EQUIVALENT) ON THE RUBBER MECHANICAL SEAL PARTS TO EASE INSTALLATION. USING ANY OTHER LUBRICANT CAN DAMAGE THE SEAL AND SEAT.**

**WARNING ! - continued**

**ENSURE THAT THE PUMP BODY AND IMPELLER BORES AND ALL MATING SURFACES OF THE MECHANICAL SEAL ASSEMBLY ARE ABSOLUTELY CLEAN THROUGHOUT THE ENTIRE INSTALLATION PROCESS.**

3. For HP200 through HP400 series pumps only, install the impeller spacer to the shaft.
4. Apply a generous coating of Pac-Ease Rubber Lubricant Emulsion to the O-ring on the seal head assembly and the shaft and seal areas.
5. Without touching the carbon seal, slide the stationary seat into the pump head. (See Figure 7a-1: "Mechanical Seal Overview / Replacement" on page 77.)
6. Carefully push the stationary seat into the pump head bore using a soft, clean pusher tube. Verify the stationary seat is firmly seated in the pump head.
7. Clean the pump shaft (and impeller spacer) with alcohol swabs.
8. Apply a generous coating of PAC-EASE Rubber Lubricant Emulsion to the seal diaphragm. (See Figure 7a-1: "Mechanical Seal Overview / Replacement" on page 77.)
9. Without touching the face of the seal ring, push the ring, diaphragm, and retainer onto the shaft with the pusher tube.
10. Keep the shaft well lubricated and verify the seal ring seats against the stationary seat. If binding occurs, apply additional PAC-EASE lubricant.
11. Slide the spring (supplied with the seal) onto the shaft. The spring must seat on the seal retainer.
12. Install the impeller shaft key and carefully slide the impeller over the pump shaft, aligning the keyway with the impeller key. Also see **CAUTION !** beginning on page 77.
13. Install the impeller shaft washer and screw. Torque the impeller screw to 40 ft.-lbs. (54 N-m).

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## 7b HP75 / HP100 Gearbox

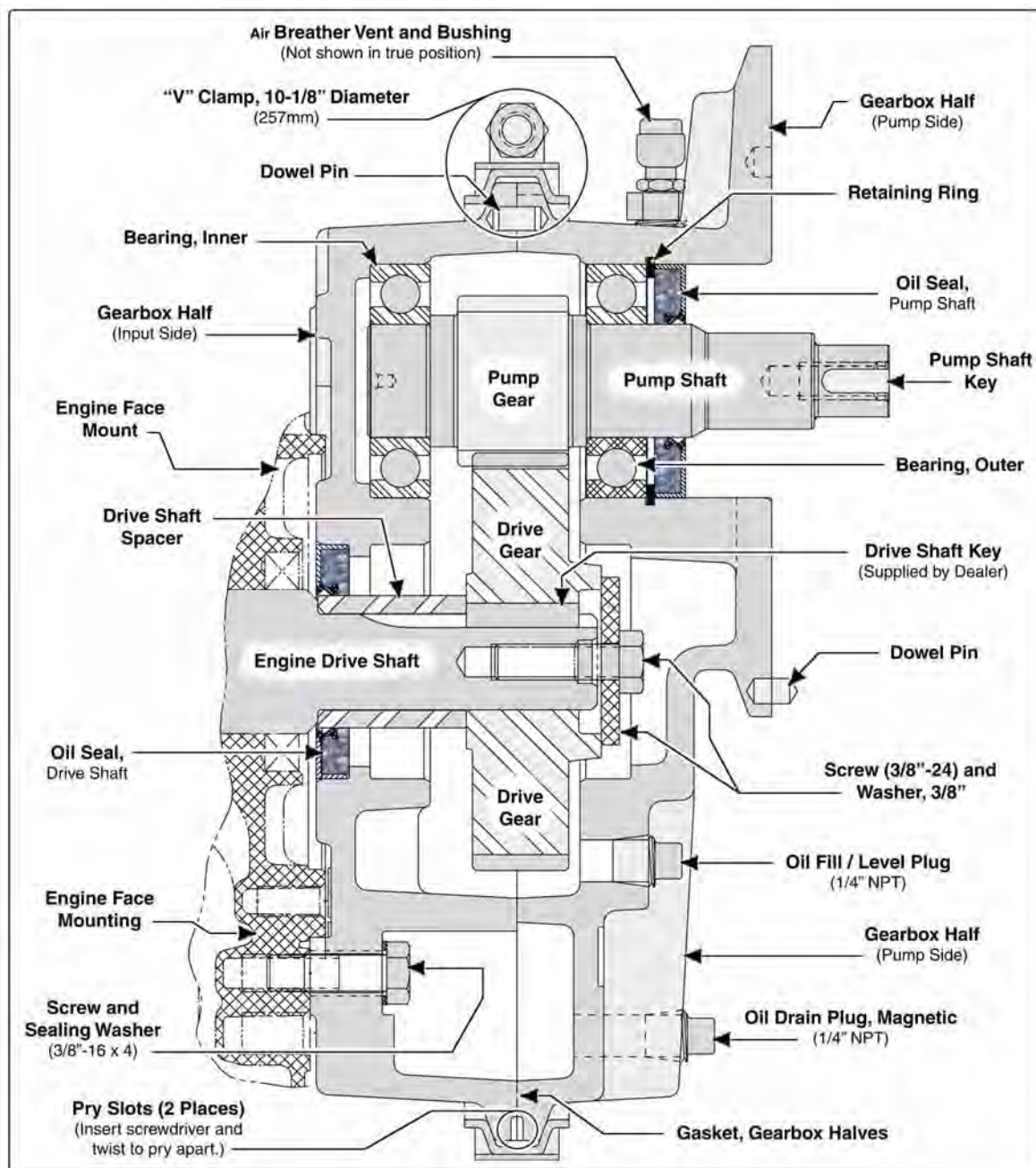


Figure 7b-1: HP75 / HP100 Gearbox Assembly

Review heading "Before You Begin..." on page 67. Also review heading "General Repair Guidelines" on page 67.



Support the gearbox on your workbench to prevent injury or damage to when the V-clamp is loosened. Exercise care if using chains to protect finished surfaces.

Remove the pump assembly to gain access to the gearbox - see "Pump Repair" beginning on page 72.

## 7B.1 DISASSEMBLY

### Pump Gear Shaft

1. Remove the V-clamp securing the two gearbox housing halves - see Figure 7b-1: "HP75 / HP100 Gearbox Assembly" on page 81.
2. Separate the housing halves from each other and remove the gasket. Remove all remaining gasket material from the gearbox halves being careful not to scratch the finished surfaces.

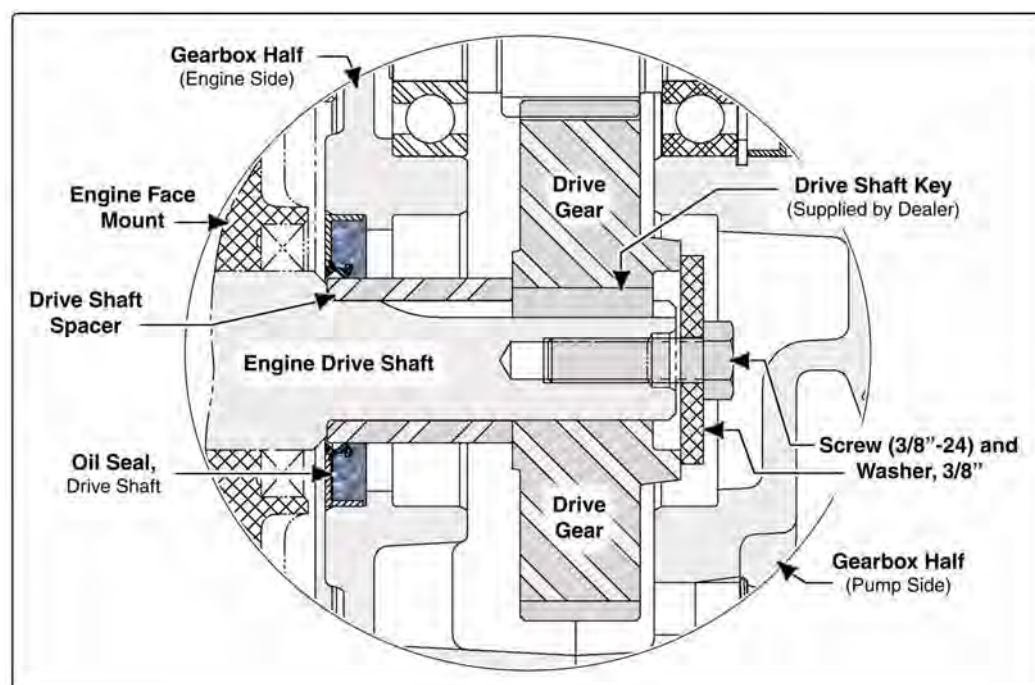
Be careful not to damage the pump shaft, bearings and gear. During disassembly the inner and outer bearings, pump shaft and pump gear should also disassemble with the pump side gearbox housing.

3. Remove the pump gear shaft, inner and outer bearings and the bearing retaining ring (and oil seal if not already removed). A press or soft mallet and bearing pusher tool may be needed.
4. After all components are removed, carefully clean and inspect the bearings, gear and shaft and other parts for excessive wear, chips, scoring or other damage. Replace all components that are worn, damaged, or pitted.

### Engine / Drive Shaft and Oil Seal

(See Figure 7b-2: "Engine / Drive Shaft Assembly" on page 83.) Also see Figure 7b-1: "HP75 / HP100 Gearbox Assembly" on page 81.

1. Remove in the following order:
  - 3/8"-24 screw and washer
  - Drive gear and shaft key
  - Shaft spacer

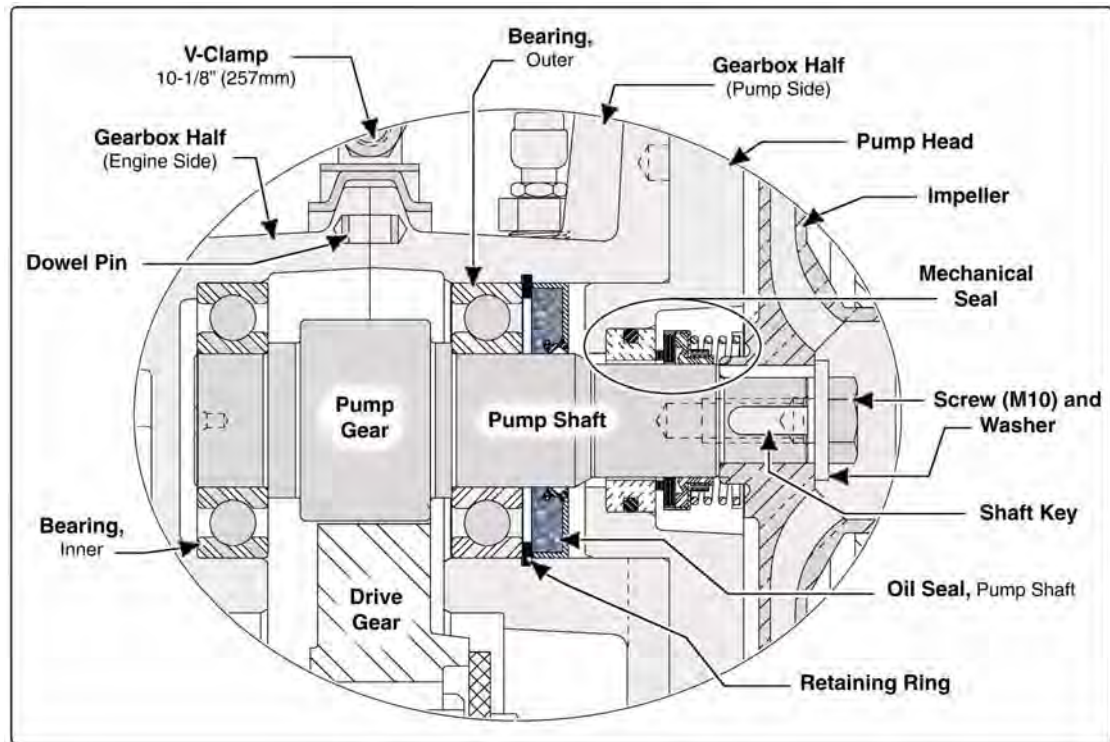


**Figure 7b-2: Engine / Drive Shaft Assembly**

2. Remove (pry out) the oil seal from the gearbox pump side housing half making sure not to damage the bore or shaft. Removing the seal renders it defective. To replace, order Hale p/n: 296-2720-01-0.
3. Clean and inspect all parts for excessive wear, chips, scoring or other damage. Repair and/or replace accordingly.
4. If the gearbox housing must be removed from the engine face, remove the four (4) 3/8"-16 screws and sealing washers, then slide the gearbox from the engine / drive shaft.

## 7B.2 REASSEMBLE

1. Review preceding sections "Before You Begin...", on page 67 and "Cleaning and Inspection Guidelines," on page 70.
2. Using a brass drift or bearing installation tool, install the pump shaft inner bearing flush against the gearbox housing surface. (See Figure 7b-3: "Pump Shaft Assembly" on page 84.)
3. Turn the gearbox halve over and from the other side insert (or press) a new oil seal into the drive shaft bore of the housing flush against the inner edge of the housing.



**Figure 7b-3: Pump Shaft Assembly**

4. Lightly tap the seal around the edges to ensure an “even” seat. Apply a coating of general purpose grease to the oil seal to ease installation. (See Figure 7b-3: “Pump Shaft Assembly.”)

Make sure to install the oil seal with the spring side of the seal facing into the engine face.

5. Install the engine / drive shaft spacer to the drive shaft, then slide the the gearbox housing (engine side), with new oil seal, over the shaft and onto the engine face, being careful not to damage the new oil seal. (See Figure 7b-2: “Engine / Drive Shaft Assembly” on page 83.)
6. Apply Loctite #246 and install the four 3/8”-16 screws and seal washers. Tighten and torque the screws in a crisscross pattern. (See Table 7-1: “Typical Torque Values Chart” on page 69.)
7. Insert the shaft key and the drive gear with the narrow shoulder against the shaft spacer (wider shoulder facing outward).
8. Apply Loctite #246 and install the large flat washer and 3/8”-24 screw. Tighten and torque the screw to 35 ft. lbs. (46 N-m).

9. Spin the drive gear to ensure a free spin with no binding.
10. Press the outer bearing onto the pump shaft assembly being careful not to damage the gear teeth. (See Figure 7b-3: "Pump Shaft Assembly" on page 84.)

Install the pump shaft and gear assembly into the inner bearing of the engine side gearbox housing half, aligning the gears teeth to the drive gear.

11. Install the retaining ring into the pump side gearbox housing half, then install the gearbox housing half and secure with the V-clamp, but DO not fully tighten.

Ensure the V-clamp is properly seated around the gearbox housing halves and that the nut is accessible for future repairs before tightening.

12. Rotate the pump shaft and drive shaft to ensure smooth, unrestricted movement, then tighten and torque the V-clamp.
13. Install a new pump shaft oil seal — see heading "Pump Oil Seal (HP75 and HP100)" on page 76.
14. Install a new mechanical seal — see heading "Installing Seal" on page 78.
15. Reassemble the pump (impeller, clearance ring(s) and volute) — see heading "Pump Repair" on page 72.

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## Appendix A: Glossary

**Atmospheric Pressure** ..... Pressure caused by the elevation of air above the earth. Atmospheric pressure is 14 pounds per square inch at sea level. Pressure increases below sea level and decreases above sea level. The weather also effects atmospheric pressure. Atmospheric pressure effects a pumps ability to pump from draft. Higher pressures increase a pumps performance, while lower pressures can cause a noticeable decrease in lift.

**Auxiliary Cooling Valve** ..... Permits water from a pump to cool the radiator water through a heat exchange.

**Capacity** ..... Pump flow rating.

**Cavitation** ..... Occurs when the pump attempts to deliver more fluid than is being supplied. This causes the formation of bubbles in the pump. When the bubbles collapse, the liquid, under pressure, rushes in to fill the empty space. This damages the pump and must be corrected immediately.

**Centrifugal Force** ..... Force that tends to make rotating bodies move away from the center of rotation.

**Centrifugal Pump** ..... A pump that uses a rapidly spinning disk or impeller to create the pressure for fluid movement.

**Certification** ..... Pumper test in accordance with NFPA standards to determine if a pump can deliver its rated volume and pressure.

**Check Valve** ..... A one-way valve or non-return valve that allows flow in one direction, but shifts to prevent flow in the reverse direction.

In two stage pumps, there are two swing check or flap valves in the suction passage of the second stage. They are located in each side of the pump between the suction tube and the pump body. These valves swing open when pumping in parallel for volume. They are closed by first stage pressure when pumping in series for pressure.

**Clearance Ring** ..... Prevents discharge fluid from returning to the eye of the impeller.

**Compound Gauge** ..... A compound gauge is graduated to read pressure in "pounds per square inch" and "vacuum in inches of mercury."

**Cut Water** ..... Cut water is a wedge-shaped point between the volute (pump body) and the pump discharge where the volume of fluid is directed to the discharge connection.

**Dead Heading** ..... Operating a pump without any discharge. The lack of flow causes temperatures to rise inside the pump.

**WARNING !**

**IF A PUMP IS OPERATED WITHOUT WATER FOR EXTENDED PERIODS, OR WITHOUT DISCHARGING WATER, IT MAY OVERHEAT. THIS COULD DAMAGE THE MECHANICAL SEAL OR THE DRIVE MECHANISM.**

**Double Suction** ..Fluid enters on both sides of the impeller.  
**Impeller**

**Dry Prime Test** ...Provides information on the ability of a priming pump to evacuate air from the main pump. If the vacuum does not hold, it is an indication there is a leak in the system.

**Flow Meter** .....Measures the volume of fluid that is flowing.

**Friction Loss** .....Loss of pressure in hose, fittings, standpipes, and other appliances because of the resistance between the fluid molecules and the inside surfaces of the hoses, fittings, standpipes, piping, and other appliances.

**Front-Mount** .....Pump mounted ahead of the vehicle's engine – usually on the front of the radiator.  
**Pump**

**Gauge** .....Pressure read from a gauge (PSIG).  
**Pressure**

**Governor**.....Minimizes pressure changes by controlling engine speed to maintain pump discharge pressure.

**Horsepower** .....A measure of mechanical work.

**Impeller** .....The working part of a centrifugal pump that, when rotating, imparts energy to fluid. Essentially, an impeller consists of two disks separated by vanes. The vanes force the fluid to move outward between the disks so that it is thrown outward at high velocity by centrifugal force. The water from the impeller discharges into a diverging passage known as a volute, converting the high velocity energy of the water into pressure.

**Impeller Eye**.....Point where fluid enters the impeller.

**Net Pump** .....The difference in pressure between discharge and suction pressure.  
**Pressure**

**Packing** .....Material that maintains an airtight seal at the point where the impeller shaft enters and exits the pump body.

**Parallel** .....Capacity position in which each impeller on a two-stage pump works independently into the discharge – often termed "Volume Mode."

**Pitot Gauge**.....Measures velocity head at the discharge of a nozzle and can be converted to flow using a chart or simple calculation.

**Positive** .....A pump with a fixed flow delivered to the discharge with each revolution.  
**Displacement Pump**





**Positive Pressure** .....Pressure above atmospheric.

**Power Valve**.....A valve that uses hydraulic pressure to transfer two-stage pump operation from volume mode to pressure mode, and vice versa.

**Pressure** .....Force per unit area.

**Pressure Gauge** .....The pressure gauge is usually graduated in pounds per square inch (PSI) only. It is connected to the pump discharge manifold, thus indicating pump discharge pressure.

**Priming** .....Priming evacuates the air from the main pump and suction hose, thus creating a vacuum. This allows atmospheric pressure on the source of the fluid to push the fluid up into the suction hose and pump.

**Priming Pump** ....An auxiliary positive displacement pump which pumps air out of the pump body that creates a vacuum to prime the main pump. The priming pump is a rotary vane type, electric motor driven. Once the main pump is primed and pumping, the priming pump is shut off.

**Priming Pump Valve** ...A valve located in the priming line between the priming pump and the main pump. It remains closed at all times except when priming. The control is normally located on the pump panel.

**Pump Shift**.....A midship pump is usually mounted with a split gearbox installed in the drive shaft. The pump shift moves a sliding gear in the gearbox that transmits power either to the pump or the rear axle. In ROAD position, power is shifted to the rear axle for driving; in PUMP position, the rear axle is disconnected, and power is shifted to the pump shaft.

**Relay** .....Movement of water from an apparatus at a water source to additional apparatus until water reaches the fire ground.

**Relief Valve**.....An automatic valve which, when activated by the relief valve control, holds pump pressure steady when discharge valves or shut-off nozzles are closed. The valve maintains its given pressure by dumping the pump discharge flow into the pump suction.

**Relief Valve Control (PM)** .....A handwheel adjustment valve which controls and/or adjusts the relief valve to maintain the working pressure (i.e., set to control the desired pressure).

**Series** .....Pressure position in which the first impeller's discharge is fed to the eye of the second impeller in a two-stage pump which then discharges the fluid from the pump (often termed "Pressure Mode").

**Service Test**.....Pump test performed to determine if the apparatus can deliver its rated volume and pressure.

**Shrouds** .....Sides of an impeller that confine the fluid.

**Slinger Ring**.....Prevents fluid from continuing to travel down a shaft to the gears and ball bearings.

**Stages** .....The number of impellers in a pump that are used in series; that is, one following another in terms of flow. Each impeller develops part of the total pump pressure.

**Tachometer** .....Indicates the speed of the engine crankshaft in revolutions per minute.

**Torque**.....The force that acts to produce rotation.

**Transfer Valve** ...A two-position valve in a pump that changes the operation from parallel (volume) to series (pressure) operation and vice versa (not used on single stage pumps).

**Vanes** .....Guides inside an impeller that direct fluid to the volute (pump body).

**Volute** .....A gradually increasing discharge waterway. Its function is to collect the water from the impeller and, depending on its design, it either increases pressure and decreases velocity or increases velocity and decreases pressure.

**Water**.....Amount of energy in the water stream.

**Horsepower**

**Wear Rings** .....See Clearance rings.



## Appendix A-1: Measurements

|                                         |                                                          |
|-----------------------------------------|----------------------------------------------------------|
| Water Horsepower .....                  | (GPM x PSI)/1,714                                        |
| One Gallon of Water Weighs .....        | 8.33 Pounds                                              |
| One Gallon.....                         | 231 Cubic Inches                                         |
| One Cubic Foot.....                     | 7.48 Gallons                                             |
| One Pound per Square Inch of Head ..... | 2.31 Feet of Water                                       |
| One Inch of Mercury .....               | 1.132 Feet of Water                                      |
| One Pound per Square Inch .....         | 2.0178 Inches of Mercury<br>equals 27.68 inches of Water |
| One Cubic Meter.....                    | 1,000 Liters                                             |
| One Imperial Gallon .....               | 1.2 Gallons                                              |

### CONVERSION CHART

| To Convert                      | To              | Multiply By |
|---------------------------------|-----------------|-------------|
| BAR                             | PSI             | 4.504       |
| Feet Head                       | Pounds Pressure | 2.31        |
| FT-LB (Torque)                  | N-m             | 1.3558      |
| Gallons                         | Liters          | 3.785       |
| HP (Horsepower)                 | KW (Kilowatts)  | 0.7457      |
| One Pound per Square Inch (PSI) | One BAR         | 0.0690      |
| One Pound per Square Inch (PSI) | KPA             | 0.001       |
| Pounds per Square Inch (PSI)    | Feed Head       | 0.433       |



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## Appendix C: Alternate Lubricant Manufacturers

In addition to the Hale recommended lubricants:

- FULL SYNTHETIC SAE 50 Transmission Lubricant (Cognis 2924/2833)
- DEXRON III SYNTHETIC (Cognis 2803) for temperatures below 32°F (0°C)

the following list of alternate oils and suppliers is provided .

| Oil / Lubricant                                                                                                      | Manufacturer                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>Alternate STANDARD-Temperature Lubricant (Cognis 2923/2833)</b><br>See Service Manual for additional information. |                                                                                                   |
| <b>Brad Penn Full Synthetic Transmission Lube SAE-50</b>                                                             | American Refining Group<br>77 N Kendall Avenue<br>Bradford, PA 16701                              |
| <b>Bulldog Synthetic Transmission Lube SAE-50 Trans.</b>                                                             | Mack Truck Company<br>2100 Mack Boulevard<br>Allentown, PA 18105                                  |
| <b>D-A SynSure Synthetic Lube SAE-50 Trans.</b>                                                                      | D.A. Lubricant Company, Incorporated<br>1340 West 29th Street<br>Indianapolis, IN 46208           |
| <b>Dyna-Plex 21C Synzol SAE-50 Trans.</b>                                                                            | Universal Lubricants<br>P O Box 2920<br>2824 North Ohio<br>Wichita, KS 67219                      |
| <b>Emgard SAE-50 Synthetic Transmission Lubricant</b>                                                                | Cognis Corporation<br>5051 Estecreek Drive<br>Cincinnati, OH 45232                                |
| <b>Fleetrite Synthetic SAE-50 Transmission Oil Trans.</b>                                                            | International Truck & Engine Corporation<br>5 Westbrook Corporate Center<br>Westchester, IL 60154 |
| <b>Hi-Tek Synthetic SAE-50 Trans.</b>                                                                                | Industrial Oils Unlimited<br>P O Box 3066<br>Tulsa, OK 74101                                      |
| <b>Kenworth SAE-50 Original Factory Fill Fluid Trans.</b>                                                            | Paccar Parts<br>750 Houser Way N<br>Renton WA 98055                                               |
| <b>Maxtro MT SAE-50 Trans.</b>                                                                                       | Country Energy LLC<br>5500 Cenex Drive<br>Inver Grove Heights, MN 55077                           |

**Table C-1: Alternate Lubricant Manufacturers**

□ Alternate Lubricant Manufacturers

| Oil / Lubricant                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Manufacturer                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Alternate STANDARD-Temperature Lubricant (Cognis 2923/2833)</b><br><b>See Service Manual for additional information.</b>                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                            |
| <b>Monarch Syntran Plus<br/>SAE-50 Trans.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Royal Manufacturing Company, Inc.<br>P O Box 3308<br>516 South 25th West Avenue<br>Tulsa, OK 75127         |
| <b>Mystik Synguard SX-7000<br/>SAE-50 Trans.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Cato Oil and Grease Company<br>P O Box 26868<br>1808 NE 9th Street<br>Oklahoma City, OK 73126              |
| <b>Peterbilt SAE-50 Original<br/>Factory Fill Fluid, Trans.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Paccar Parts<br>750 Houser Way N<br>Renton, WA 98055                                                       |
| <b>SYN-CD Gear Lubricant<br/>SAE-50 Trans.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Black Bear Company, Incorporated<br>27-10 Hunters Point Avenue<br>Long Island City, NY 11101               |
| <b>Valvoline HD Synthetic Trans.<br/>Oil SAE-50 Trans.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Valvoline, Incorporated<br>A Subsidiary of Ashland Oil, Inc.<br>3499 Blazer Parkway<br>Lexington, KY 40512 |
| <b>Alternate LOW-Temperature Lubricant (Cognis 2803)</b><br><b>See Service Manual for additional information.</b><br><div style="display: flex; justify-content: space-between; align-items: center;">  <div style="text-align: center;"> <b>CAUTION !</b><br/> <b>USE ONLY FOR EXTREME LOW TEMPERATURES, BELOW<br/>FREEZING (32° F / 0° C)</b> </div>  </div> |                                                                                                            |
| <b>Motorcraft Synthetic ATF</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Local Ford Dealership                                                                                      |

Table C-1: Alternate Lubricant Manufacturers



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## Appendix C1: Lube and Sealant Specifications

| Pump                                                 | Gearbox                            | Approximate Capacity |        | Recommended Oil                                                                                       |
|------------------------------------------------------|------------------------------------|----------------------|--------|-------------------------------------------------------------------------------------------------------|
|                                                      |                                    | Quarts               | Liters |                                                                                                       |
| 4DK                                                  |                                    | 5                    | 4.7    | SAE 50 - above 0° F (above -18° C); Dextron III or Cognis 2803 - between -40°F to 0°F (-40° to -18°C) |
| APS<br>APSM<br>MBP<br>MBPM<br>4DB<br>SBP             | B<br>(Vertical)                    | 2                    | 1.9    | SAE 50<br>80W-90; 75W-80 Synthetic                                                                    |
|                                                      | B<br>(Horizontal)                  | 1.5                  | 1.4    | SAE 50<br>80W-90; 75W-80 Synthetic                                                                    |
|                                                      | B<br>(Inverted)                    | 1.75                 | 1.7    | SAE 50<br>80W-90; 75W-80 Synthetic                                                                    |
| QTWO / QMAX<br>QPAK / QFLO / DSD<br>QFLOPLUS / SMD   | G<br>X, L and R<br>Series          | 4                    | 3.8    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)              |
| SMM / QSMG / QG<br>8FGF / 8FGR / RGA /<br>QMID / LGA | G<br>S Series                      | 3                    | 2.8    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)              |
| QPAK-J                                               | J                                  | 2                    | 1.9    | SAE EP 90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)             |
| RSD-M / RSD<br>PSM / SMR-A                           | HG *                               | 1.4                  | 1.3    | ISO 68 Grade; SAE 50W<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.) |
| QFLO-A / QPAK-A<br>HFM / CSD / PSD                   | A                                  | 1                    | 0.95   | SAE 20W Non-Detergent Oil<br>SAE 30W                                                                  |
| PSD (Inverted)                                       |                                    | 2.5                  | 2.4    | SAE 20W Non-Detergent Oil<br>SAE 30W                                                                  |
| HP Portables                                         |                                    | 1.5                  | 1.4    | SAE 30W                                                                                               |
|                                                      | P                                  | 4                    | 3.8    | SAE EP 90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)             |
| A                                                    |                                    | 4                    | 3.8    | SAE EP 90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)             |
| APM / AP<br>(Inverted)                               |                                    | 1.25                 | 1.2    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)              |
| APMG<br>MG                                           | MGA<br>(Horizontal or<br>Vertical) | 3                    | 2.8    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)              |
|                                                      | I (Special)                        | 3.5                  | 3.3    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)              |
| CBP4 / CBP5<br>2CBP4 / 2CBP5                         | Table continued<br>on next page    | 1                    | 0.95   | SAE EP90;<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.)             |

Table C1-2: Oil Capacity and Recommendation



## □ Lubricant Specifications

| Pump                                                  | Gearbox | Approximate Capacity |        | Recommended Oil                                                                          |
|-------------------------------------------------------|---------|----------------------|--------|------------------------------------------------------------------------------------------|
|                                                       |         | Quarts               | Liters |                                                                                          |
| APM / AP / CBP<br>2CBP / CBP2 / CBP3<br>2CBP2 / 2CBP3 |         | 1.75                 | 1.7    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.) |
| 20FS<br>30FS                                          |         | 1.75                 | 1.7    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.) |
| 50FBG / 80FBG<br>609FBG                               | G       | 3                    | 2.8    | SAE EP90<br>80W-90; 75W-140 Synthetic<br>(Lubricants must meet service rating API GL-5.) |

**Table C1-2: Oil Capacity and Recommendation**

\* For domestic use, Hale recommends using an SAE EP-90, 80W-90 Lubricant or "Roadrunner" Full Synthetic SAE 50 Transmission Lubricant, manufactured by the Eaten® Corporation, or equivalent.

## **Grease**

Use a Lithium-based grease with 1% to 3% Molybdenum Dissolved, i.e.,

- Dow Corning BR2-PLUS
- Shell Super Duty Grease
- Mobile Grease Special
- Lubricate-Fiske #3000
- Imperial #777
- Sunoco Moly #2EP

**Note:** For Hale SVS Torrent Stainless Valves see separate manual for additional lubrication information.

## **Loctite Sealant**

- #246 High Temperature Removable Threadlock (or equivalent) - primarily for gearbox assembly
- #242 Medium Strength Threadlock (or equivalent) - primarily for pump assembly

## **Oil**

See "Appendix C: Alternate Lubricant Manufacturers" on page 93.

## **Recommended Cleaners**

- Safety Kleen®
- Stoddard Solvent

**IMPORTANT !** The use and disposal of solvents / cleaners must be in accordance with your local environmental regulations.



## Appendix D: Hose Friction Loss

| GPM (LPM) | 3/4" (19mm) Booster | 1.0" (25.4mm) Booster | 1-1/2" (38mm) Hose | GPM (LPM)     | 1-3/4" (44mm) Hose with 1-1/2" (38mm) Coupling | 2.0" (38) Hose with 1-1/2" (38mm) Coupling | 2-1/2" (64mm) Hose | 3.0" (76mm) Hose with 2-1/2" (38mm) Coupling | 3.0" (76mm) Hose | GPM (LPM)     | 3-1/2" (89mm) Hose | 4.0" (102mm) Hose | 5.0" (217mm) Hose |
|-----------|---------------------|-----------------------|--------------------|---------------|------------------------------------------------|--------------------------------------------|--------------------|----------------------------------------------|------------------|---------------|--------------------|-------------------|-------------------|
| 10 (38)   | 13.5 (0.9)          | 3.5 (0.24)            |                    | 95 (360)      | 14 (0.96)                                      | 8 (0.6)                                    |                    |                                              |                  | 500 (1,893)   | 9.5 (0.7)          | 3 (0.2)           |                   |
| 20 (76)   | 44 (3.0)            | 6 (0.4)               |                    | 125 (473)     | 24 (1.7)                                       | 13 (0.9)                                   |                    |                                              |                  | 750 (2,839)   | 20 (1.4)           | 11 (0.8)          | 5 (0.4)           |
| 30 (114)  | 99 (6.8)            | 14 (0.96)             |                    | 150 (568)     | 35 (2.4)                                       | 18 (1.2)                                   |                    |                                              |                  | 1,000 (3,785) | 34 (2.4)           | 20 (1.4)          | 8 (0.6)           |
| 40 (151)  | 176 (12.0)          | 24 (1.7)              | 4 (0.3)            | 175 (662)     | 47 (3.2)                                       | 25 (1.7)                                   | 6 (0.4)            |                                              |                  | 1,250 (4,732) | 53 (3.7)           | 31 (2.1)          | 13 (0.9)          |
| 50 (189)  |                     | 38 (2.6)              | 7 (0.5)            | 200 (757)     | 62 (4.3)                                       | 32 (2.2)                                   | 8 (0.6)            |                                              |                  | 1,500 (5,678) | 74 (5.1)           | 45 (3.1)          | 18 (1.2)          |
| 60 (227)  |                     | 54 (3.7)              | 9 (0.6)            | 225 (852)     |                                                |                                            | 10 (0.7)           |                                              |                  | 1,750 (6,625) |                    | 61 (4.2)          | 25 (1.7)          |
| 70 (265)  |                     |                       | 12 (0.8)           | 250 (946)     |                                                |                                            | 13 (0.9)           | 5 (0.4)                                      | 4 (0.3)          | 2,000 (7,571) |                    |                   | 32 (2.2)          |
| 80 (303)  |                     |                       | 15 (1.03)          | 275 (1,041)   |                                                |                                            | 15 (1.03)          |                                              |                  |               |                    |                   |                   |
| 95 (360)  |                     |                       | 22 (1.5)           | 300 (1,136)   |                                                |                                            | 18 (1.2)           |                                              |                  |               |                    |                   |                   |
| 125 (473) |                     |                       | 38 (2.6)           | 325 (1,230)   |                                                |                                            | 22 (1.5)           | 8 (0.6)                                      |                  |               |                    |                   |                   |
| 150 (568) |                     |                       | 54 (3.7)           | 350 (1,325)   |                                                |                                            | 25 (1.7)           |                                              | 8 (0.6)          |               |                    |                   |                   |
|           |                     |                       |                    | 500 (1,893)   |                                                |                                            |                    | 20 (1.4)                                     | 17 (1.2)         |               |                    |                   |                   |
|           |                     |                       |                    | 750 (2,839)   |                                                |                                            |                    | 45 (3.1)                                     | 36 (2.5)         |               |                    |                   |                   |
|           |                     |                       |                    | 1,000 (3,785) |                                                |                                            |                    | 80 (5.5)                                     | 68 (4.7)         |               |                    |                   |                   |

Table D-1: Hose Friction Loss (PSI / BAR 100 Feet)



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## Appendix E: Nozzle Size vs. Pressure

| GPM (LPM) at Various Nozzle Sizes |                                     |           |           |           |             |             |             |             |
|-----------------------------------|-------------------------------------|-----------|-----------|-----------|-------------|-------------|-------------|-------------|
| Nozzle Pressure                   | Nozzle Size in Inches (millimeters) |           |           |           |             |             |             |             |
| PSI (BAR)                         | 1/2" (13)                           | 5/8" (16) | 3/4" (19) | 7/8" (22) | 1.0" (25.4) | 1-1/8" (29) | 1-1/4" (32) | 1-3/8" (35) |
| 30 (2.1)                          | 41 (155)                            | 64 (242)  | 92 (348)  | 125 (473) | 163 (617)   | 206 (780)   | 254 (962)   | 308 (1,166) |
| 35 (2.4)                          | 44 (167)                            | 69 (261)  | 99 (375)  | 135 (511) | 176 (666)   | 222 (840)   | 275 (1,041) | 332 (1,257) |
| 40 (2.7)                          | 47 (178)                            | 73 (296)  | 106 (401) | 144 (545) | 188 (711)   | 238 (901)   | 294 (1,113) | 355 (1,334) |
| 45 (3.1)                          | 50 (189)                            | 78 (295)  | 112 (424) | 153 (579) | 199 (753)   | 252 (954)   | 311 (1,177) | 377 (1,437) |
| 50 (3.5)                          | 53 (201)                            | 82 (310)  | 118 (447) | 161 (610) | 210 (795)   | 266 (1,007) | 328 (1,242) | 397 (1,503) |
| 55 (3.8)                          | 55 (208)                            | 86 (326)  | 124 (469) | 169 (640) | 220 (833)   | 279 (1,056) | 344 (1,302) | 417 (1,647) |
| 60 (4.1)                          | 58 (220)                            | 90 (341)  | 130 (492) | 176 (666) | 230 (871)   | 291 (1,102) | 360 (1,363) | 435 (1,663) |
| 62 (4.3)                          | 58 (220)                            | 91 (345)  | 132 (500) | 179 (678) | 234 (886)   | 296 (1,121) | 366 (1,385) | 442 (1,673) |
| 64 (4.4)                          | 59 (223)                            | 93 (352)  | 134 (507) | 182 (689) | 238 (901)   | 301 (1,139) | 371 (1,404) | 449 (1,700) |
| 66 (4.6)                          | 60 (227)                            | 94 (356)  | 136 (515) | 185 (700) | 241 (912)   | 305 (1,155) | 377 (1,427) | 456 (1,726) |
| 68 (4.7)                          | 61 (231)                            | 96 (363)  | 138 (522) | 188 (711) | 245 (927)   | 310 (1,174) | 383 (1,450) | 463 (1,753) |
| 70 (4.8)                          | 62 (235)                            | 97 (367)  | 140 (530) | 190 (719) | 248 (939)   | 315 (1,192) | 388 (1,469) | 470 (1,779) |
| 72 (5.0)                          | 63 (238)                            | 99 (375)  | 142 (538) | 193 (731) | 252 (954)   | 319 (1,208) | 394 (1,492) | 477 (1,806) |
| 74 (5.1)                          | 64 (242)                            | 100 (379) | 144 (545) | 196 (742) | 255 (965)   | 323 (1,223) | 399 (1,510) | 483 (1,828) |
| 76 (5.2)                          | 65 (246)                            | 101 (382) | 146 (553) | 198 (750) | 259 (980)   | 328 (1,242) | 405 (1,553) | 490 (1,855) |
| 78 (5.4)                          | 66 (250)                            | 103 (390) | 148 (560) | 201 (761) | 262 (992)   | 332 (1,257) | 410 (1,552) | 496 (1,878) |
| 80 (5.5)                          | 66 (250)                            | 104 (394) | 150 (568) | 203 (768) | 266 (1,007) | 336 (1,272) | 415 (1,571) | 502 (1,900) |
| 85 (5.9)                          | 68 (257)                            | 107 (405) | 154 (583) | 210 (795) | 274 (1,037) | 347 (1,314) | 428 (1,620) | 518 (1,961) |
| 90 (6.2)                          | 70 (265)                            | 110 (416) | 159 (602) | 216 (818) | 282 (1,067) | 357 (1,351) | 440 (1,666) | 533 (2,018) |
| 95 (6.6)                          | 72 (273)                            | 113 (428) | 163 (617) | 222 (840) | 289 (1,094) | 366 (1,386) | 452 (1,711) | 547 (2,071) |
| 100 (6.9)                         | 74 (280)                            | 116 (439) | 167 (362) | 228 (863) | 297 (1,124) | 376 (1,423) | 464 (1,756) | 562 (2,127) |
| 105 (7.2)                         | 76 (288)                            | 119 (451) | 171 (647) | 233 (882) | 304 (1,151) | 385 (1,457) | 476 (1,802) | 575 (2,177) |
| 110 (7.6)                         | 78 (295)                            | 122 (462) | 175 (663) | 239 (905) | 311 (1,117) | 394 (1,492) | 487 (1,844) | 589 (2,230) |
| 115 (7.9)                         | 80 (303)                            | 125 (473) | 179 (678) | 244 (924) | 319 (1,208) | 403 (1,526) | 498 (1,885) | 602 (2,279) |
| 120 (8.3)                         | 81 (307)                            | 127 (481) | 183 (712) | 249 (943) | 325 (1,203) | 412 (1,560) | 509 (1,927) | 615 (2,328) |

Chart E-1: Nozzle Flow and Pressure Ratings, Part 1



❑ Nozzle vs. Pressure Rating

| GPM (LPM) at Various Nozzle Sizes |                                     |             |             |               |               |               |               |                |
|-----------------------------------|-------------------------------------|-------------|-------------|---------------|---------------|---------------|---------------|----------------|
| Nozzle Pressure                   | Nozzle Size in Inches (millimeters) |             |             |               |               |               |               |                |
| PSI (BAR)                         | 1-1/2" (13)                         | 1-5/8" (16) | 1-3/4" (19) | 1-7/8" (22)   | 2.0" (25.4)   | 2-1/4" (57)   | 2-1/2" (64)   | 3.0" (76)      |
| 30 (2.1)                          | 366 (1,386)                         | 430 (1,628) | 498 (1,885) | 572 (2,065)   | 651 (2,464)   | 824 (3,119)   | 1,017 (3,850) | 1,464 (5,542)  |
| 35 (2.4)                          | 395 (1,495)                         | 464 (1,756) | 538 (2,037) | 618 (2,339)   | 703 (2,661)   | 890 (3,369)   | 1,098 (4,156) | 1,581 (5,985)  |
| 40 (2.7)                          | 423 (1,601)                         | 496 (1,878) | 575 (2,177) | 660 (2,498)   | 751 (2,843)   | 951 (3,600)   | 1,174 (4,444) | 1,691 (6,401)  |
| 45 (3.1)                          | 448 (1,696)                         | 525 (1,987) | 610 (2,309) | 700 (2,650)   | 797 (3,017)   | 1,009 (3,820) | 1,245 (4,713) | 1,793 (6,787)  |
| 50 (3.5)                          | 473 (1,791)                         | 555 (2,101) | 643 (2,434) | 738 (2,794)   | 840 (3,180)   | 1,063 (4,024) | 1,313 (4,970) | 1,890 (7,154)  |
| 55 (3.8)                          | 496 (1,878)                         | 582 (2,203) | 675 (2,555) | 774 (2,930)   | 881 (3,335)   | 1,115 (4,221) | 1,377 (5,213) | 1,982 (7,503)  |
| 60 (4.1)                          | 518 (1,961)                         | 608 (2,302) | 705 (2,669) | 809 (3,062)   | 920 (3,483)   | 1,165 (4,410) | 1,438 (5,444) | 2,071 (7,840)  |
| 62 (4.3)                          | 526 (1,991)                         | 618 (2,339) | 716 (2,710) | 822 (3,112)   | 935 (3,540)   | 1,184 (4,482) | 1,462 (5,534) | 2,105 (7,968)  |
| 64 (4.4)                          | 535 (1,025)                         | 628 (2,377) | 728 (2,756) | 835 (3,161)   | 950 (3,596)   | 1,203 (4,554) | 1,485 (5,621) | 2,138 (8,093)  |
| 66 (4.6)                          | 543 (1,056)                         | 637 (2,411) | 739 (2,797) | 848 (3,210)   | 965 (3,653)   | 1,222 (4,626) | 1,508 (5,708) | 2,172 (8,222)  |
| 68 (4.7)                          | 551 (1,086)                         | 647 (2,449) | 750 (2,839) | 861 (3,259)   | 980 (3,710)   | 1,240 (4,694) | 1,531 (5,796) | 2,204 (8,343)  |
| 70 (4.8)                          | 559 (1,116)                         | 656 (2,483) | 761 (2,886) | 874 (3,309)   | 994 (3,763)   | 1,258 (4,762) | 1,553 (5,879) | 2,236 (8,464)  |
| 72 (5.0)                          | 567 (1,146)                         | 666 (2,521) | 772 (2,922) | 886 (3,354)   | 1,008 (3,816) | 1,276 (4,830) | 1,575 (5,962) | 2,268 (8,585)  |
| 74 (5.1)                          | 575 (1,177)                         | 675 (2,555) | 783 (2,964) | 898 (3,390)   | 1,022 (3,869) | 1,293 (4,895) | 1,597 (6,045) | 2,299 (8,703)  |
| 76 (5.2)                          | 583 (1,207)                         | 684 (2,589) | 793 (3,002) | 910 (3,445)   | 1,036 (3,922) | 1,311 (4,963) | 1,618 (6,125) | 2,330 (8,820)  |
| 78 (5.4)                          | 590 (1,233)                         | 693 (2,623) | 803 (3,040) | 922 (3,490)   | 1,049 (3,971) | 1,328 (5,027) | 1,639 (6,204) | 2,361 (8,937)  |
| 80 (5.5)                          | 598 (1,264)                         | 707 (2,657) | 814 (3,081) | 934 (3,536)   | 1,063 (4,024) | 1,345 (5,091) | 1,660 (6,284) | 2,391 (9,051)  |
| 85 (5.9)                          | 616 (1,332)                         | 723 (2,737) | 839 (3,176) | 963 (3,645)   | 1,095 (4,145) | 1,386 (5,247) | 1,711 (6,477) | 2,465 (9,331)  |
| 90 (6.2)                          | 634 (2,400)                         | 744 (2,816) | 863 (3,266) | 991 (3,751)   | 1,127 (4,266) | 1,427 (5,402) | 1,761 (6,666) | 2,536 (9,600)  |
| 95 (6.6)                          | 651 (2,464)                         | 765 (2,896) | 887 (3,358) | 1,018 (3,858) | 1,158 (4,384) | 1,466 (5,549) | 1,809 (6,848) | 2,605 (9,861)  |
| 100 (6.9)                         | 668 (2,529)                         | 784 (2,968) | 910 (3,445) | 1,044 (3,952) | 1,188 (4,497) | 1,504 (5,693) | 1,856 (7,027) | 2,673 (10,118) |
| 105 (7.2)                         | 685 (2,593)                         | 804 (3,044) | 932 (3,529) | 1,070 (4,050) | 1,217 (4,607) | 1,541 (5,833) | 1,902 (7,200) | 2,739 (10,368) |
| 110 (7.6)                         | 701 (2,654)                         | 823 (3,115) | 954 (3,611) | 1,095 (4,145) | 1,246 (4,717) | 1,577 (5,970) | 1,947 (7,370) | 2,803 (10,611) |
| 115 (7.9)                         | 717 (2,714)                         | 841 (3,184) | 976 (3,695) | 1,120 (4,240) | 1,274 (4,823) | 1,613 (6,106) | 1,991 (7,537) | 2,867 (10,853) |
| 120 (8.3)                         | 732 (2,771)                         | 859 (3,252) | 997 (3,774) | 1,144 (4,331) | 1,301 (4,925) | 1,647 (6,235) | 2,034 (7,700) | 2,928 (11,084) |

Chart E-2: Nozzle Flow and Pressure Ratings, Part 2

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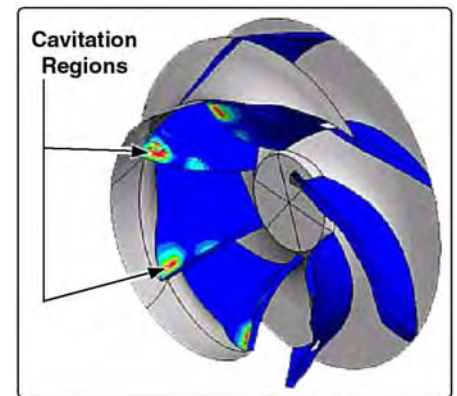


## Appendix F: Cavitation

(See Figure F-1: “Sample, Cavitation Regions.”)

Cavitation can occur while pumping from draft, in relay, or from a hydrant (although it is more likely from draft conditions). The operator must be aware of the warning signs and immediately correct the situation.

Cavitation can damage the impeller and other sensitive components, impair pump performance, and reduce flow capacity. The damage done during any one period of cavitation is not great, but the effects are cumulative. Implosions occurring during cavitation break away or erode tiny pieces of metal from the internal parts and the pump casing. When enough metal has been chipped away, the impeller becomes unbalanced causing a strain and vibration on bearings, bushings and shafts.



**Figure F-1: Sample, Cavitation Regions**

### Process of Cavitation

Cavitation occurs when a centrifugal pump attempts to discharge more water than it is receiving. Bubbles are created under the vacuum, formed near the eye of the impeller. Cavitation is often referred to as “the pump running away from the fluid supply.” This means you are trying to pump more water out of the pump than is going into the pump.

The formation of bubbles in the low pressure regions of the impeller cause the impeller to “slip” in the water, since the impeller is designed to move liquid not the air in the bubbles. (See Figure F-1: “Sample, Cavitation Regions.”)

When increased discharge flow exceeds the intake, bubbles form in the low-pressure region at the eye of the impeller. The pressure of the water in the pump drops as it flows from the suction flange through the suction nozzle and into the impeller.

As flow from the pump increases, the vacuum at the impeller increases. As vacuum increases, water near the impeller eye begins to boil and vaporizes.

Once the vapor pockets (bubbles) enter the impeller, the process begins to reverse itself. As the vapor reaches the discharge side of the pump, it is subjected to a high positive pressure and condenses back to a liquid.

This sudden change from vapor to liquid generates a shock effect that damages the impeller and pump housing. Usually there are thousands of tiny vapor pockets (or bubbles).

It is the collapsing (or implosion) of these bubbles that causes the characteristic sound of cavitation that has been described as rocks tumbling in the pump.

## **Warning Signs of Cavitation (Discharge and Gauges)**

### **Discharge Pressure**

In a properly functioning pump, an increase in RPM increases the discharge pressure and volume. An increase in engine RPM that does not cause an increase in the pump discharge pressure is the most reliable indication that a pump is approaching cavitation.

### **Vacuum Compound Gauge**

Do not depend entirely on the vacuum (compound) gauge to indicate when a pump is nearing cavitation.

The vacuum gauge is usually installed several inches away from the leading edge of the impeller eye where the greatest amount of vacuum occurs. The vacuum gauge does not take into account ambient temperature nor atmospheric pressure and is not accurate near zero (0) on the vacuum scale.

## **To Eliminate Cavitation**

To eliminate cavitation, the operator must be aware of the warning signs listed above. Low barometer, high elevation, and elevated water temperature also contribute to cavitation.

The most common way to eliminate cavitation is to decrease the amount of water being discharged by decreasing engine speed or closing discharge valves. However, this also results in a reduction of flow.

Cavitation is also eliminated by increasing the pump inlet pressure. This is accomplished with reduced vertical lift, reduced inlet losses, or running from positive pressure supplies.

## During Operations

- Do not increase pump speed beyond the speed at which the pressure ceases to rise. The higher the elevation above sea level, the lower the atmospheric pressure and less lift. *Lift loss is in addition to NFPA Baseline of 2.38 ft. (0.73 meters) at 2,000 (610 meters) of elevation - see Figure F-3: "Lift Loss from Elevation" on page 103.*
- Open the throttle gradually and watch the pressure gauge and the tachometer, if equipped. An increase in engine RPM without a corresponding increase in pressure indicates cavitation.
- Monitor the water temperature. Figure F-2: "Lift Loss from Temperature" shows the amount of lift loss as temperatures rise.
- Monitor barometric pressure. NFPA standard sets a baseline of 29.9" Hg. (See Figure F-3a: "Lift Loss from Barometric Reading.")

| Water Temperature<br>F° (C°) |       | Lift Losses<br>Head Ft. (Meters) |        |
|------------------------------|-------|----------------------------------|--------|
| 60°                          | (16°) | NFPA Base Line - 2.38 (0.73mm)   |        |
| 70°                          | (21°) | 0.3                              | (0.09) |
| 80°                          | (27°) | 0.6                              | (0.18) |
| 90°                          | (32°) | 1.1                              | (0.34) |
| 100°                         | (38°) | 1.7                              | (0.52) |
| 110°                         | (43°) | 2.5                              | (0.76) |

Figure F-2: Lift Loss from Temperature

| Elevation, Feet (Meters) |         | Lift Loss, Feet (Meters)       |        |
|--------------------------|---------|--------------------------------|--------|
| 2,000                    | (610)   | NFPA Base Line - 2.38 (0.73mm) |        |
| 3,000                    | (914)   | 1.1                            | (0.33) |
| 4,000                    | (1,219) | 2.2                            | (0.67) |
| 5,000                    | (1,524) | 3.3                            | (1.00) |
| 6,000                    | (1,829) | 4.4                            | (1.34) |
| 7,000                    | (2,134) | 5.5                            | (1.67) |
| 8,000                    | (2,438) | 6.6                            | (2.01) |
| 9,000                    | (2,743) | 7.7                            | (2.35) |
| 10,000                   | (3,048) | 8.8                            | (2.68) |

Figure F-3: Lift Loss from Elevation

| Barometric Reading<br>in. (mb) |           | Lift Loss, Head Ft. (Meters)   |        |
|--------------------------------|-----------|--------------------------------|--------|
| 29.9                           | (1,012.5) | NFPA Base Line - 2.38 (0.73mm) |        |
| 29.7                           | (1,005.8) | 0.2                            | (0.6)  |
| 29.5                           | (999)     | 0.5                            | (0.15) |
| 29.3                           | (999.2)   | 0.7                            | (0.21) |
| 29.1                           | (985.4)   | 0.9                            | (0.27) |
| 28.9                           | (987.7)   | 1.1                            | (0.33) |
| 28.7                           | (971.9)   | 1.4                            | (0.43) |

Figure F-3a: Lift Loss from Barometric Reading

- Regularly inspect suction hoses to check for air leaks. Air leaks can also cause cavitation.
- Check suction strainer for blockage or effectiveness. See heading "Strainers:" on page 104.

## Preventive Measures

- Consider the size of the suction hose. Figure F-4: "Hose Size vs. Pump Rating Capacity" on page 104, lists the NFPA pre-selected hose sizes for each pump-rating capacity. Using the appropriately sized hose minimizes the occurrence of cavitation. An undersized suction hose can lead to cavitation.



## □ Cavitation

- Consider the piping within the truck. Suction losses can result from additional suction piping added to the fire pump during assembly.

| Hose Diameter<br>in. (mm) | 3"<br>(76)            | 4"<br>(102) | 4.5"<br>(127) | 5"<br>(127) | 6"<br>(152) | Dual<br>6" (152) |
|---------------------------|-----------------------|-------------|---------------|-------------|-------------|------------------|
| Flow - gpm (lpm)          | Lift Loss (gpm (lpm)) |             |               |             |             |                  |
| 250 (946)                 | 5.2 (20)              |             |               |             |             |                  |
| 350 (1,325)               |                       | 2.5 (9.5)   |               |             |             |                  |
| 500 (1,893)               |                       | 5.0 (19)    | 3.6 (13.6)    |             |             |                  |
| 750 (2,839)               |                       | 11.4 (43)   | 8.0 (30)      | 4.7 (18)    | 1.9 (7.2)   |                  |
| 1,000 (3,785)             |                       |             | 14.5 (55)     | 8.5 (32)    | 3.4 (13)    |                  |
| 1,250 (4,732)             |                       |             |               | 13 (49)     | 5.2 (20)    |                  |
| 1,500 (5,678)             |                       |             |               |             | 7.6 (29)    | 1.9 (7.2)        |
| 1,750 (6,625)             |                       |             |               |             | 10.4 (39)   | 2.6 (10)         |
| 2,000 (7,571)             |                       |             |               |             |             | 3.4 (13)         |
| 2,500 (9,464)             |                       |             |               |             |             | 5.2 (20)         |

**Figure F-4: Hose Size vs. Pump Rating Capacity**

- Follow the maintenance and inspection procedures.
- Cavitation can also occur when air enters the pump. The pump could be primed; however, air leaks can cause rough operation and an increase of engine speed without an increase in pressure or flow. If an air leak is suspected, refer to Section 5 "Troubleshooting" on page 47.
- Using "soft sleeve" vs. "hard sleeve." The soft sleeve has an advantage as the sleeve collapses under a partial vacuum (visual indication of cavitation), even though the intake gauge might still indicate a positive pressure. With a hard sleeve, the only indicator would be the intake gauge, which is inaccurate at close to the ZERO (0) reading.

### **Strainers:**

Clogged strainers or suction strainer selection, restricting flow. Verify the hose strainers and suction strainer are clear (unobstructed) and located deep enough in the water source to insure constant, uninterrupted water flow.

**Note:** Strainer type, basket vs. barrel, also has an affect on water flow which can contribute to flow restrictions, thus causing cavitation and reduced pump performance, especially during high drafting conditions. Basket strainers are preferred by Hale due to their overall suction and straining area.

- Turbulence or whirlpools in the hose line can be caused by excessive operating pressures from the intake source. Carefully monitor and reduce pressures as needed.

## Express Warranty

**EXPRESS WARRANTY:** Class1 (Hale Products, Inc.) hereby warrants to the original Buyer that products manufactured by Class1 are free of defects in material and workmanship for one (1) year. The "Warranty Period" commences on the date the original Buyer takes delivery of the product from the manufacturer.

**LIMITATIONS:** Class1's obligation is expressly conditioned on the Product being:

- Subjected to normal use and service.
- Properly maintained in accordance with Class1's Instruction Manual as to recommended services and procedures.
- Not damaged due to abuse, misuse, negligence, or accidental causes.
- Not altered, modified, serviced (non-routine) or repaired other than by an Authorized Service Facility.
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- Any notice to Class1 must be in writing, identifying the Product (or component) claimed defective and circumstances surrounding its failure.
- Class1 reserves the right to physically inspect the Product and require Buyer to return same to Class1's plant or other Authorized Service Facility.
- In such event, Buyer must notify Class1 for a Returned Goods Authorization Number and Buyer must return the product F.O.B. within thirty (30) days thereof.
- If determined defective, Class1 shall, at its option, repair or replace the Product, or refund the purchase price (less allowance for depreciation).
- Absent proper notice *within* the Warranty Period, Class1 shall have no further liability or obligation to Buyer therefore.

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# HP Series Trans-Portable Pumps

## Drawing Package and Engine Manual

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| HP75 - B18 Series Layout.....                 | EQ757A |
| HP100 - B18 Series Layout.....                | EQ758A |
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| HP400 - B18 Series Layout.....                | EQ761A |
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| HPX300-BD26, Diesel SLIP .....                | EQ723A |

### Pump Parts Drawings

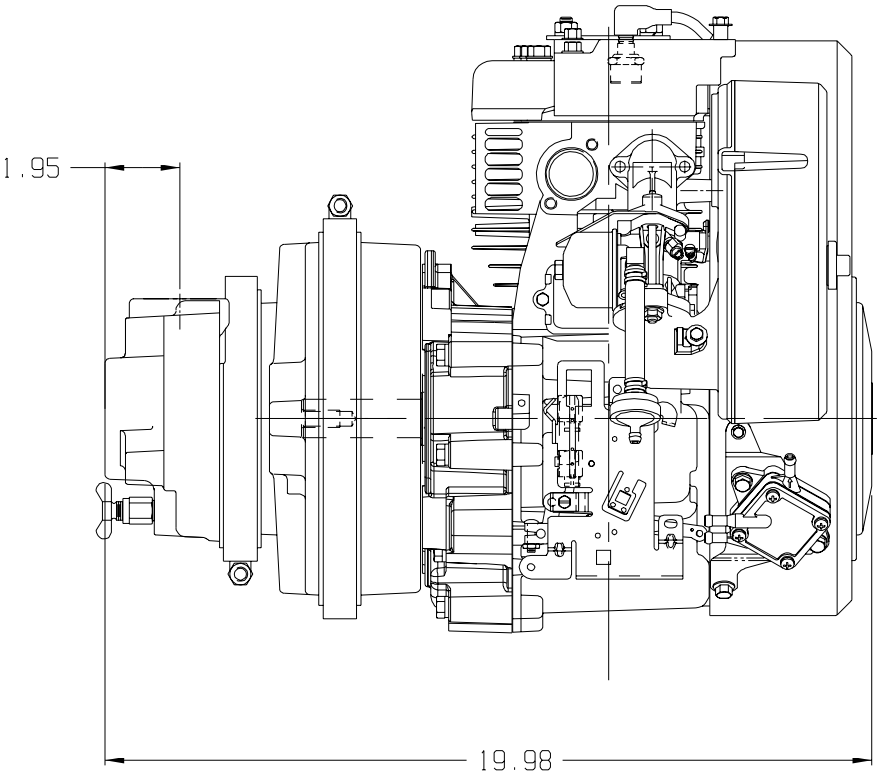
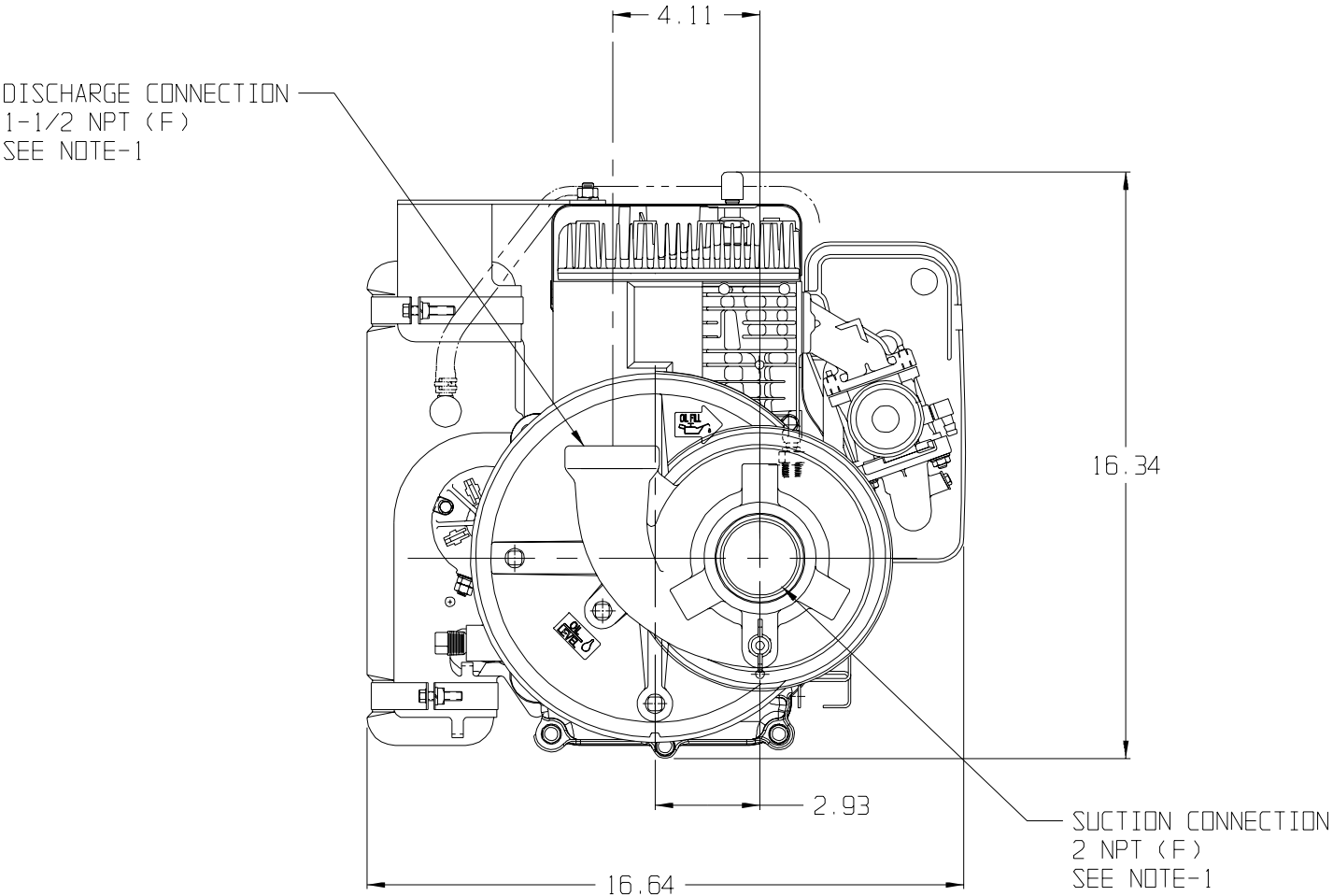
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### Engine Manual

|                                                                                |             |
|--------------------------------------------------------------------------------|-------------|
| Brigs & Stratton, Vanguard V-Twin Operating and Maintenance Instructions ..... | 276343-7/05 |
| Honda Option, Engine Owner's Manual, GX610 ● GX620 ● GX670.....                | POM53094-C  |



WEIGHT: 157 LBS



NOTE:  
1. REFERENCE PLATE 935 FOR OPTIONAL SUCTION/DISCHARGE ADAPTERS.

MODEL: HPX75-B11 MAX-STREAM PUMP

NOTE: WEIGHT IS APPROXIMATE. ACTUAL WEIGHT DEPENDS ON FINAL CONFIGURATION.

EQ763AA

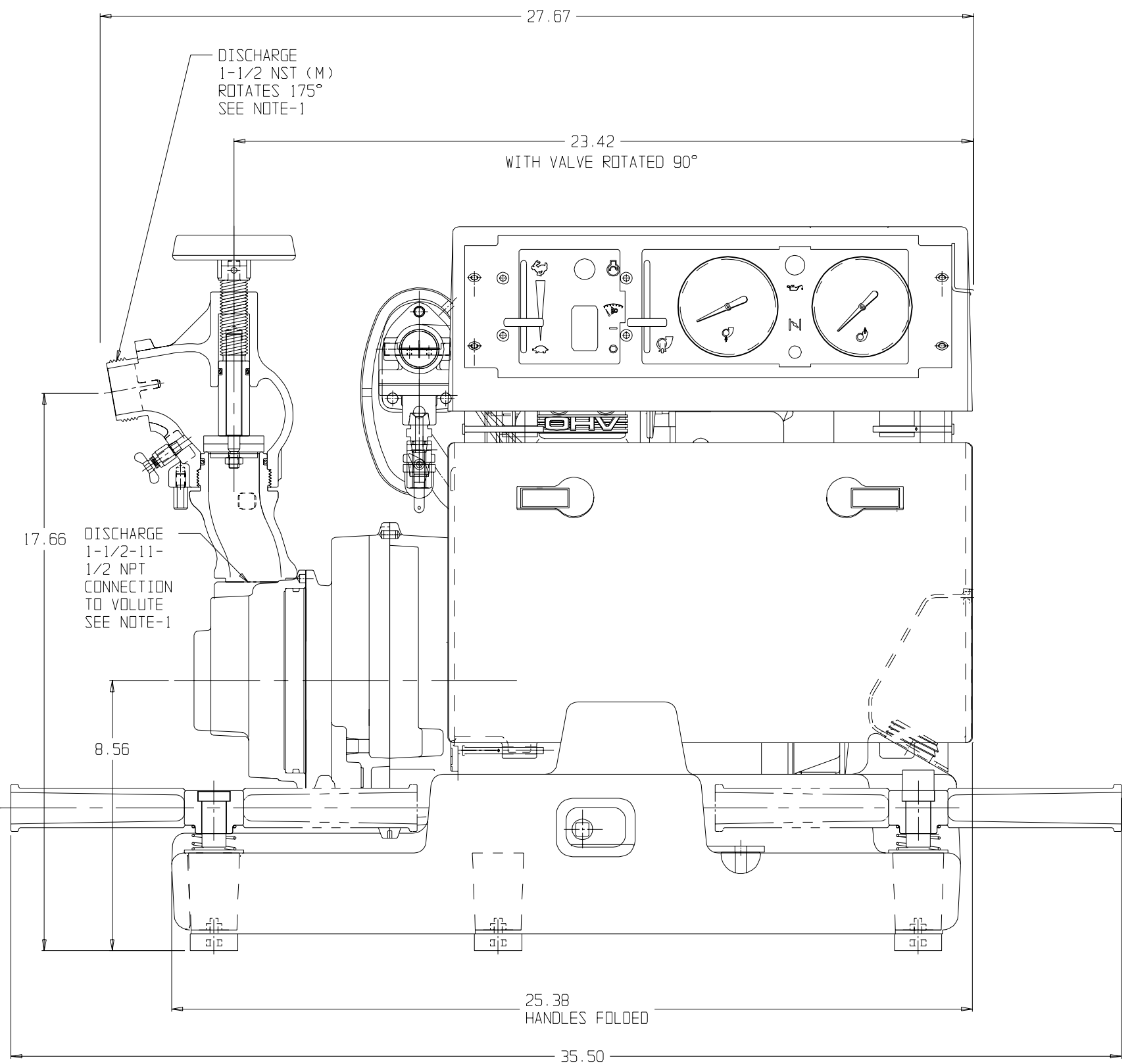
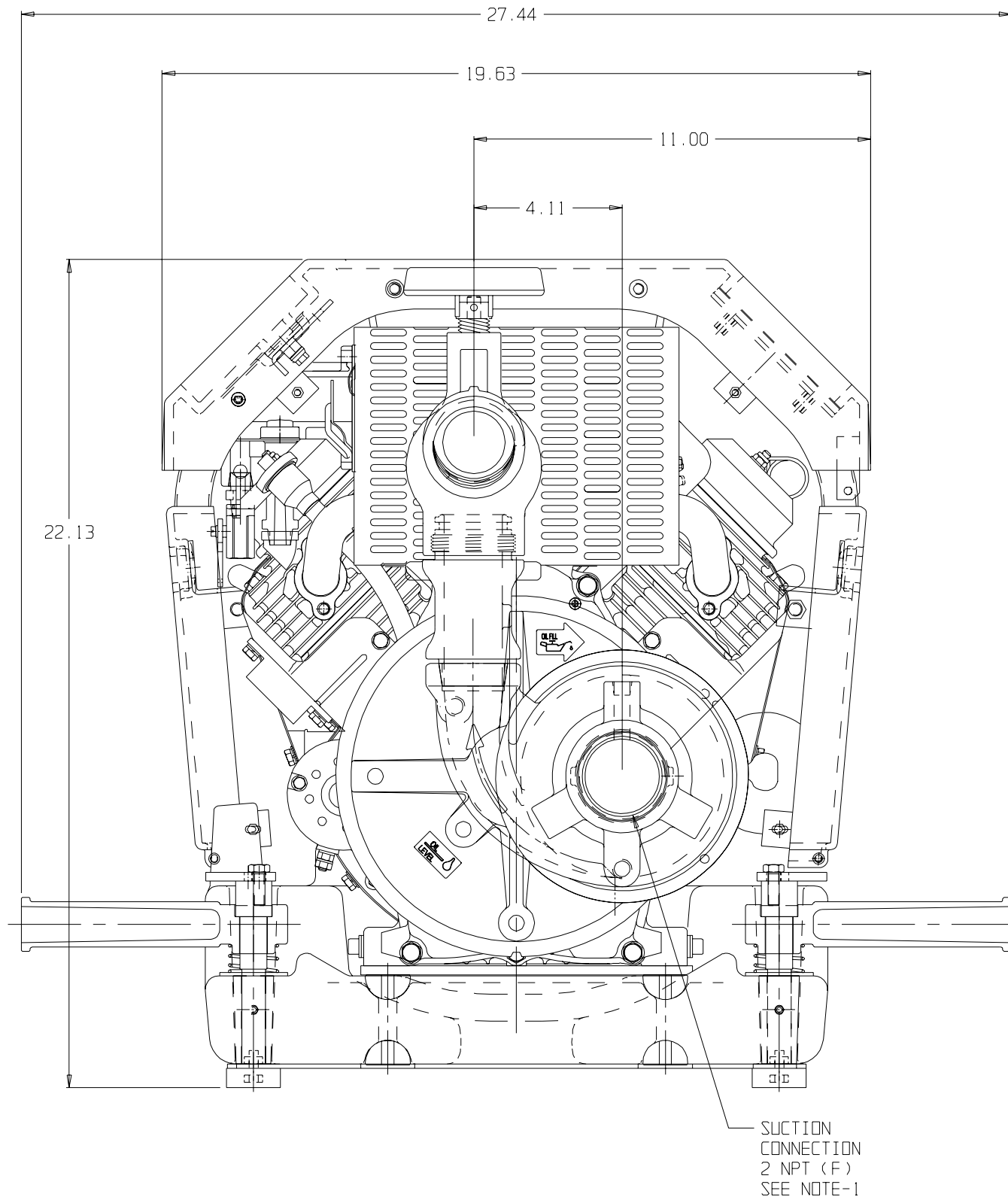
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## Notes

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NOTE:  
1. REFERENCE PL935 FOR OPTIONAL SUCTION/DISCHARGE ADAPTERS.

## HP75-B18 SERIES MASTER LAYOUT

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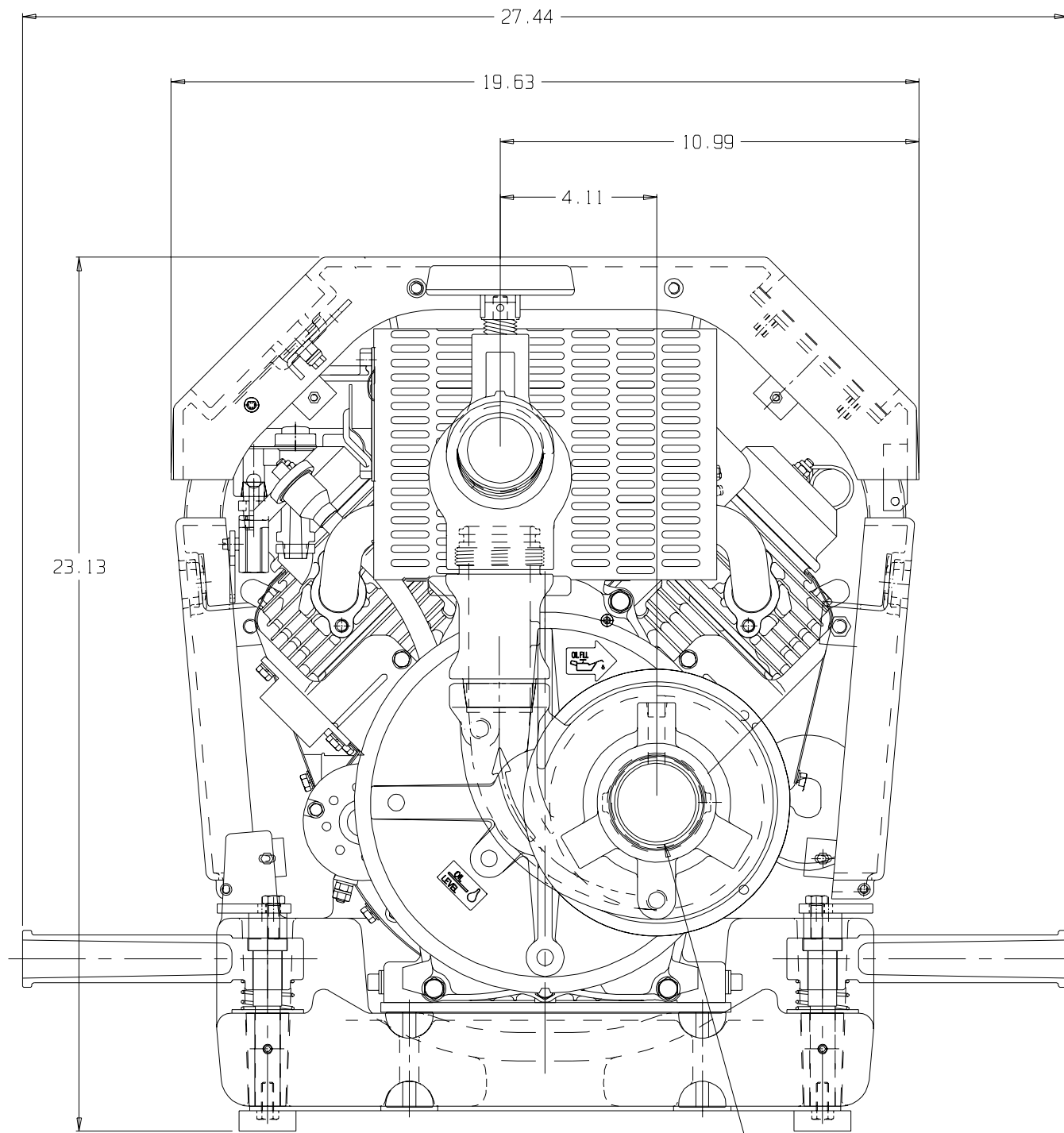
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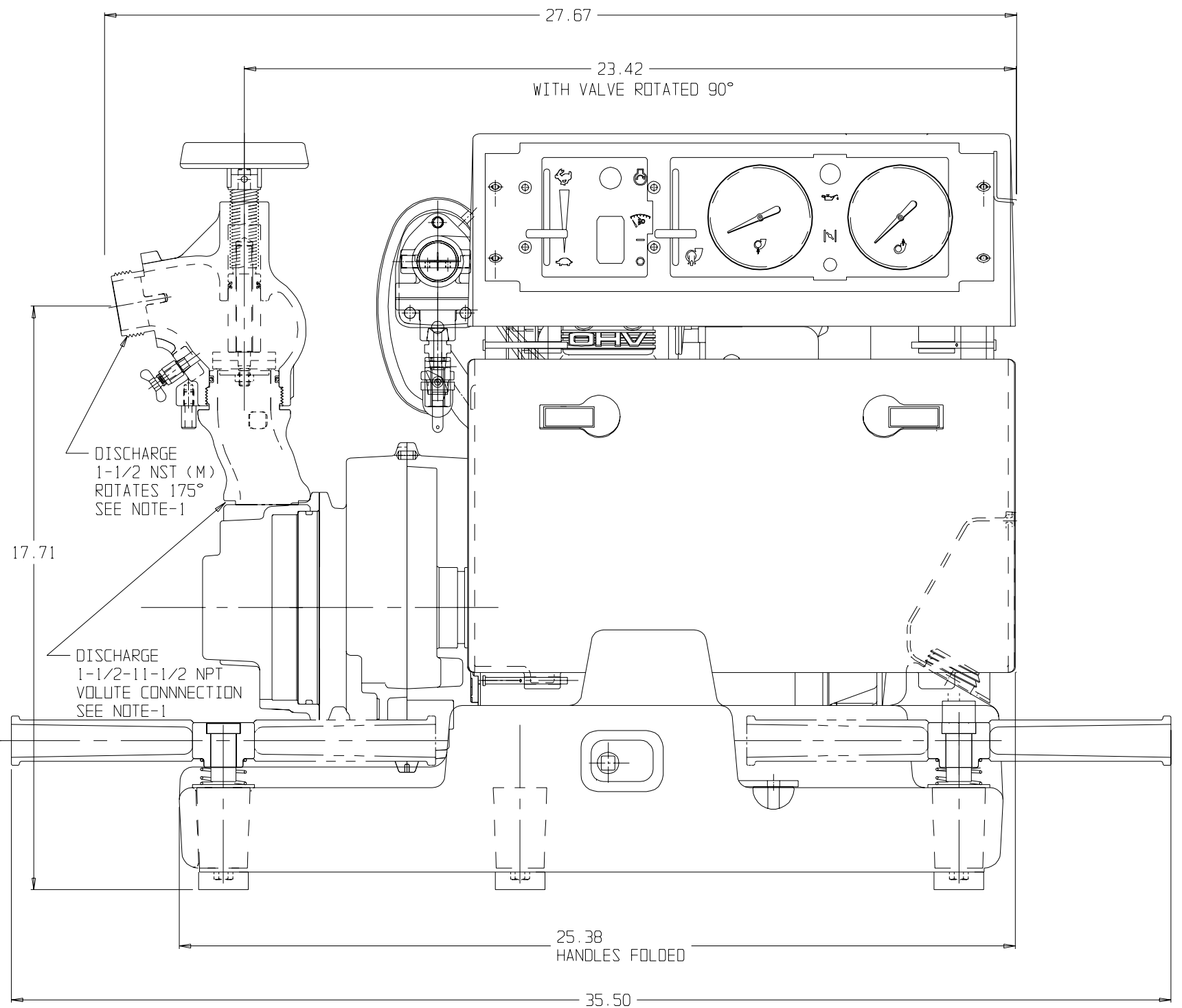


## Notes

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NOTE:  
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## HP100-B18 SERIES MASTER LAYOUT

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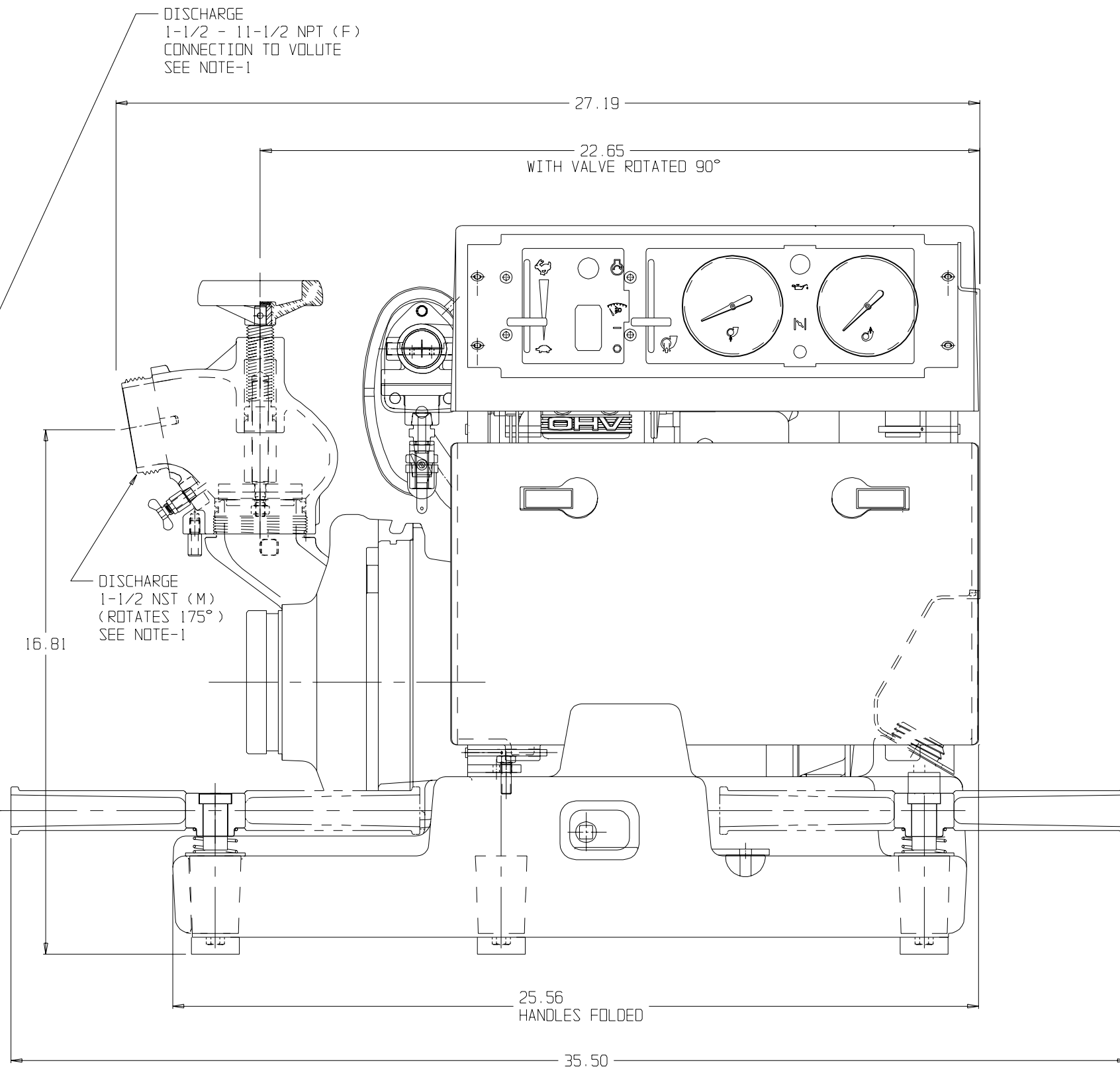
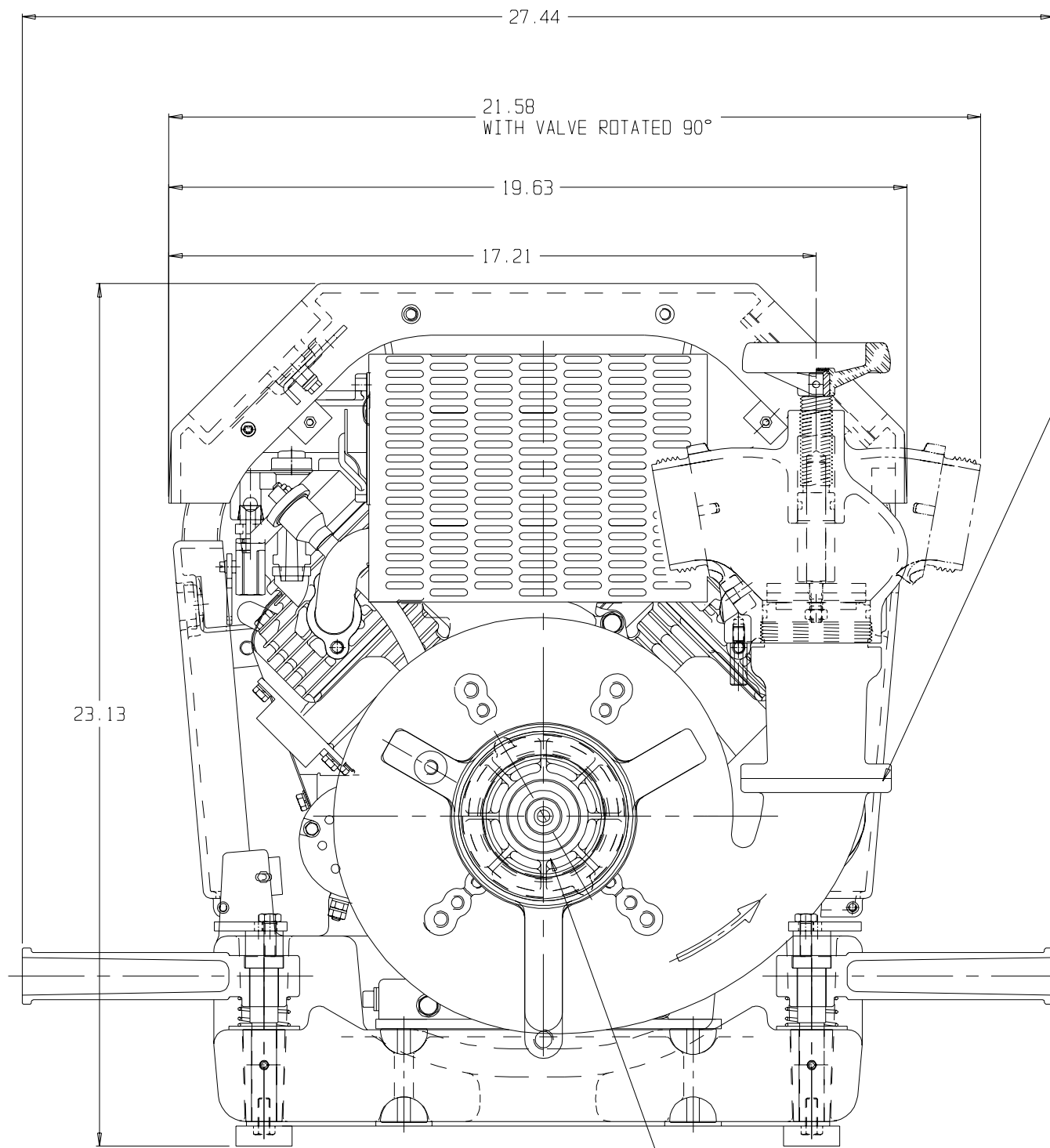
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## Notes

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NOTE:  
1. REFERENCE PL935 FOR OPTIONAL SUCTION/DISCHARGE ADAPTERS.

## HP200-B18 SERIES MASTER LAYOUT

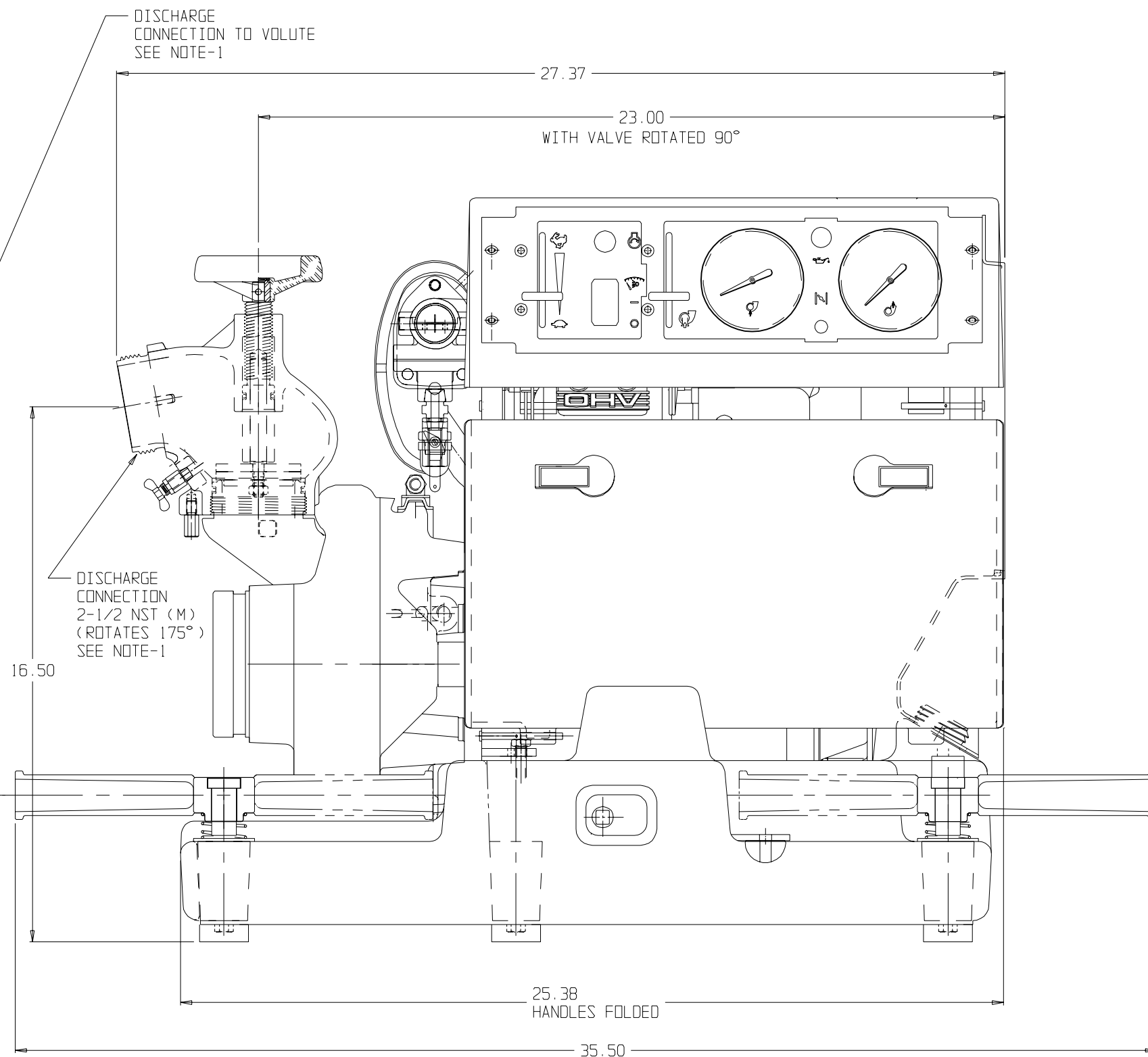
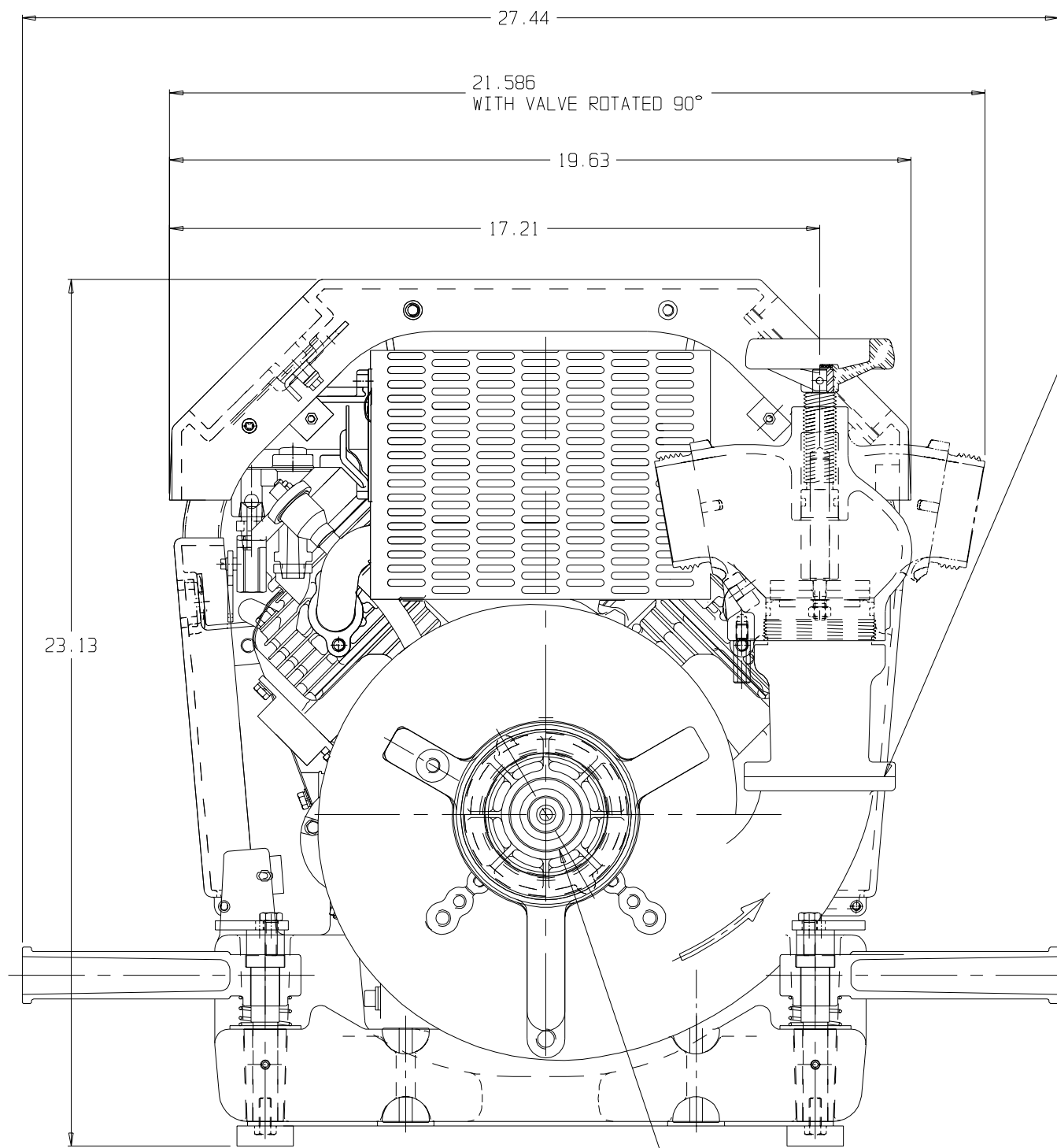
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|                                                                                       |                  |                                                                                 |             |
|---------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------|-------------|
|  |                  | HALE PRODUCTS, INC.<br>A Unit of IDEX Corporation<br>Conshohocken, PA 19428 USA |             |
|                                                                                       |                  | DATE 1-3-01                                                                     | SCALE: FULL |
| NOT TO BE REPRODUCED OR USED TO MAKE OTHER DRAWINGS OR MACHINERY                      | DRAWN<br>CHECKED | TC<br>MAL                                                                       | SIZE<br>D   |

## Notes

[illegible]



NOTE:  
1. REFERENCE PLATE 935 FOR OPTIONAL SUCTION/DISCHARGE ADAPTERS.

## HP300-B18 SERIES MASTER LAYOUT

EQ760AA

| ECD NO | REV | CHANGED FROM            | BY | DATE   | APVD |
|--------|-----|-------------------------|----|--------|------|
| 01-005 | A   | RELEASED FOR PRODUCTION | TC | 1-8-01 | MAL  |
|        |     |                         |    |        |      |
|        |     |                         |    |        |      |

|                                                                                    |  |                  |           |             |           |             |
|------------------------------------------------------------------------------------|--|------------------|-----------|-------------|-----------|-------------|
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|------------------------------------------------------------------------------------|--|------------------|-----------|-------------|-----------|-------------|

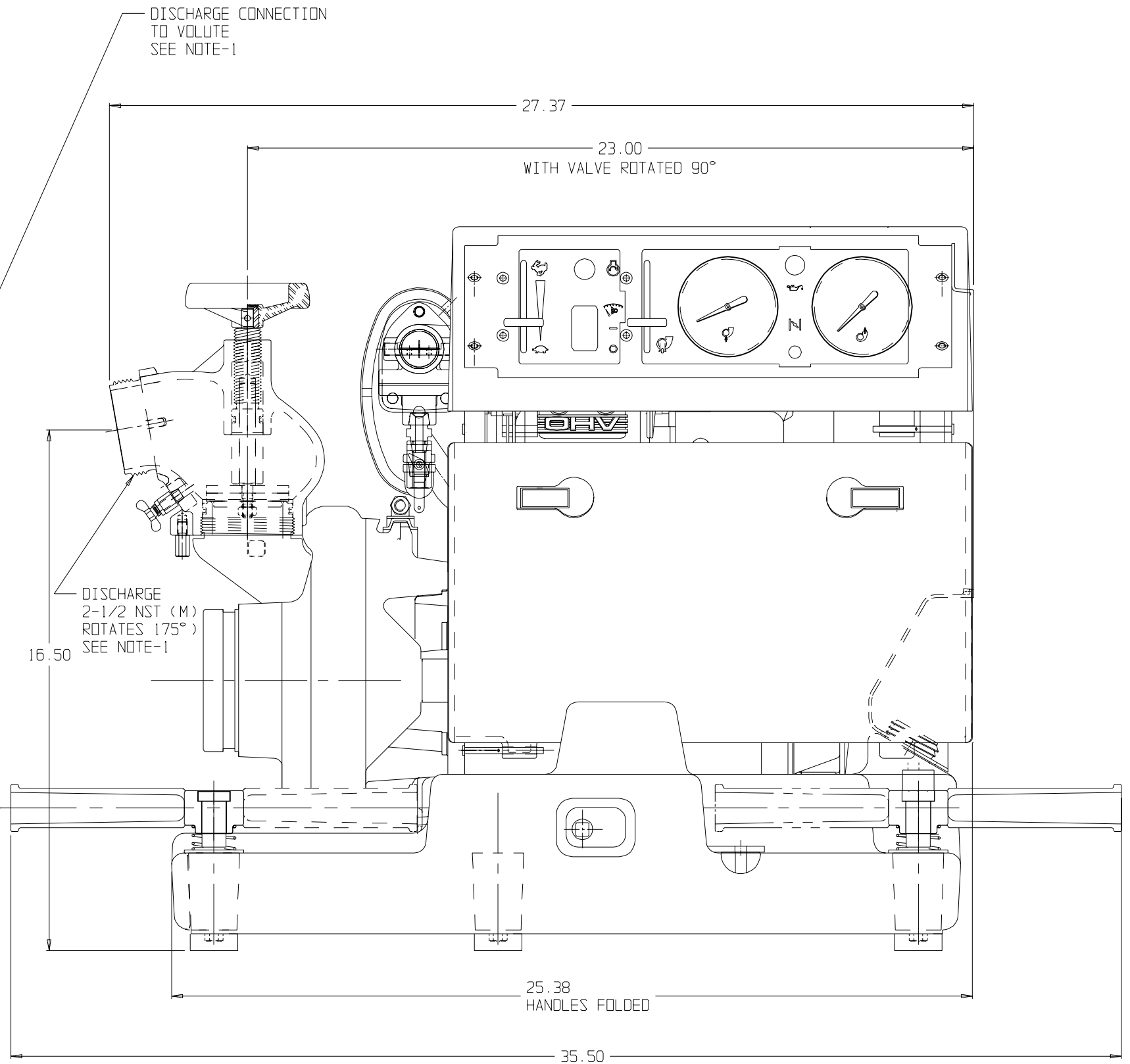
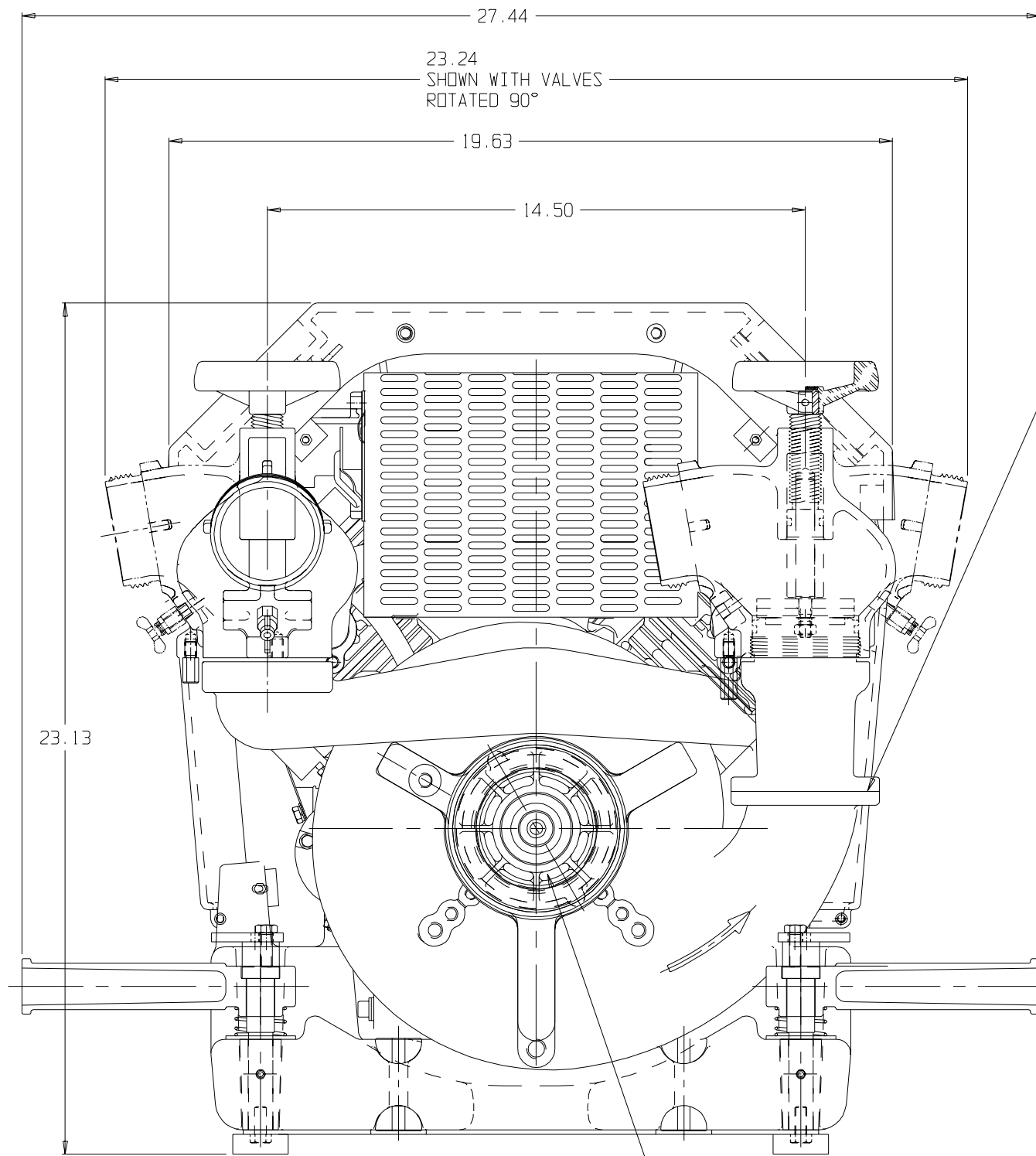


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## Notes

[illegible]



NOTE:  
1. REFERENCE PLATE 935 FOR OPTIONAL SUCTION/DISCHARGE ADAPTERS.

## HP400-B18 SERIES MASTER LAYOUT

EQ761AA

| ECD NO | REV | CHANGED FROM            | BY | DATE   | APVD |
|--------|-----|-------------------------|----|--------|------|
| 01-005 | A   | RELEASED FOR PRODUCTION | TC | 1-8-01 | MAL  |
|        |     |                         |    |        |      |
|        |     |                         |    |        |      |

|                                                                                       |                  |                                                                                 |             |
|---------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------|-------------|
|  |                  | HALE PRODUCTS, INC.<br>A Unit of IDEX Corporation<br>Conshohocken, PA 19428 USA |             |
|                                                                                       |                  | DATE 1-3-01                                                                     | SCALE: FULL |
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## Notes

[illegible]

# HPX200-BD26 DIESEL SLIP-ON PUMP

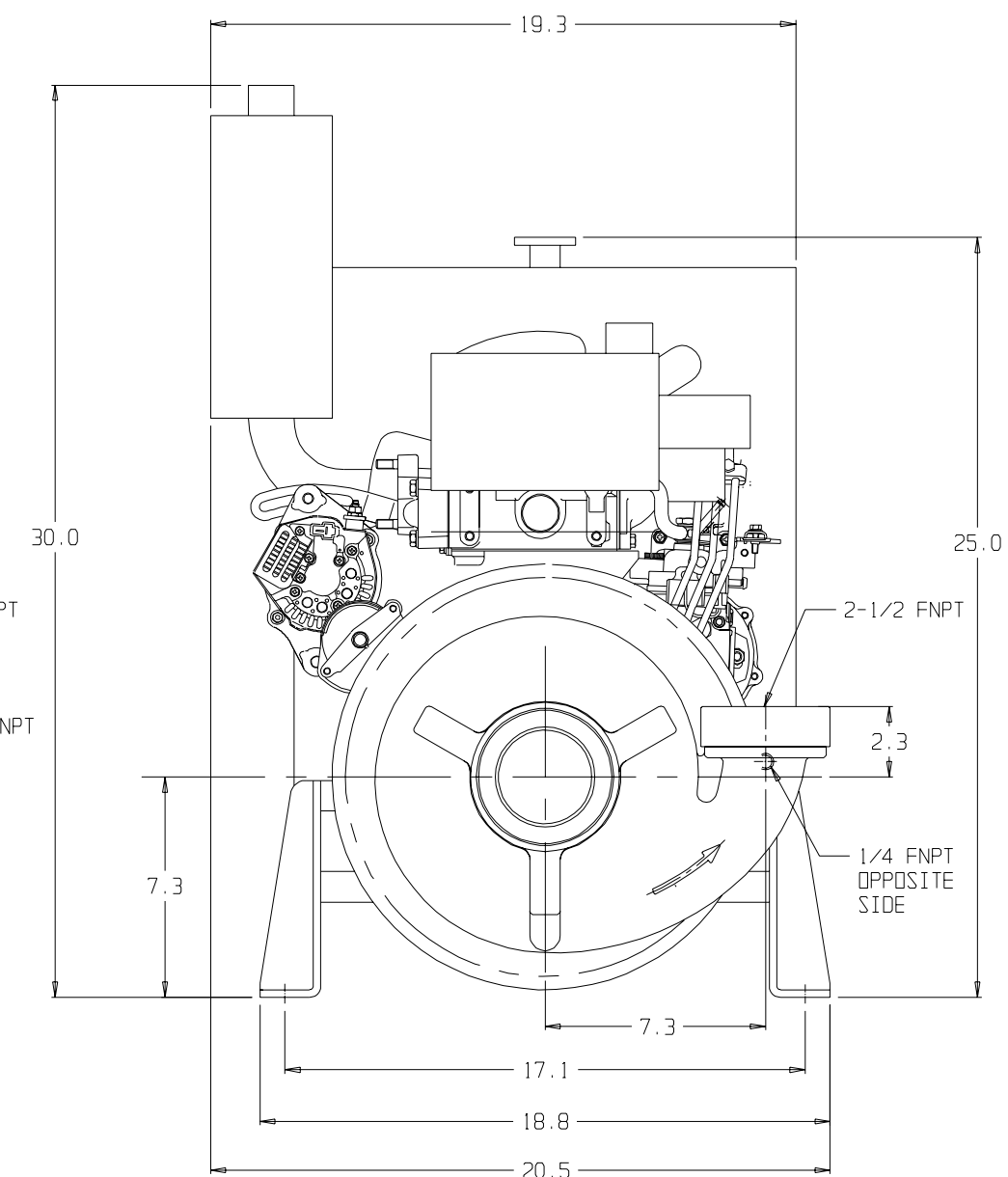
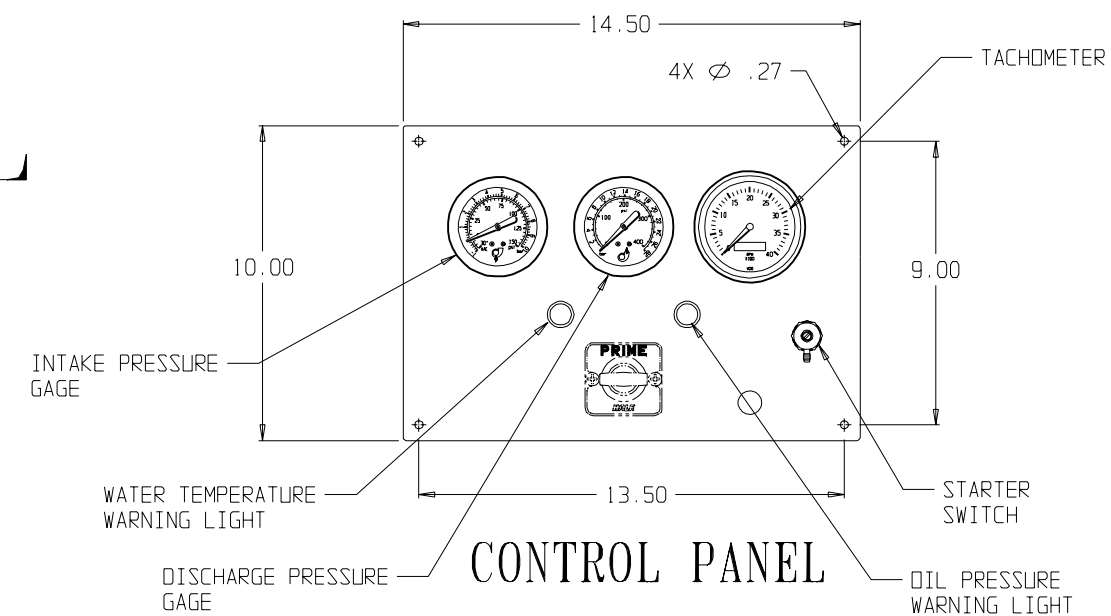
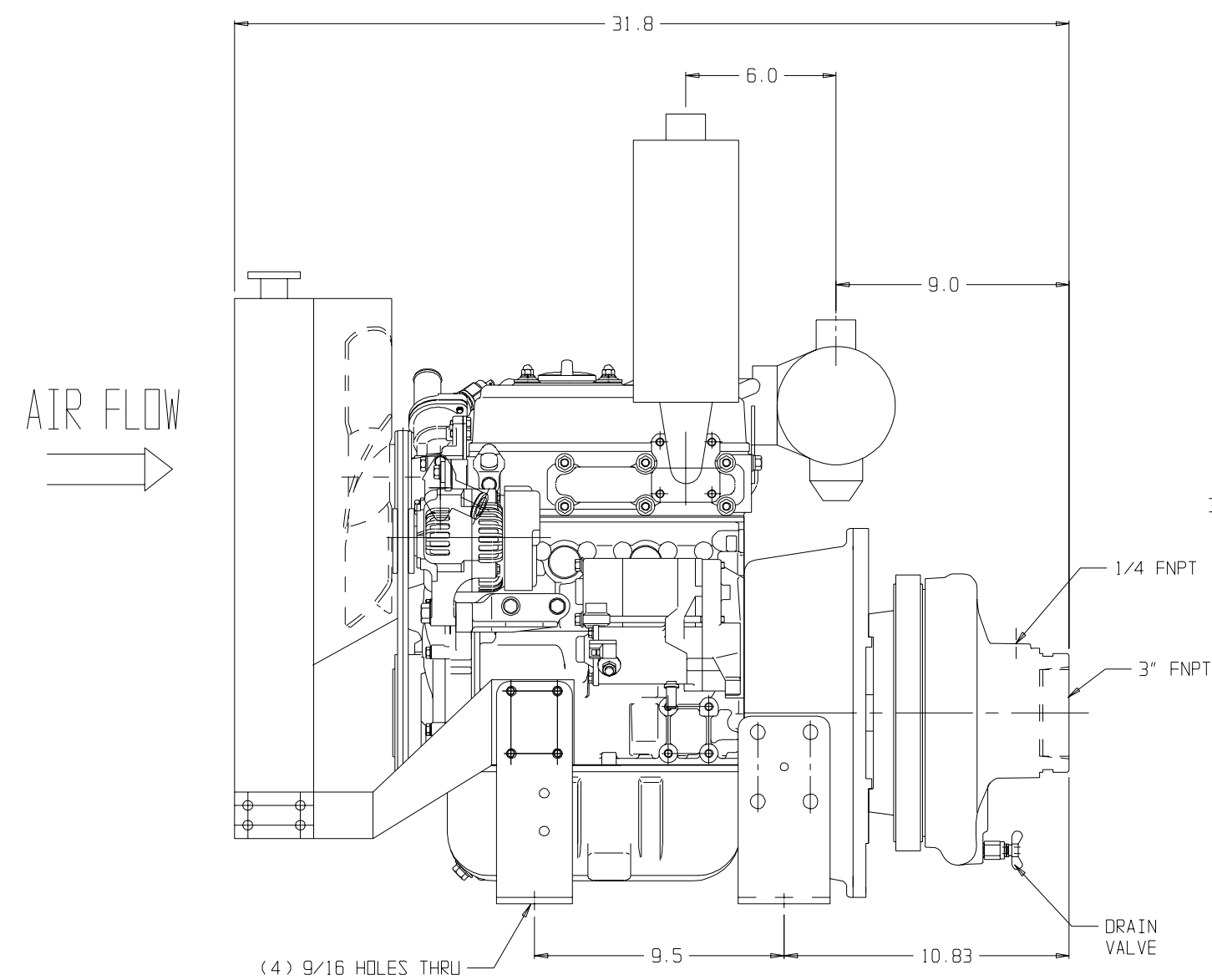


PLATE NO. EQ722C

| ECO NO  | REV | CHANGED FROM                    | BY  | DATE     | APVD |  | HALE PRODUCTS, INC.<br>A Unit of IDEX Corporation<br>Conshohocken, PA 19428 USA | DRAWN [CJ]<br>CHECKED [MS] | DATE 11-14-97 | SCALE: NONE |
|---------|-----|---------------------------------|-----|----------|------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------|---------------|-------------|
| 1N98-20 | .   | RELEASED                        | MS  | 3-6-98   | MS   |                                                                                       |                                                                                 |                            |               |             |
| 1N98-37 | A   | ADDED ENG MOUNTS                | MS  | 6-11-98  | MS   |                                                                                       |                                                                                 |                            |               |             |
| 1N98-04 | B   | CHANGED PUMP NAME               | JK  | 01-30-99 | JK   |                                                                                       |                                                                                 |                            |               |             |
| 02-089  | C   | UPDATED DIMENSIONS, ADDED PANEL | JBS | 03-28-02 | MAL  |                                                                                       |                                                                                 |                            |               |             |

## Notes

[illegible]

# HPX300-BD26 DIESEL SLIP-ON PUMP

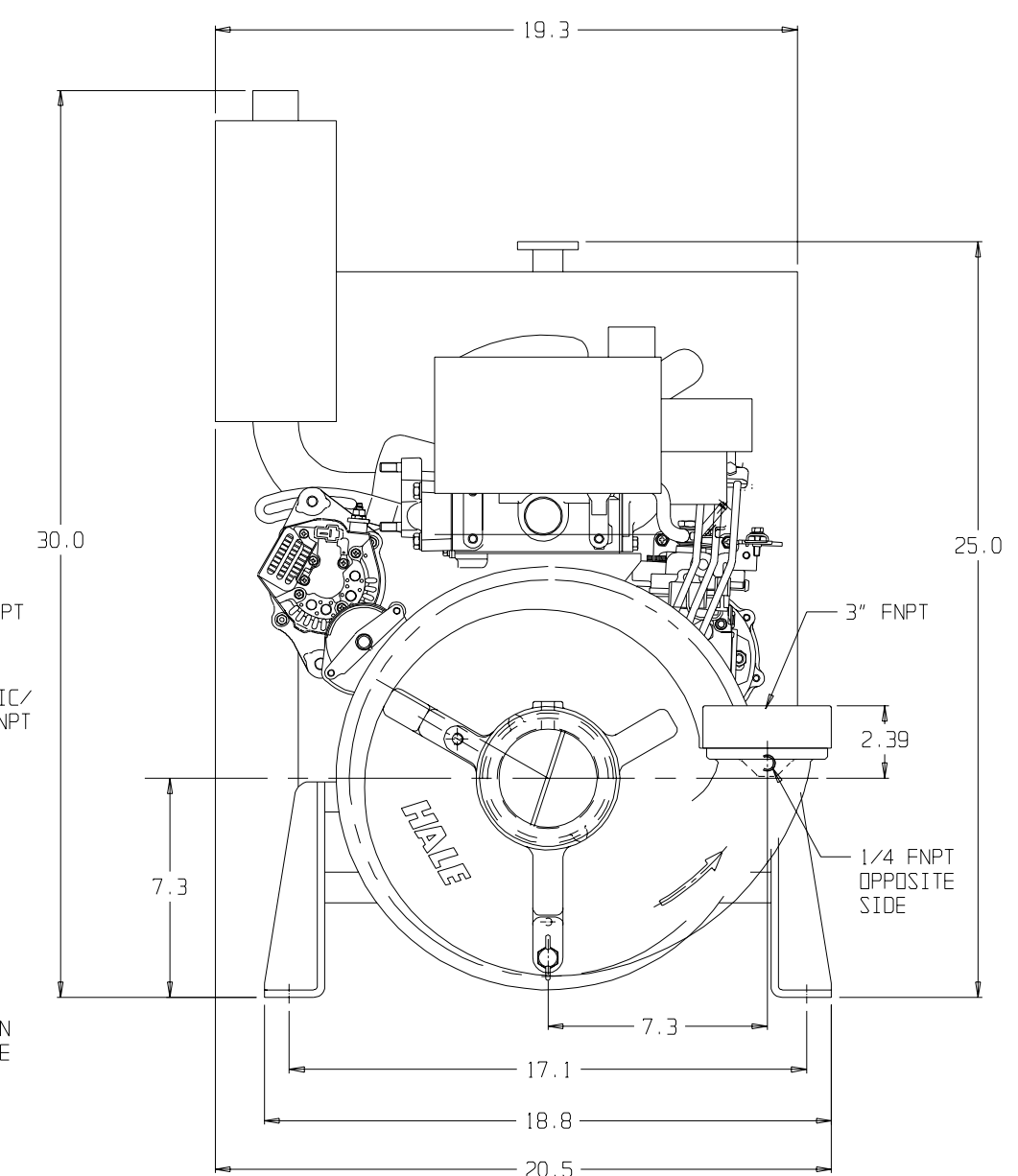
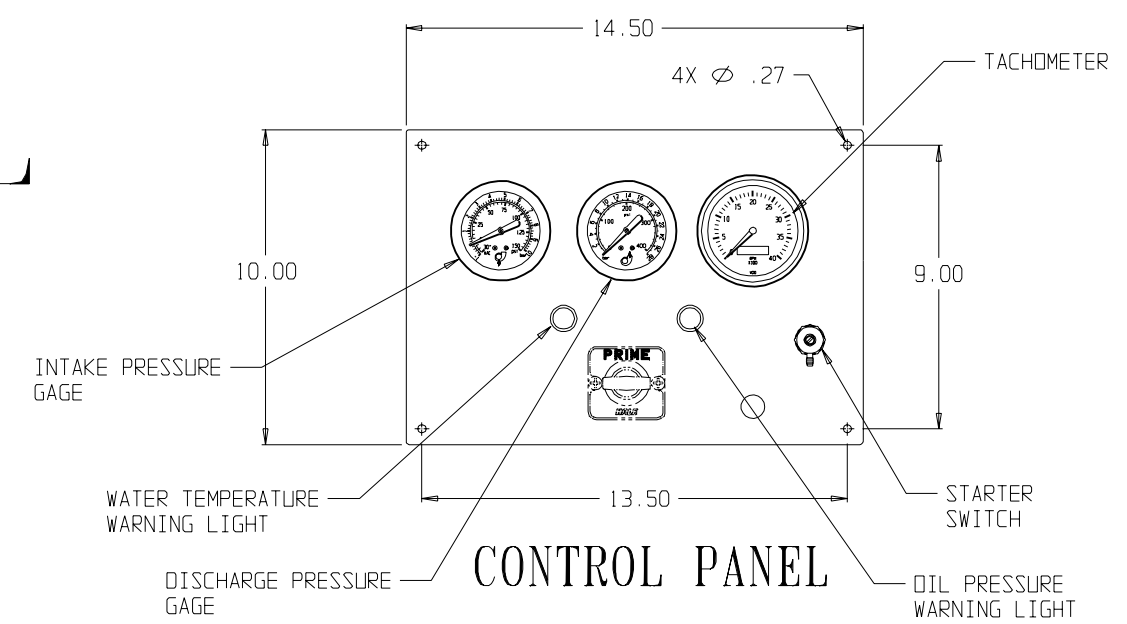
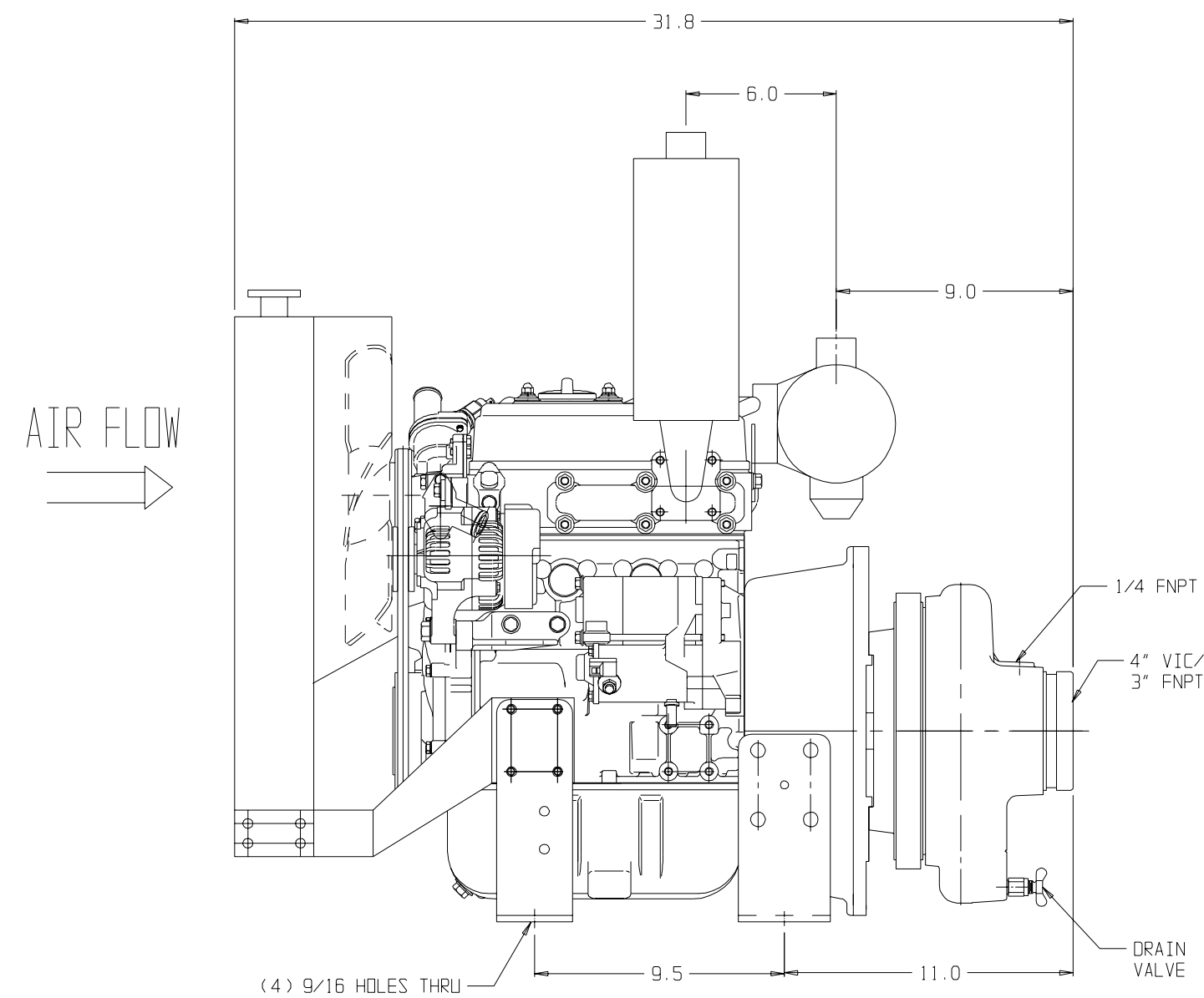


PLATE NO. EQ723A

|        |     |                 |     |          |      |
|--------|-----|-----------------|-----|----------|------|
| ECO NO | REV | CHANGED FROM    | BY  | DATE     | APVD |
| 02-194 | A   | INITIAL RELEASE | JBS | 06-27-02 | MAL  |
|        |     |                 |     |          |      |
|        |     |                 |     |          |      |
|        |     |                 |     |          |      |

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DRAWN

JBS

CHECKED

MAL

DATE

06-27-02

SIZE

1/8

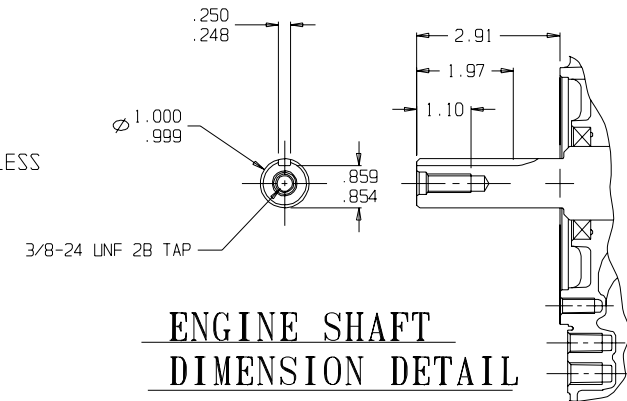
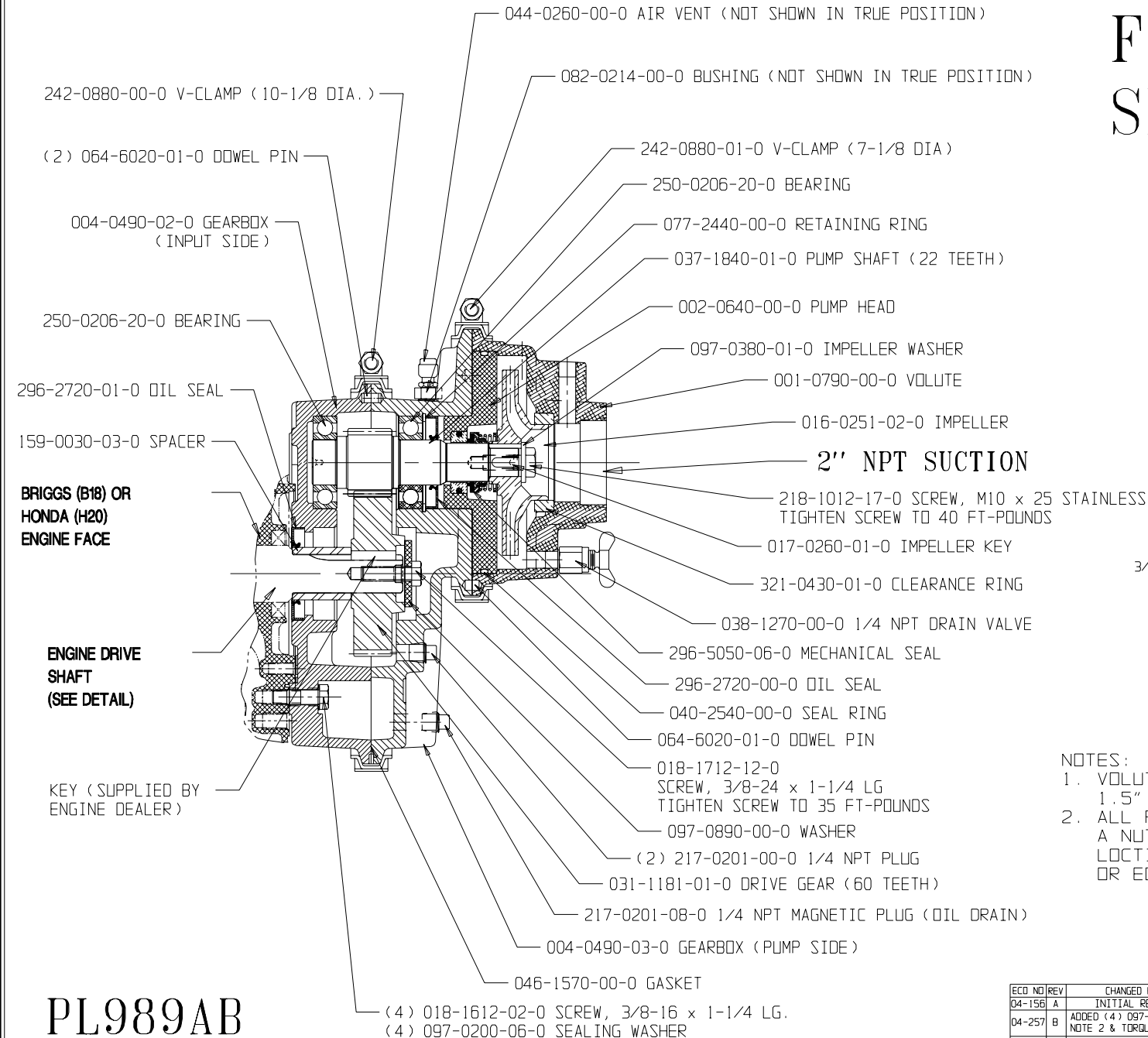
SCALE

NONE

## Notes

[illegible]

# HP75 PUMP END FOR 1" KEYED SHAFT ENGINES



## NOTES:

- VOLUTE DISCHARGE IS 1-1/2 FNPT OR 1.5" MNST DISCHARGE VALVE.
- ALL FASTENERS SHALL BE INSTALLED WITH A NUT LOCKING ANAEROBIC ADHESIVE/SEALANT: LOCTITE® #246 HIGH TEMPERATURE THREADLOCKER OR EQUIVALENT.

PL989AB

| ECO NO | REV | CHANGED FROM                                | BY  | DATE     | APVD |
|--------|-----|---------------------------------------------|-----|----------|------|
| 04-156 | A   | INITIAL RELEASE                             | JBS | 07/07/04 | MAL  |
| 04-257 | B   | ADDED (4) 097-0200-06-0<br>NOTE 2 & TORQUES | JBS | 10/26/04 | MAL  |



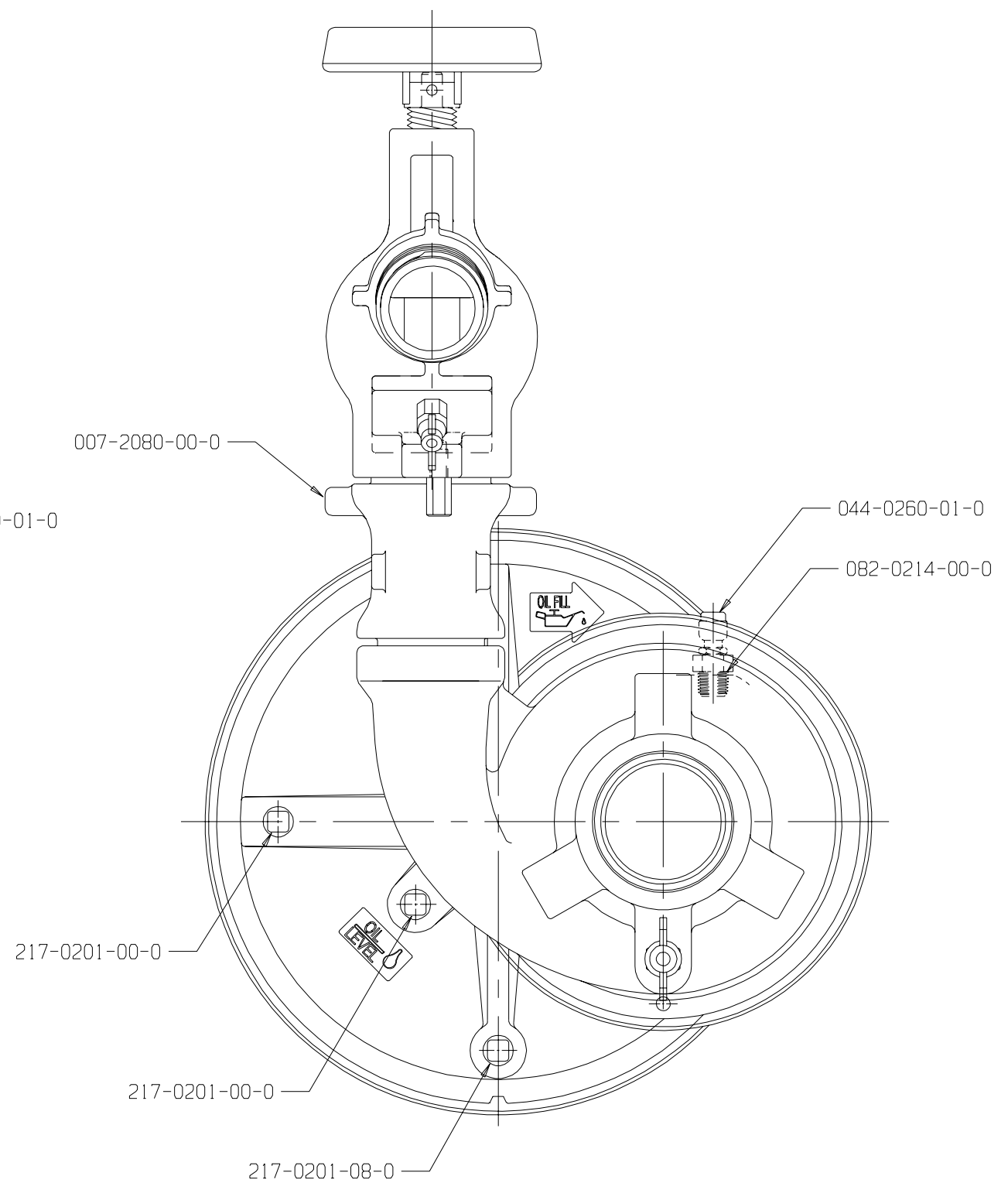
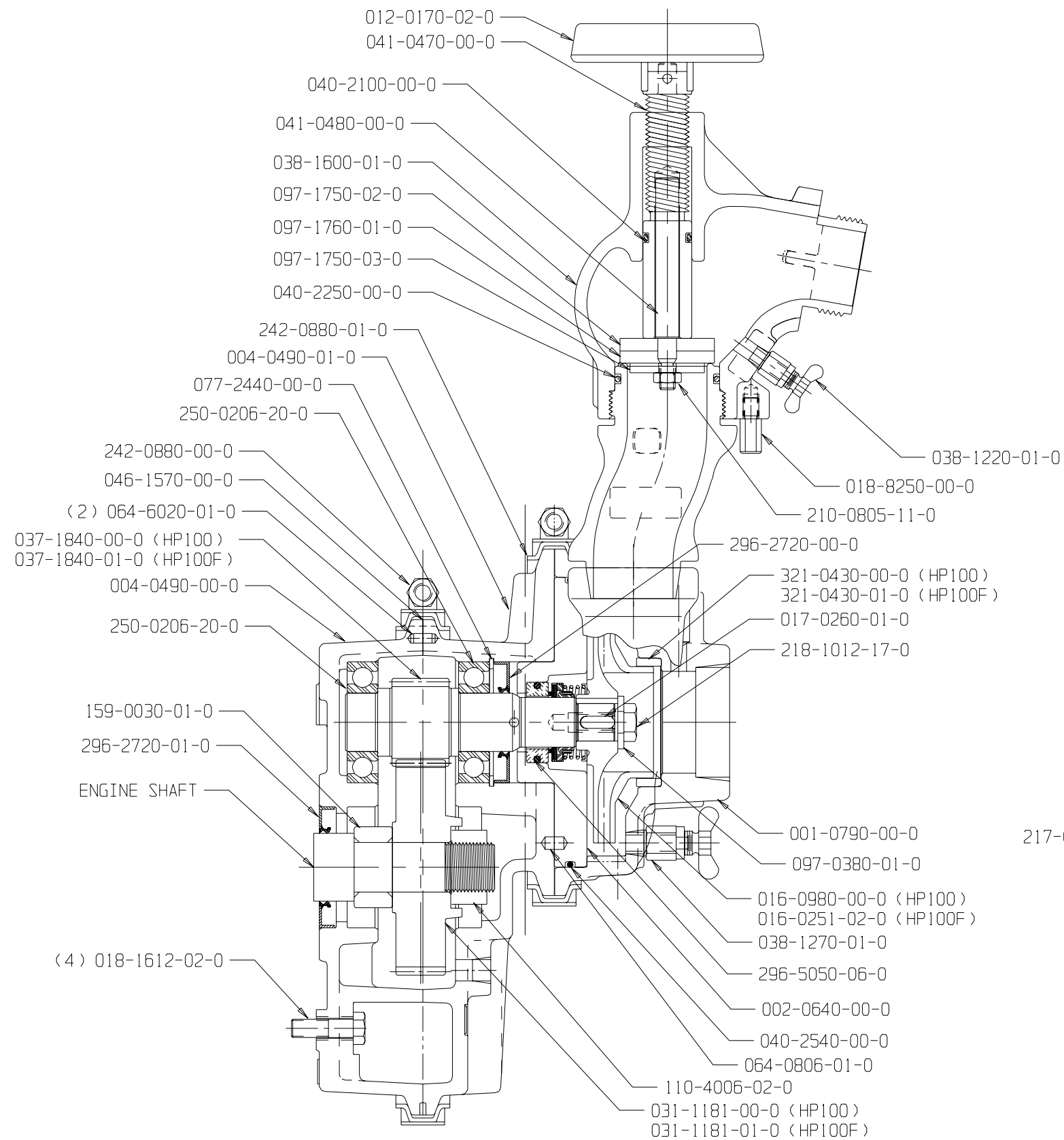
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DRAWN JBS  
CHECKED MAL  
DATE 08-27-03  
SIZE  
NTS  
SCALE: FULL

## Notes

[illegible]





# HALE TYPE HP100 PORTABLE PUMP

PLATE NO. 773

| ECO NO  | REV | CHANGED FROM                | BY | DATE    | APVD |
|---------|-----|-----------------------------|----|---------|------|
| TN97-43 | A   | ADDED GEARS, SPACER AND NUT | MS | 5-29-97 | MS   |
| TN97-78 | B   | CHANGED FROM 038-1600-00-0  | CJ | 7-24-97 | MS   |
|         |     |                             |    |         |      |
|         |     |                             |    |         |      |

HALE

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DRAWN [FAS]  
CHECKED [MS]

DATE 11-29-93

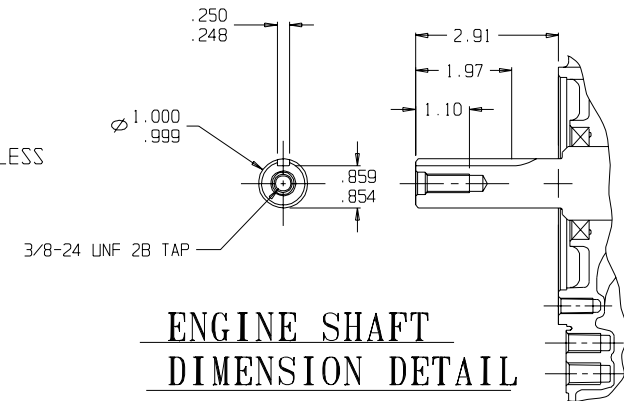
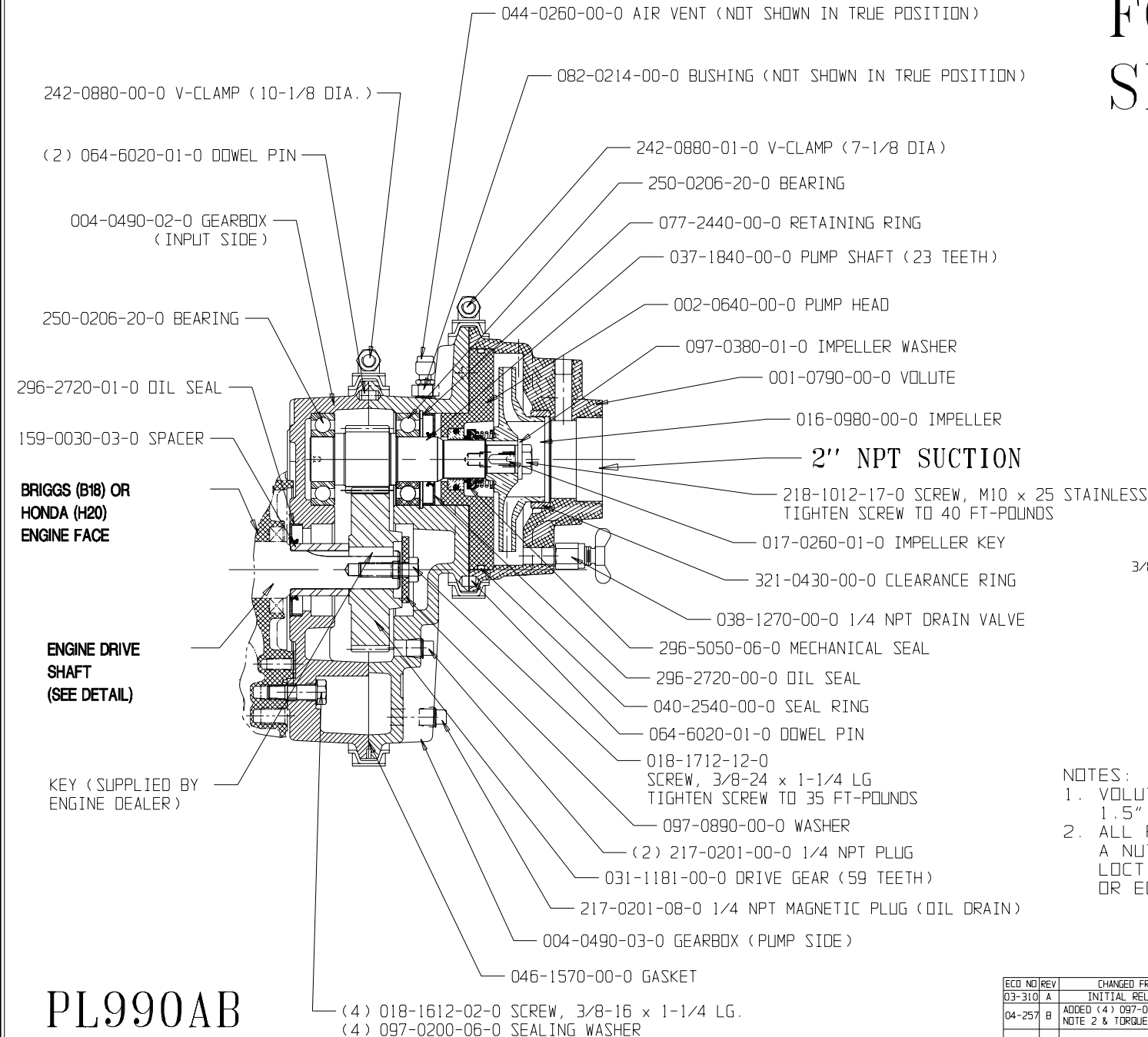
SIZE [B]  
SCALE: NONE



## Notes

[illegible]

# HP100 PUMP END FOR 1" KEYED SHAFT ENGINES



## NOTES:

- VOLUTE DISCHARGE IS 1-1/2 FNPT OR 1.5" MNST DISCHARGE VALVE.
- ALL FASTENERS SHALL BE INSTALLED WITH A NUT LOCKING ANAEROBIC ADHESIVE/SEALANT: LOCTITE® #246 HIGH TEMPERATURE THREADLOCKER OR EQUIVALENT.

PL990AB

| ECO NO | REV | CHANGED FROM                                | BY  | DATE     | APVD |
|--------|-----|---------------------------------------------|-----|----------|------|
| 03-310 | A   | INITIAL RELEASE                             | JBS | 10/24/03 | MAL  |
| 04-257 | B   | ADDED (4) 097-0200-06-0<br>NOTE 2 & TORQUES | JBS | 10/26/04 | MAL  |

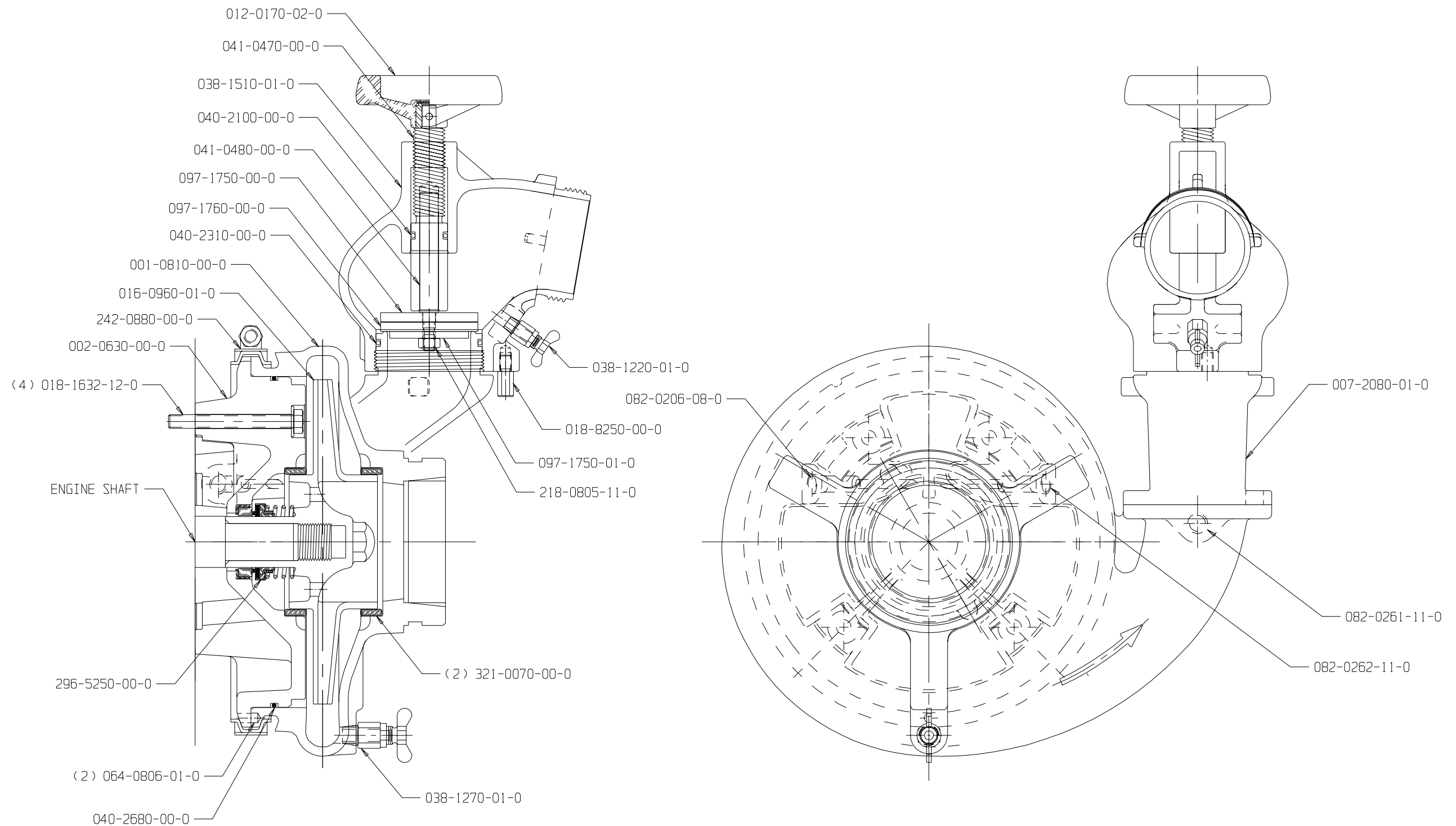


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DRAWN: JBS  
CHECKED: MAL  
DATE: 08-27-03  
SIZE: NTS  
SCALE: FULL

## Notes

[illegible]



# HALE TYPE HP200 PORTABLE PUMP

PLATE NO. 774

| ECO NO  | REV | CHANGED FROM                 | BY | DATE    | APVD |
|---------|-----|------------------------------|----|---------|------|
| TN97-78 | A   | CORRECTED FROM 016-0960-00-0 | CJ | 7-24-97 | MS   |
|         |     | CHANGED FROM 038-1510-00-0   |    |         |      |
|         |     |                              |    |         |      |
|         |     |                              |    |         |      |

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DRAWN  
 CHECKED

FAS  
 MS

DATE 11-29-93

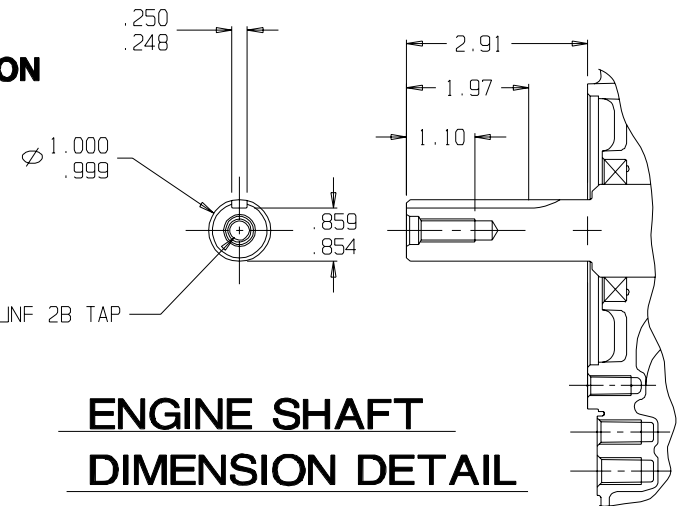
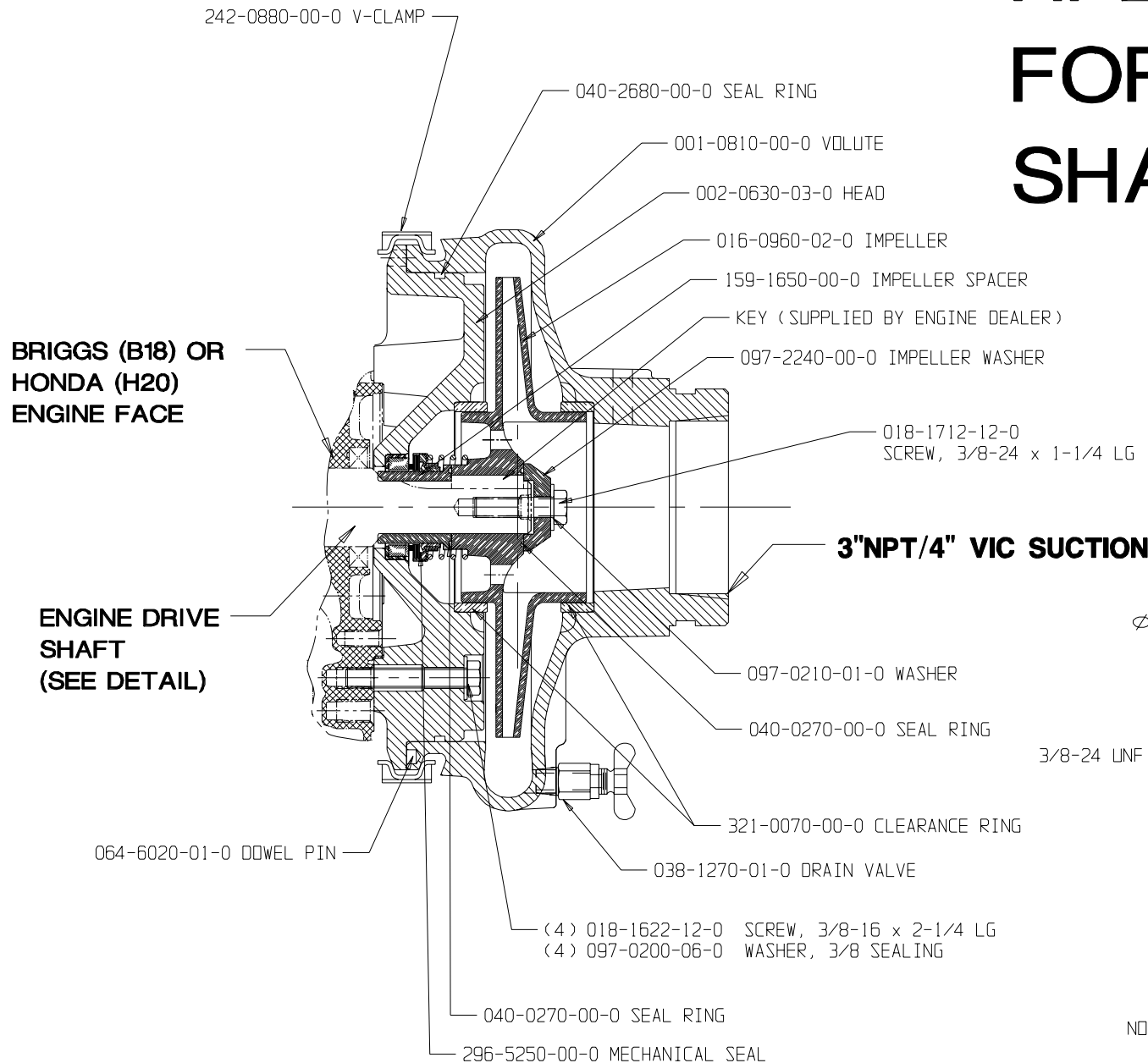
SIZE  
 A

SCALE: NONE

## Notes

[illegible]

# HP200 PUMP END FOR 1" KEYED SHAFT ENGINES



NOTE: VOLUTE DISCHARGE IS A HALE 115 FLANGE  
OPENING FOR 2.5" NPT DISCHARGE FLANGE OR  
2.5" NST DISCHARGE VALVE.

**PL991AA**

| ECD NO | REV | CHANGED FROM    | BY  | DATE     | APVD |
|--------|-----|-----------------|-----|----------|------|
| 03-250 | A   | INITIAL RELEASE | JBS | 08/26/03 | MAL  |
|        |     |                 |     |          |      |
|        |     |                 |     |          |      |

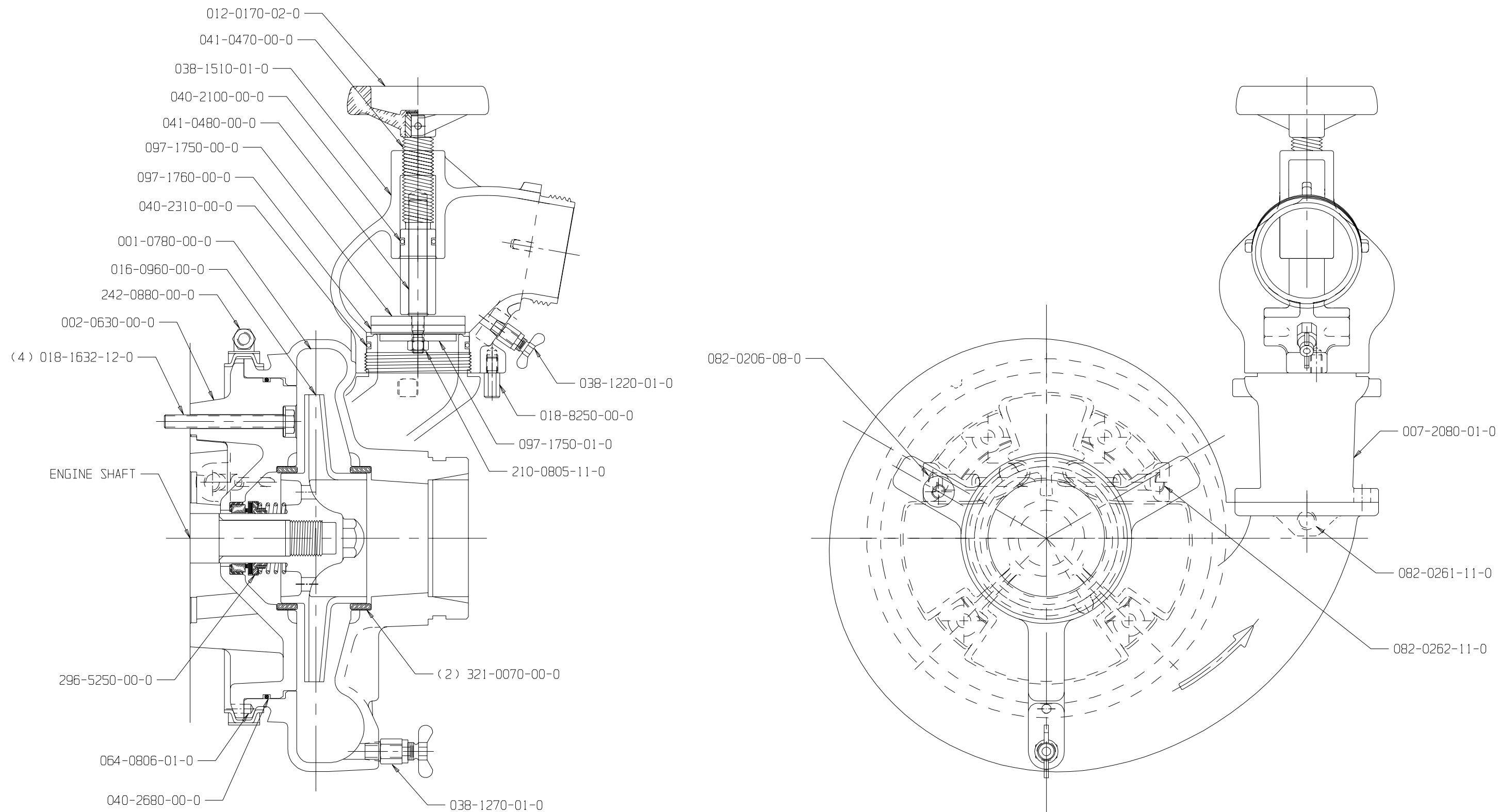


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## Notes

[illegible]



# HALE TYPE HP300 PORTABLE PUMP

PLATE NO. 775

| ECO NO                                                                                                                                                                                                                                             | REV | CHANGED FROM               | BY | DATE    | APVD |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|----|---------|------|
| TN97-78                                                                                                                                                                                                                                            | A   | CHANGED FROM 038-1510-00-0 | CJ | 7-24-97 | MS   |
|                                                                                                                                                                                                                                                    |     |                            |    |         |      |
|                                                                                                                                                                                                                                                    |     |                            |    |         |      |
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**HALE**

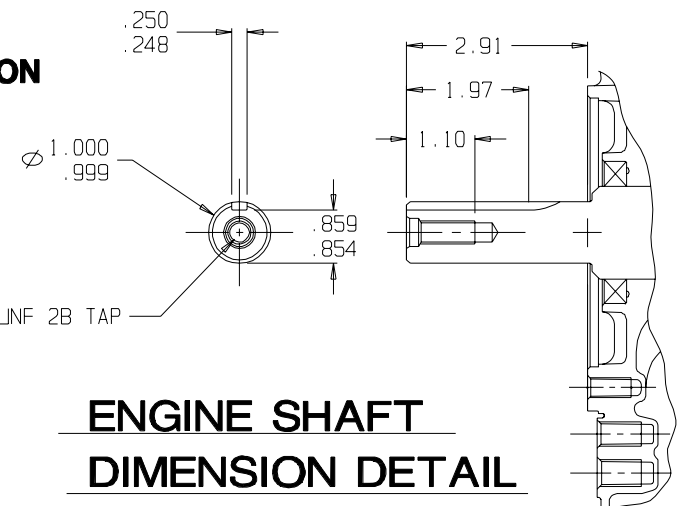
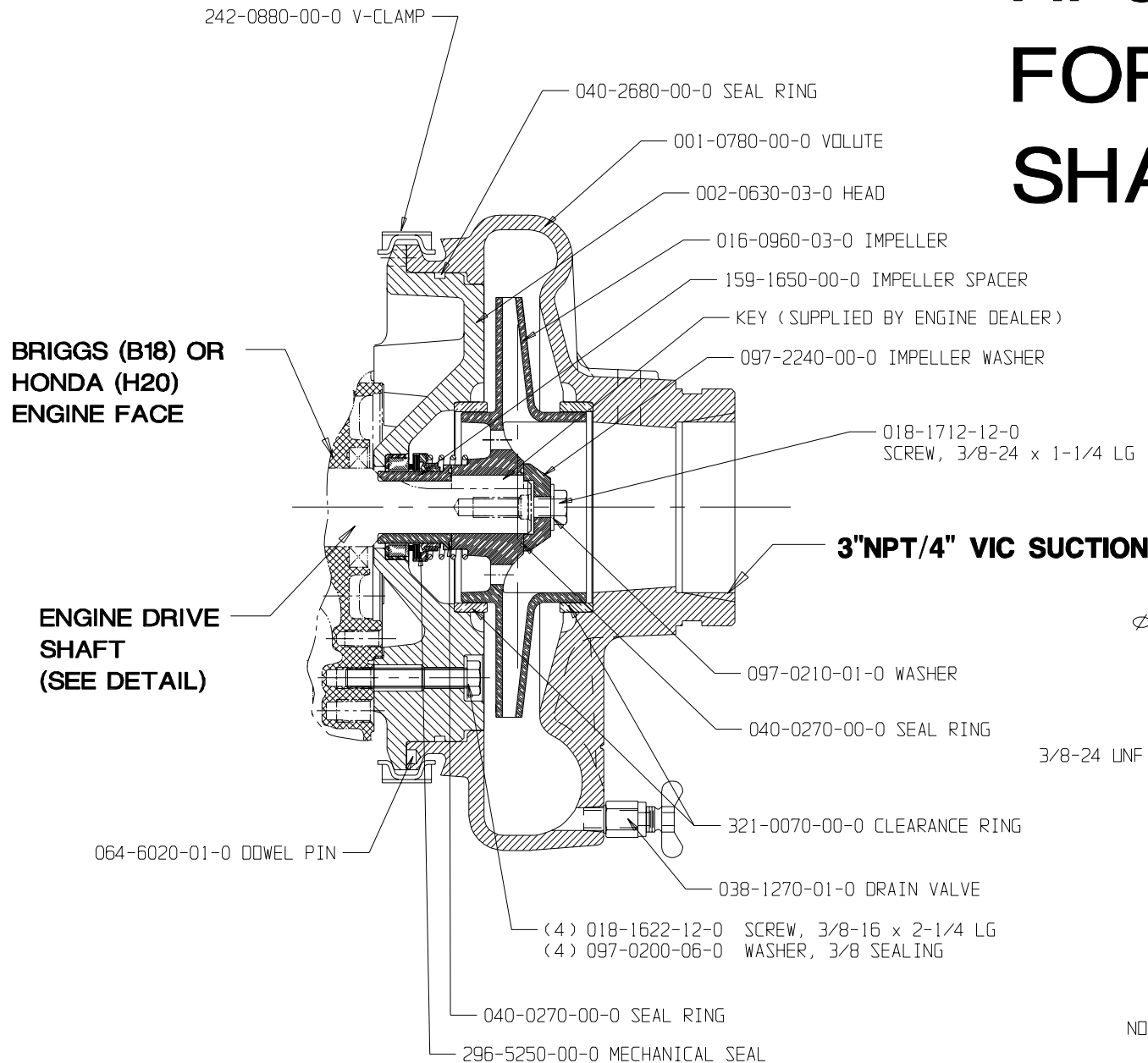
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## Notes

[illegible]

# HP300 PUMP END FOR 1" KEYED SHAFT ENGINES



NOTE: VOLUTE DISCHARGE IS A HALE 115 FLANGE  
OPENING FOR 2.5" NPT DISCHARGE FLANGE OR  
2.5" NST DISCHARGE VALVE.

**PL992AA**

| ECD NO | REV | CHANGED FROM    | BY  | DATE     | APVD |
|--------|-----|-----------------|-----|----------|------|
| 03-250 | A   | INITIAL RELEASE | JBS | 08/26/03 | MAL  |
|        |     |                 |     |          |      |
|        |     |                 |     |          |      |

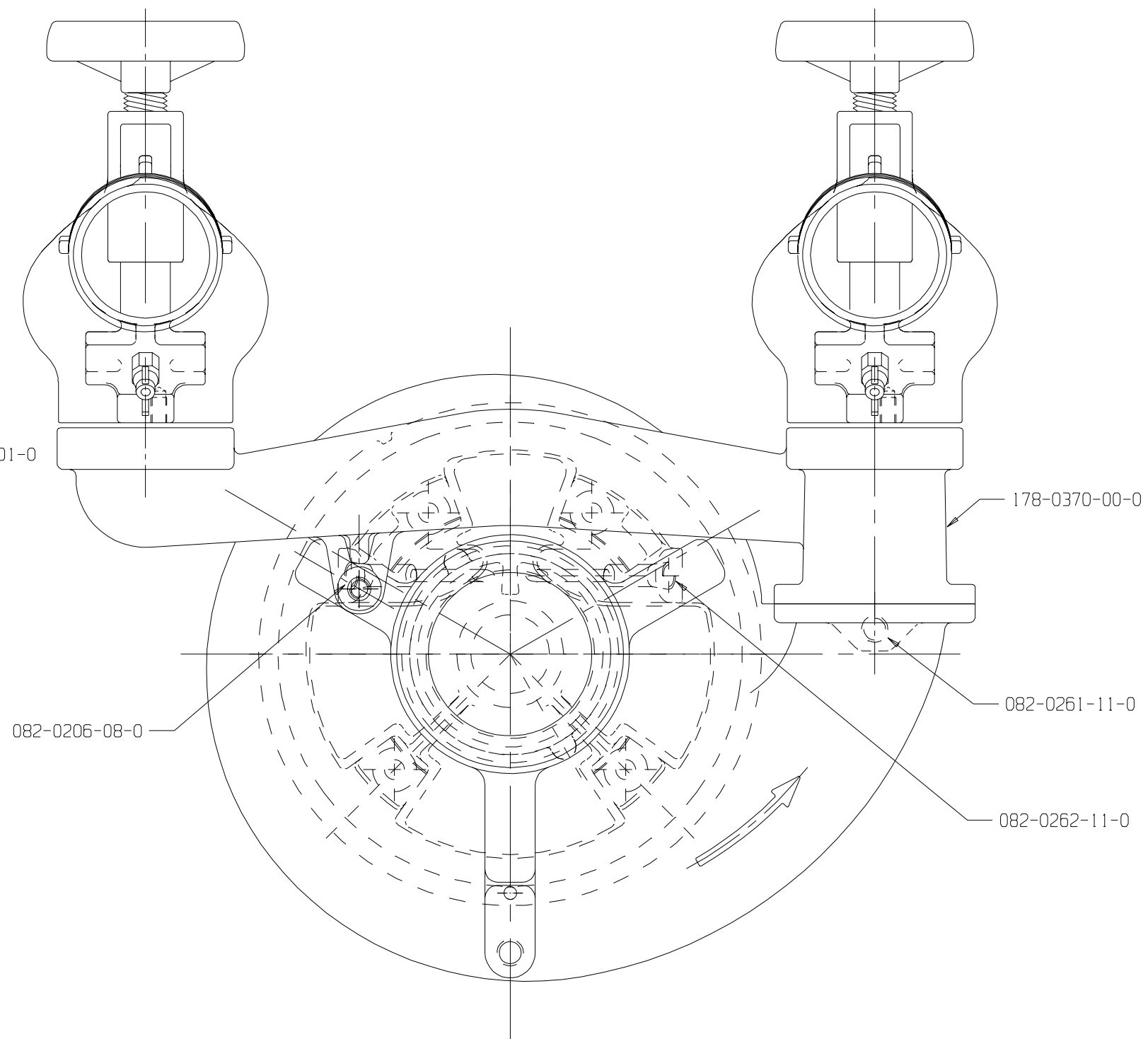
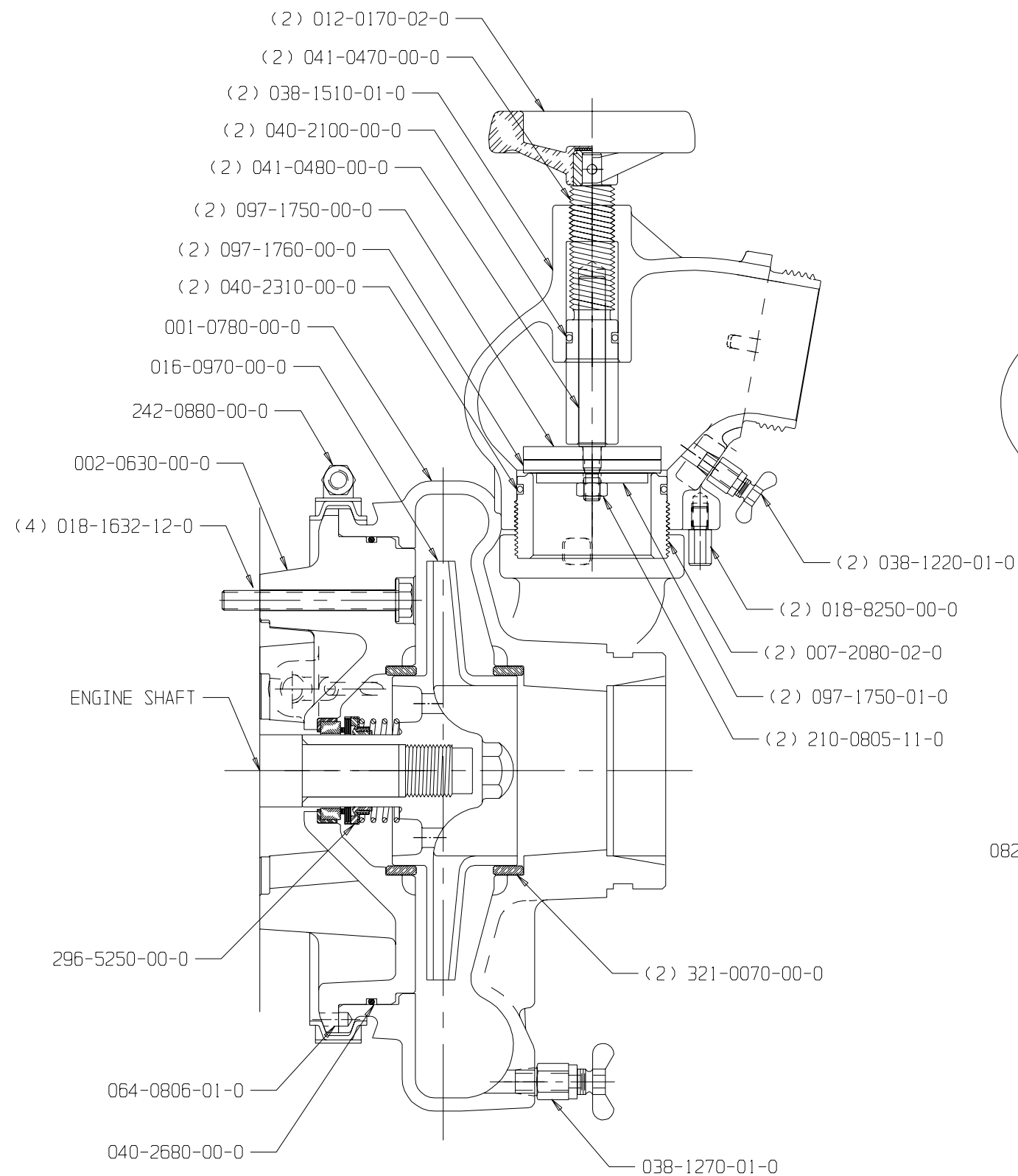


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## Notes

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# HALE TYPE HP400 PORTABLE PUMP

PLATE NO. 776

| ECO NO  | REV | CHANGED FROM               | BY | DATE    | APVD |
|---------|-----|----------------------------|----|---------|------|
| TN97-78 | A   | CHANGED FROM 038-1510-00-0 | CJ | 7-24-97 | MS   |
|         |     |                            |    |         |      |
|         |     |                            |    |         |      |
|         |     |                            |    |         |      |

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DRAWN  
 CHECKED

FAS  
 MS

DATE 7-24-97

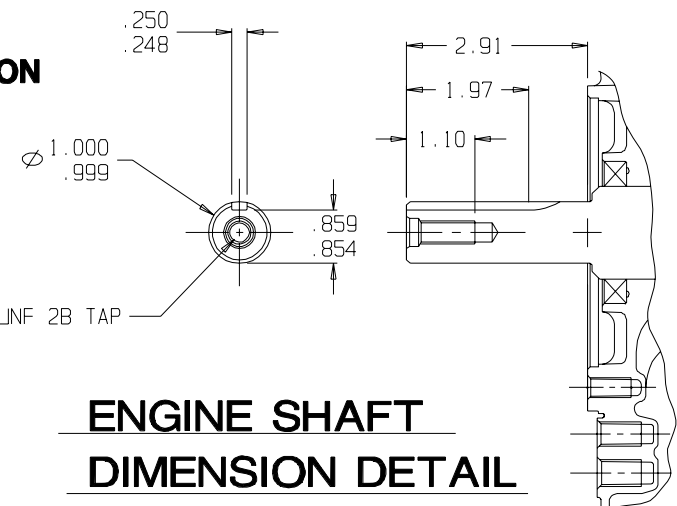
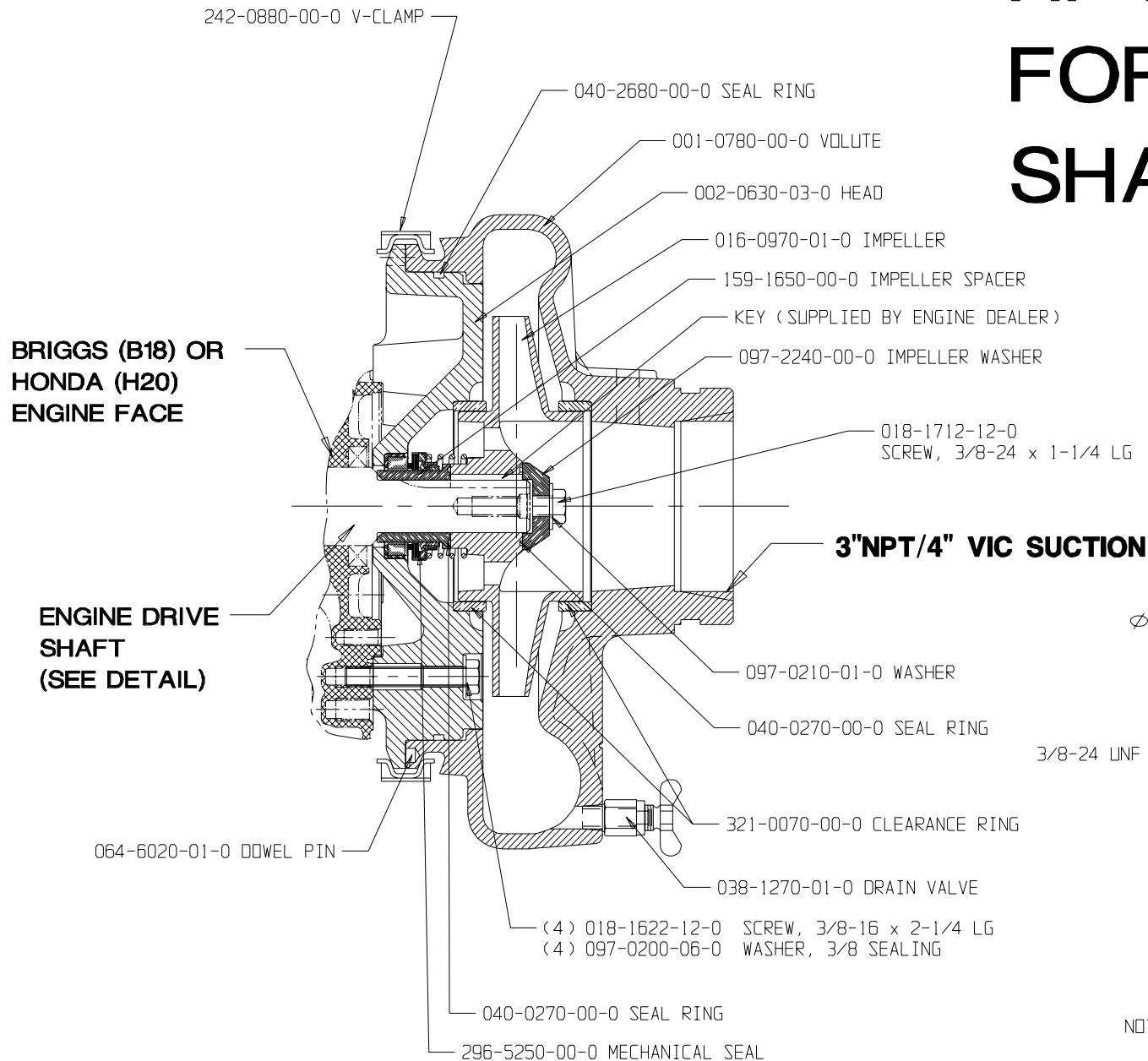
SIZE  
 B

SCALE: NONE

## Notes

[illegible]

# HP400 PUMP END FOR 1" KEYED SHAFT ENGINES



NOTE: VOLUTE DISCHARGE IS A HALE 115 FLANGE  
OPENING FOR 2.5" NPT DISCHARGE FLANGE OR  
TWO 2.5" NST DISCHARGE VALVES ON MANIFOLD.

**PL993AA**

| ECD NO | REV | CHANGED FROM    | BY  | DATE     | APVD |
|--------|-----|-----------------|-----|----------|------|
| 03-304 | A   | INITIAL RELEASE | JBS | 10/20/03 | MAL  |
|        |     |                 |     |          |      |
|        |     |                 |     |          |      |



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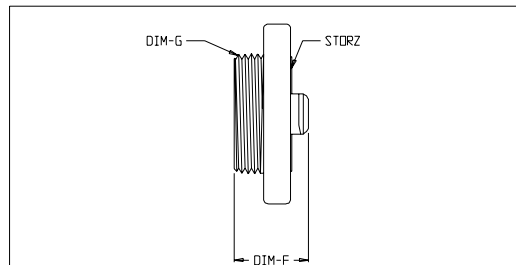
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|         |     |               |      |             |
|---------|-----|---------------|------|-------------|
| DRAWN   | JBS | DATE 08-01-03 | SIZE | SCALE: FULL |
| CHECKED | MAL |               | NTS  |             |

## Notes

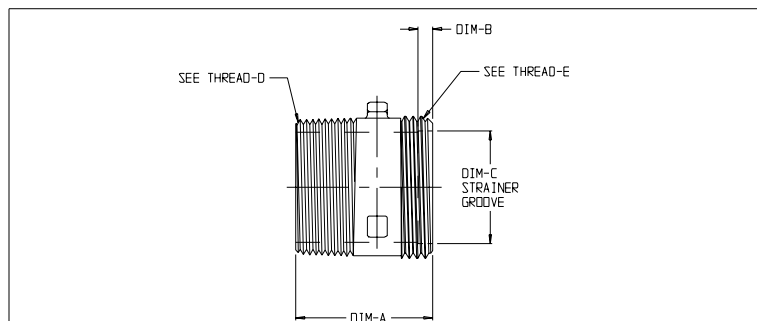
This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

# HP-SERIES PORTABLE PUMP OPTIONAL SUCTION/DISCHARGE ADAPTERS



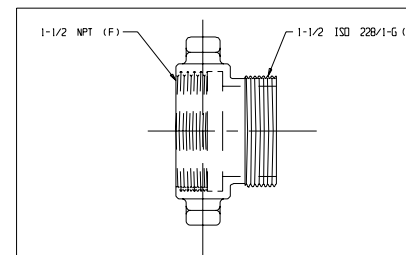
SUCTION ADAPTERS

| PART#         | DIM-F | DIM-G     | STORZ        |
|---------------|-------|-----------|--------------|
| 007-3040-00-0 | 3.21  | 2 NPT (M) | 52MM (2.00)  |
| 007-3100-00-0 | 3.97  | 3 NPT (M) | 72MM (3.00)  |
| 007-3120-00-0 | 4.28  | 3 NPT (M) | 110MM (4.25) |

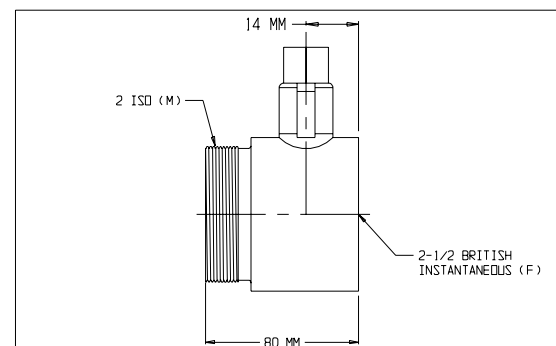


SUCTION ADAPTERS

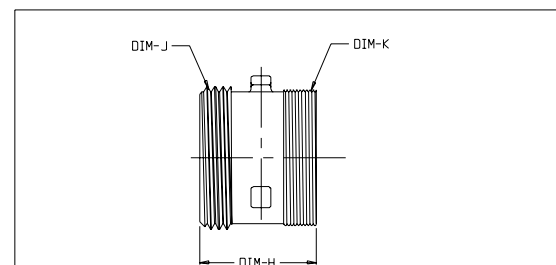
| PART#         | DIM-A | DIM-B     | DIM-C       | THREAD-D  | THREAD-E            |
|---------------|-------|-----------|-------------|-----------|---------------------|
| 007-3010-00-0 | 2.25  | N/A       | N/A         | 2 NPT (M) | 2 NST (M)           |
| 007-3020-00-0 | 2.50  | N/A       | N/A         | 2 NPT (M) | 2.5 NST (M)         |
| 007-3030-00-0 | 2.69  | N/A       | N/A         | 2 NPT (M) | 3 BRITISH ROUND (M) |
| 007-3050-00-0 | 2.42  | N/A       | N/A         | 2 NPT (M) | 2 ISO 228/1-G (M)   |
| 007-3060-00-0 | 3.13  | .406      | 2.625/2.635 | 3 NPT (M) | 2.5 NST (M)         |
| 007-3210-00-0 | 3.00  | .406      | 3.120/3.130 | 3 NPT (M) | 3 NST (M)           |
| 007-3070-00-0 | 3.38  | .750/.780 | 4.180/4.190 | 3 NPT (M) | 4 NST (M)           |
| 007-3080-00-0 | 3.26  | N/A       | N/A         | 3 NPT (M) | 3 BRITISH ROUND (M) |
| 007-3090-00-0 | 3.26  | N/A       | N/A         | 3 NPT (M) | 4 BRITISH ROUND (M) |
| 007-3110-00-0 | 2.88  | N/A       | N/A         | 3 NPT (M) | 3 ISO .288/1-G (M)  |



P/N 007-3200-01-0  
DISCHARGE ADAPTER



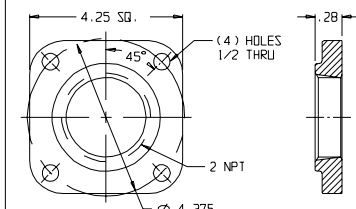
P/N 007-3140-00-0  
DISCHARGE ADAPTER



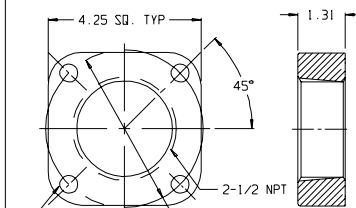
DISCHARGE ADAPTER

| PART#         | DIM-H | DIM-J       | DIM-K               |
|---------------|-------|-------------|---------------------|
| 007-3130-00-0 | 1.80  | 1.5 NST (M) | 2.5 ISO 288/1-G (M) |
| 007-3160-00-0 | 2.19  | 2.5 NST (M) | 2.5 ISO 228/1-G (M) |

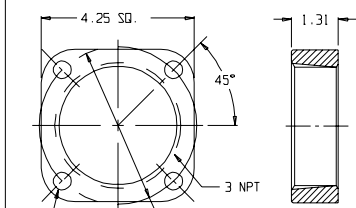
115 SERIES  
DISCHARGE FLANGES



FLANGE (115-2)  
115-0060-00-0



FLANGE (115)  
115-0070-00-0



FLANGE  
115-0080-00-0

PLATE NO. PL935AA

| ECD NO | REV | CHANGED FROM    | BY | DATE    | APVD |
|--------|-----|-----------------|----|---------|------|
| 01-123 | A   | INITIAL RELEASE | TC | 3-10-01 | MAL  |
|        |     |                 |    |         |      |
|        |     |                 |    |         |      |



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| DRAWN   | TC  | DATE    | SIZE | SCALE |
|---------|-----|---------|------|-------|
| CHECKED | MAL | 3-10-01 | C    | FULL  |



## Notes

[illegible]