Kyle W. Lewis
817-773-1690
klewis@piercepumpco.com

O&M MANUAL

SQUABBLE CREEK LIFT STATION IMPROVEMENTS – PERMANENT BYPASS PUMPING STATION

SPEC SECTIONS C-5 BYPASS PUMP AND C-6 ENCLOSURE

Owner:

City of Rockwall

Engineer:

Birkhoff, Hendricks, & Carter

Contractor:

Heritage Construction

Prepared by:

PIERCE PUMP

AN FCX PERFORMANCE COMPANY

9010 JOHN W. CARPENTER FREEWAY

DALLAS, TX 75247

214-320-3604, PH

214-328-5819, FAX

PIERCE PUMP
an FCX Performance Company

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Sections

PIERCE PUMP
an FCX Performance Company

SECTION - 1

Scope

PIERCE PUMP
an FCX Performance Company

9010 John W. Carpenter Frwy.
Dallas, Texas 75247
Phone: 214.320.3604

TO: ALL BIDDING CONTRACTORS

Rockwall Squabble Creek Permanent Bypass Pump

BIDS 7/3/18
2PM CST

Salesman: Kyle W. Lewis KLewis@piercepumpco.com **Quote Expiration:**

Date: 7/3/2018

Item No.	Qty.	EQUIPMENT DESCRIPTION	Unit Price	Total Price
		Pierce Pump is the sole distributor in the Municipal market for the Gorman Rupp Pump Company in North Texas. Attempts by other authorized distibutors to provide Gorman Rupp products on this project will be rejected by the manufacturer.		
		Specification Section C-5:		
	1	**Gorman Rupp PAH16A60C-B-C18**		
		~16" x 18" Priming Assisted Centrifugal Pump with Autostart		
		~Caterpiller C18 ACERT 18.1L 6-Cylinder Liquid Cooled Turbo Diesel Engine		
		~Belt-Driven Air Compressor. 2:1 Gear Reducer. Hoisting Bail.		
		~Combination Skid Base w/Fuel Tank. Strainer. Check Valve. Auto Air Release Valve.		
	2	~Batteries (2 Req'd). Suction Vacuum and Discharge Pressure Gauge Kit		
	1	~Full Feature Control Panel with Submerisble Transducer Liquid Level Sensor (80ft Cable)		
	1	~Certified Performance Testing		
	1	~ Electronic Pressure Switch liquid Level Control per spec		
		Specification Section C-6:		
	1	**EC&A Sound Attenuated Outdoor Weather Enclosure**		
		~Base Dimensions: 120" wide x 344" long x 130" tall		
		~Inside Dimensions: 112" wide x 242" long x 126" tall		
		~14 Ga Galvannealed Steel Outer Skin, Roof Skin, and Interior Stiffeners		
		~60dba @ 30ft Sound Rating; 4# Per Cubic Foot Mineral Wool		
		~2 Mil Mylar Protective Liner; Fixed Weather Louvers		
		~2 double-access service doors, 2 single-access service doors		
		~1 Engine Exhaust Opening with weather cap and muffler supports		
		~4 lifting eyes; 2 Pipe Openings to be aligned with Gorman Rupp Unit		
	1	Freight to Jobsite included		
	1	Day (8-hour) Start Up Services		
		NOTE: Contractor will need to mount the muffler that comes with the unit on the roof of the enclosure and pipe the exhaust as required.		
		Exclusions: Installation of any kind, piping, anchor or foundation materials, and anything outside of spec sections C-5 and C-6.		

PIERCE PUMP
an FCX Performance Company

SECTION - 2

Bypass Pump

Priming Assisted Centrifugal Pump w/Autostart

Model PAH16A60C-B-C18

Size 18" x 16"

Total Head		Capacity of Pump in U.S. Gallons per Minute (GPM) at Continuous Performance			
P.S.I.	Feet				
78.0	180	N/A	5000	5000	5000
69.4	160	N/A	8300	10400	10400
60.0	140	N/A	8500	11600	13200
52.0	120	N/A	8600	12000	13800
43.4	100	5600	8800	12000	13900
34.7	80	6000	8900	12100	13900
26.0	60	6100	9100	12100	13900
17.3	40	6200	9200	12200	14000
8.7	20	6500	9400	12300	14000
Suction Lift		25'	20'	15'	10'

WARNING!

Do not use in explosive atmosphere or for pumping volatile flammable liquids.

PUMP SPECIFICATIONS

Size: 18" x 16" (457 mm x 406 mm) Flanged.
Casing: Ductile Iron 65-45-12.
Maximum Operating Pressure 117 psi (807 kPa).*
Enclosed Type, Four Vane Impeller: Ductile Iron 80-55-06.
Handles 4" (101,6 mm) Diameter Spherical Solids.
Impeller Shaft: Alloy Steel 4150M.
Replaceable Wear Ring: Ductile Iron 65-45-12.
Bearing Pedestal: Gray Iron 30.
Seal Plate: Ductile Iron 65-45-12.
Seal: Mechanical, SAE 30 Non-Detergent Oil-Lubricated. Silicon Carbide Rotating Face and Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel 316 Cage and Stainless Steel 18-8 Spring. Maximum Temperature of Liquid Pumped 160°F (71°C).*
Shaft Sleeve: Stainless Steel 303/304.
Priming Chamber: Gray Iron 30 Housing w/Stainless Steel Float and Linkage.
Discharge Check Valve: Ductile Iron Housing w/Buna-N Flapper.
Radial Bearing: Open Single Row Straight Roller.
Radial/Thrust Bearing: Open Double Row Tapered Roller.
Bearing Cavity Lubrication: Lithium EP2 Grease.
Suction Spool: Gray Iron 30.
Gaskets: Resistant Synthetic Rubber, Vegetable Fiber w/Compressed Synthetic Fibers.
O-Rings: Buna-N.
Hardware: Standard Plated Steel.
Seal Cavity Oil Level Sight Gauges.
**Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*

Standard Equipment: Belt-Driven Air Compressor. 2:1 Gear Reducer. Hoisting Bail. Combination Skid Base w/Fuel Tank. Strainer. Single Ball Type Float Switch. **
***50 Ft. (15 m) Standard Length; Dual Switches and Alternate Cable Lengths Available From the Factory.*

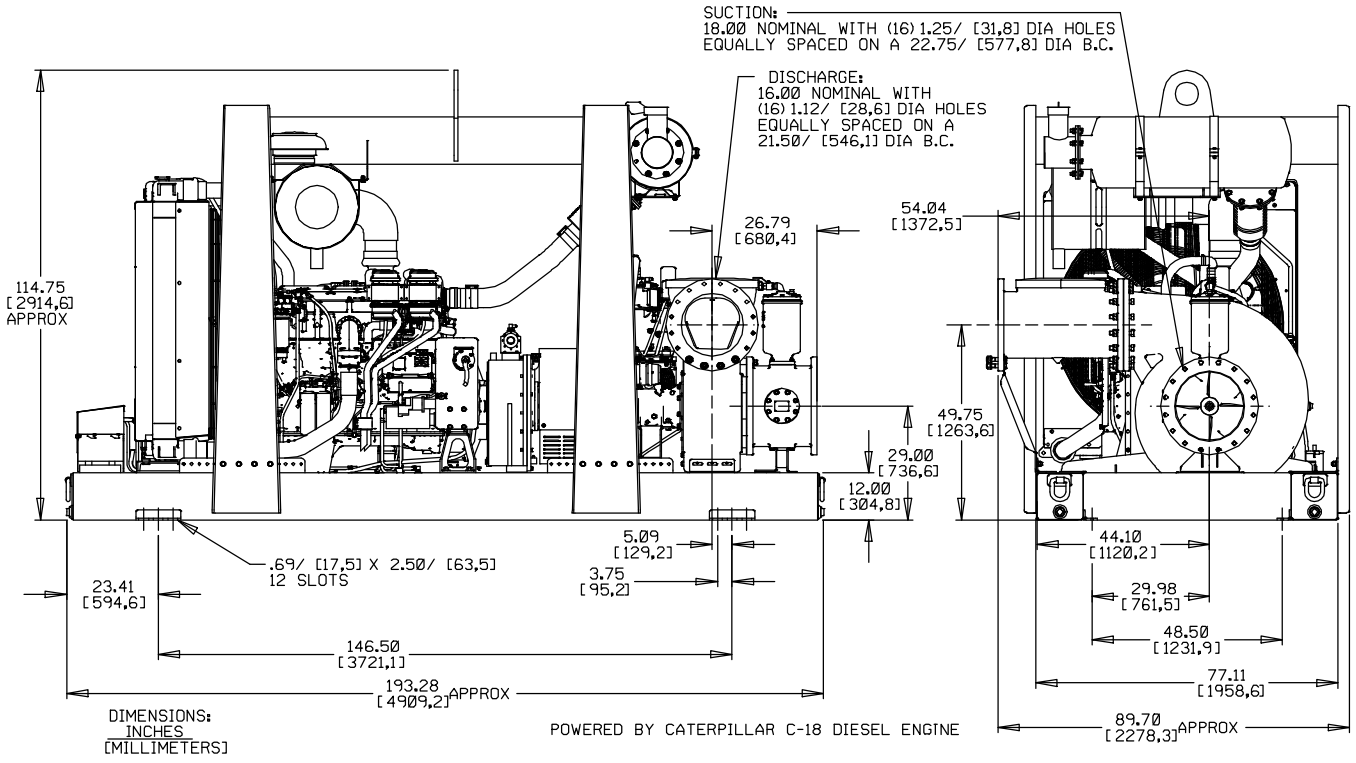
Optional Equipment: Batteries (2 Req'd). Heated Priming Chamber Kit. Suction Vacuum and Discharge Pressure Gauge Kit. Full Feature Control Panel For Use w/Submersible Transducer Liquid Level Sensor (50 Ft. [15 M] Cable Standard, Alternate Lengths Available).

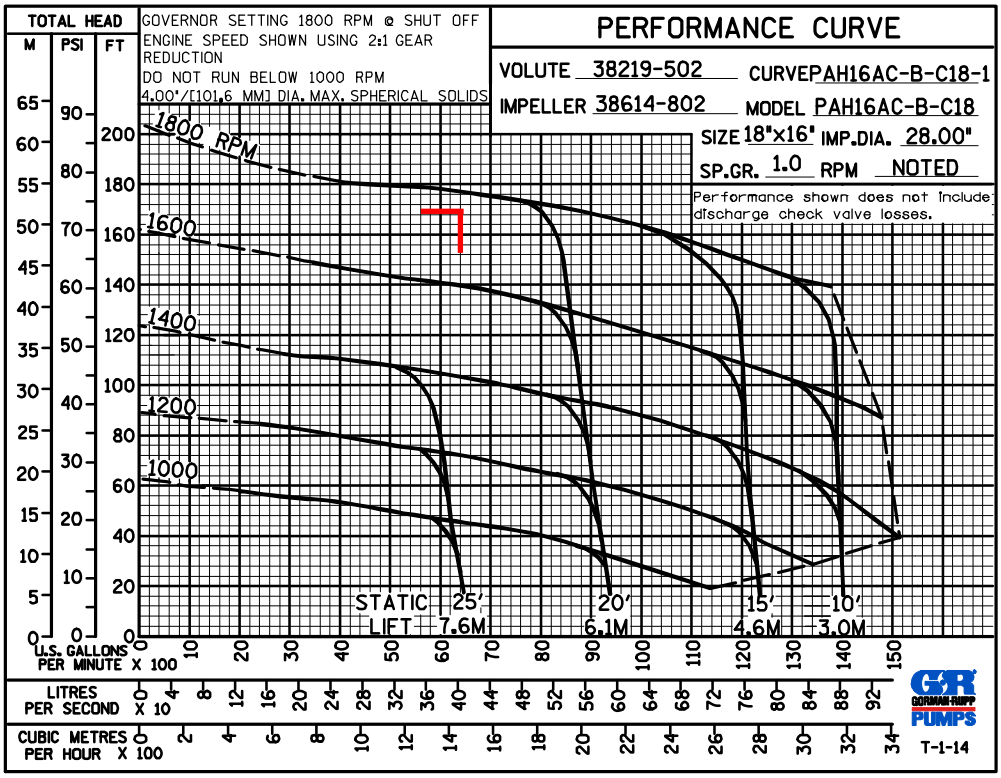
ENGINE SPECIFICATIONS

Model: Caterpillar C18 ACERT™.
EPA Tier: Interim Tier 4.
Type: Six Cylinder, Turbocharged AfterCooled, Liquid Cooled Diesel Engine.
Displacement: 1104.5 Cu. In. (18,1 liters).
Lubrication: Forced Circulation.
Air Cleaner: Dry Type.
Fuel Tank: 368 U.S. Gals. (1393 liters).
Full Load Operating Time: 12.1 Hrs.
Starter: 12V Electric.
Standard Features: Muffler w/Weather Cap.
Engine Control Features: Padlockable Box with Throttle Control, Tachometer, Coolant Temperature, Oil Pressure, Voltage and Overstart Indicators/Shutdowns. Manual/Stop/Auto Keyswitch. Audible Startup Warning Delay. Electronic Fuel Level Sensor. Fuel Level Display/Alarm/Shutdown.

CATERPILLAR PUBLISHED PERFORMANCE:
Maximum Gross Industrial BHP (Intermittent)
755 (563 kW) @ 1800 RPM

Specification Data	APPROXIMATE DIMENSIONS and WEIGHTS	NET WEIGHT: 16020 LBS. (7266,5 KG.)
SECTION, 43 PAGE 800		SHIPPING WEIGHT: 16800 LBS. (7620,4 KG.)
		EXPORT CRATE SIZE: 1333 CU. FT. (37,7 CU. M.)



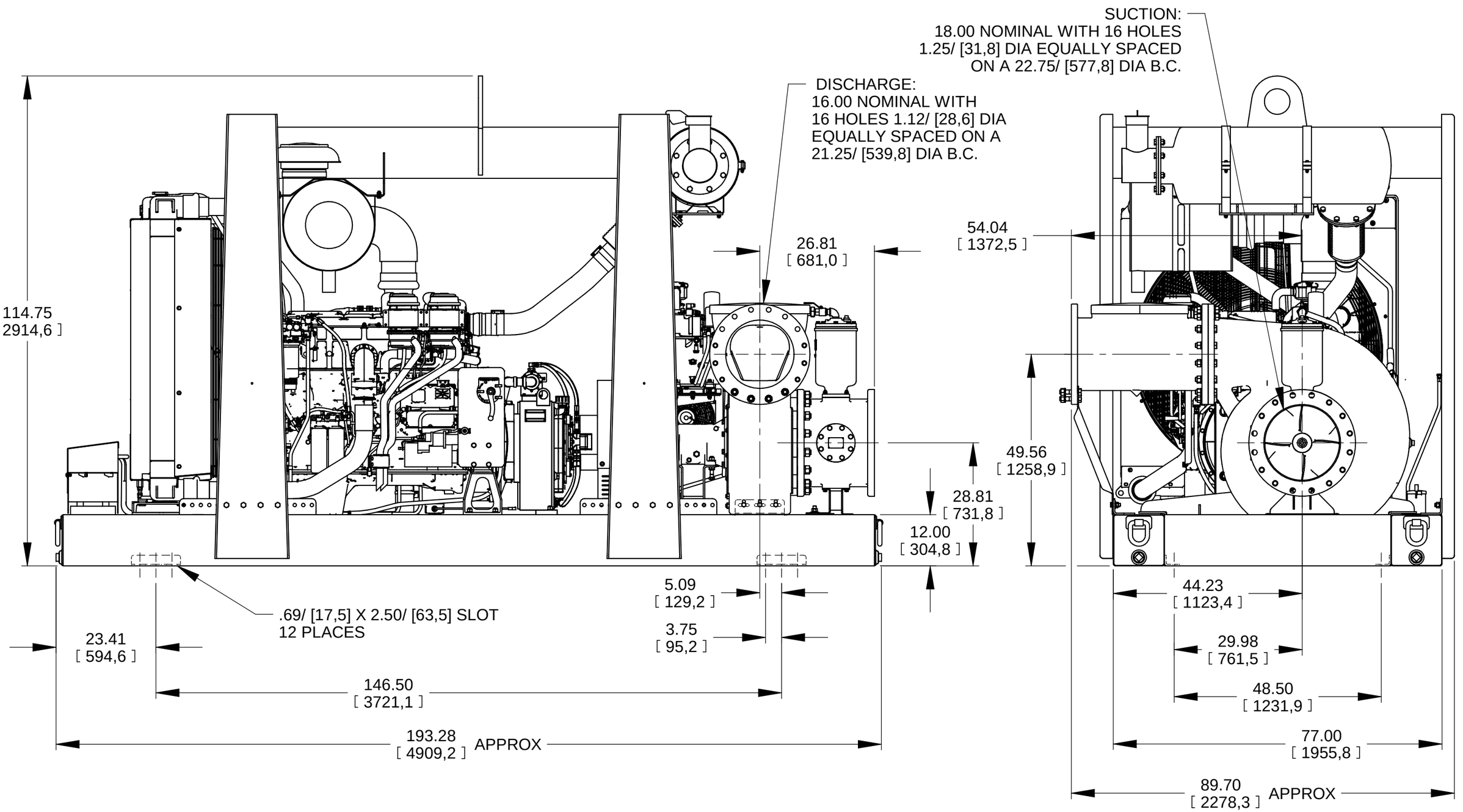


GORMAN-RUPP PUMPS
www.grpumps.com

Computer Generated Curve was incorrect and has been removed from submittal. Please use the this performance curve for review. Design Point of 6,400gpm @ 172ft TDH has been added to the curve.

-

B | 18913 | SHEET 1 OF 1



DIMENSIONS:
INCHES
[MILLIMETERS]

WEIGHT: 16000 LBS APPROX

POWERED BY CATERPILLAR C-18 DIESEL ENGINE

16-027

THE GORMAN-RUPP CO. MANSFIELD, OHIO ST. THOMAS, ONTARIO	DRAWN BY JB	SCALE 3/64	MODEL PAH16A60C-B-C18
	DATE 12/23/13	REVISED 04/08/16	OUTLINE NUMBER 18913

P/N 29284-084

THREE LEVELS OF CONTROL

Three panel options are available to match the level of control with the requirements of the pump application. The table below shows the additional features provided at each level.

PART #	DESCRIPTION
29284-083	**MANUAL START** • Manual start/stop, manual throttle • Full display • Fault code reader • Alarm Log • Service Alerts • Relay outputs to signal horns and other devices
29284-084	**AUTO START** • Auto start/stop (single and dual float) • Warm up, prime, operating and cool down speeds • Monitor suction and discharge pressures • Low battery exercise • CAN bus and Modbus communications
29284-085	**FULL-FEATURE** • Pressure and level start/stop • Automatic throttle to maintain pressure or level • Failsafe float backup • Additional relay outputs • Additional inputs

CONTROL TECHNOLOGY

Controls, Incorporated brings its advanced engine control technology and reputation for durability to three pump control panels that provide sophisticated pump control combined with simple and intuitive operation.

DURABILTY

The water tight, IP67 rated display and control module is mounted in a NEMA 4X rated panel providing a two layer construction for maximum protection.

EASY-TO-READ DISPLAY

A high level OLED display provides superior visibility on all lighting conditions and an extended operating temperature down to -40°C/-40°F.

Suction and discharge pressure display is also available.

THROTTLE CONTROL

Manual throttle is provided via the up and down buttons. Minimum speed, maximum speed and rate of acceleration are selectable.

AUTO START OPERATION

Auto start and auto throttle are available providing a wide range of pump control options.

Auto Start/Stop

- Floats, Level, Pressure, Real-Time Clock Scheduler

Auto Throttle

- Warm Up, Prime, Operating and Cool Down Speeds
- Auto Throttle to Maintain Level or Pressure

FAULT CODES

Engine alarm codes are displayed along with easy-to-read messages and corresponding yellow or red lamp illumination.

COMMUNICATIONS

Communication capabilities have been incorporated to communicate to external devices and remote monitoring systems.

	Manual Start 29284-083 U-G7015	Auto Start 29284-084 U-G7030-AS	Full Feature 29284-085 U-G8340-AS
Replaces	**29284-029 (EMT1-GR-K)** **29284-063 (C3-7020)**	**29284-012 (EMGRT1)** **29284-028 (EMGRT2)**	**New Full Feature Panel Specification**
Connectors	**21 Pin Engine Harness Connector**	**21 Pin Engine Harness Connector** **Float Connector**	**21 Pin Engine Harness Connector** **Float Connector** **31 Pin Accessory Harness Connector**

TIER 4 READY Stage IIIB/IV

Universal Engine Coverage:
Mechanical Engine, J1939 Engine, J1939 iT4 Engine & J1939 Tier 4 Final Engine

Manual Start 29284-083 U-G7015	Auto Start 29284-084 U-G7030-AS	Full Feature 29284-085 U-G8340-AS
Manual Start	**Auto Start** • Single & Dual Float Start & Stop	**Auto Start** • Single & Dual Float Start & Stop • Application Level / Pressure Start & Stop • Telemetry Start & Stop
Full Engine Display	**Full Engine Display** • Suction Pressure, Discharge Pressure	**Full Engine Display Plus:** • Suction Pressure, Discharge Pressure, Application Operating Level/Pressure
Standard Shutdowns (O/P, W/T, O/S)	**Standard Shutdowns (O/P, W/T, O/S)**	**Standard Shutdowns (O/P, W/T, O/S)**
Event History / Alarm Log (32 events)	**Event History / Alarm Log** (32 events)	**Event History / Alarm Log** (32 events)
Service Alerts	**Service Alerts**	**Service Alerts**
Fuel Level Available	**Fuel Level Available**	**Fuel Level Available**
	Low Battery Exercise	**Low Battery Exercise**
	Additional Shutdowns: • Emergency Stop, Fuel Level Switch, Low Water Level, Low Oil Level	**Additional Shutdowns** • Emergency Stop, Fuel Level Switch, Low Water Level, Low Oil Level
	Auto Start Throttle Operation • Warm Up, Prime, Operating & Cool Down Speeds	**Auto Start Throttle Operation** • Warm Up, Prime, Operating & Cool Down Speeds • 4-20 mA (Level or Pressure)
		Additional Relay Outputs • Four 5 amp relay outputs
	Additional Communications: • MOD bus • CAN bus	**Additional Communications:** • MOD bus • CAN bus
	Additional Inputs • Suction & Discharge Pressure	**Additional Inputs** • Suction & Discharge Pressure • Operating Level or Pressure • Other Available Digital Inputs

Feature	29284-083 Manual Start	29284-084 Auto Start	29284-085 Full Feature
Engine ECU Data	CAN bus Only	YES	YES
Inlet & Outlet Pressure	N/A	YES	YES
Telemetry Start/Stop	N/A	YES	YES
Telemetry Engine Speed Adjust (Manual Mode)	N/A	YES	YES
Telemetry Idle Speed Adjust	N/A	YES	YES
Application Water Level	N/A	N/A	YES
Telemetry Target Speed Adjust	N/A	N/A	YES

21 Pin Connector

Pin	Description
A	OPEN
B	Battery Positive
C	MPU-
D	Crank Signal
E	Battery Negative
F	CAN Shield
G	Fuel Solenoid/ECU Signal
H	Temperature Sender Input
J	Alternator Excite
K	Speed Signal/MPU+
L	Pre Heat Signal
M	Throttle Down
N	Fuel Level Sender Return
P	Fuel Level Sender Input
R	OPEN
S	OPEN
T	OPEN
U	CAN Bus Low
V	CAN Bus High
W	Throttle Up
X	Oil Pressure Sender Input

16 Pin Connector

Pin	Description
A	MPU-
B	Throttle Down
C	Oil Pressure Sender Input
D	Crank Signal
E	Throttle Up
F	Battery Negative
G	Alternator Excite
H	Temperature Sender Input
J	Pre Heat Signal
K	Fuel Level Sender Return
L	Fuel Level Sender Input
M	OPEN
N	OPEN
P	MPU+/Alternator Tach Signal Input
R	Fuel/Run Signal to Engine
S	Battery Positive

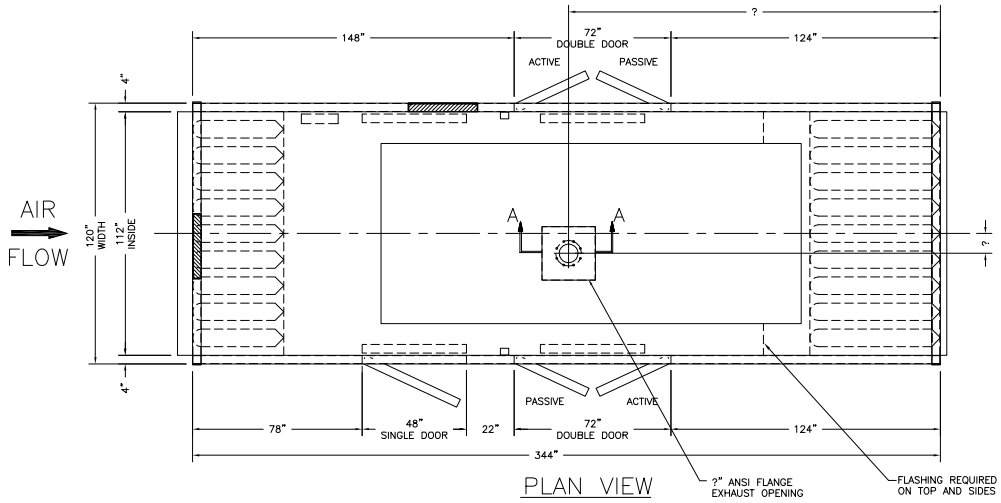
Pins B and E are in the existing Deere mechanical engine harness for throttle linear actuator and are not available for fuel level sender.

PIERCE PUMP
an FCX Performance Company

SECTION - 3

Enclosure

E & C A "CUSTOM FIT"



PLAN VIEW

NOTES: ENCLOSURE ASSEMBLY:
- FULLY ASSEMBLED DROP OVER ENCLOSURE TO BE ANCHORED TO THE FOUNDATION.
- PANEL JOINTS ARE SKIP WELDED AND CAULKED.

ENCLOSURE CONSTRUCTION:
- WALLS AND ROOF – 14 GAUGE GALVANNEALED STEEL.
- FRAME CONSTRUCTION – A36 STRUCTURAL CHANNEL & A-500 TUBING.
- INNER LINER – PERFORATED GALVANNEALED STEEL.
- INSULATION – MINERAL WOOL AND POLY LINER.
- DOORS – ONE (1) SINGLE & TWO (2) DOUBLE ACCESS SERVICE DOORS. SERVICE DOORS WITH STAINLESS STEEL HINGE AND DOOR LATCHES.
- BAFFLES – 42" DEEP INLET & 60" DEEP DISCHARGE PANELS. GALVANNEALED CONSTRUCTION.
- LOUVERS – FIXED INLET WEATHER LOUVERS W/BIRDSCREEN. GALVANNEALED CONSTRUCTION.
- DISCHARGE GRAVITY BACKDRAFT DAMPERS. ALUMINUM CONSTRUCTION.
- BOLTING HARDWARE – STAINLESS STEEL.

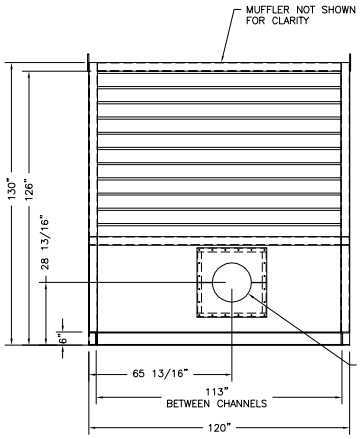
DESIGN SPECIFICATIONS:
- DESIGNED TO TO REDUCE THE AIRBORNE GEN-SET EQUIPMENT NOISE LEVELS TO 60 dB(A) WHEN MEASURED AT A DISTANCE OF 25 FEET FROM THE ENCLOSURE AND 5 1/2 FEET ABOVE GRADE IN A FREE FIELD ENVIRONMENT.
- THE GEN-SET EQUIPMENT NOISE DOESN'T EXCEED 119 dB.
- BASED ON A TOTAL AIR REQUIREMENT OF 37,949 CFM AT LESS THAN 1/2" W.G. BACK PRESSURE THROUGH THE ENCLOSURE.
- ENGINE EXHAUST IS NOT INCLUDED.

PAINTING:
- ALL EXTERIOR GALVANNEALED SURFACES TO BE SOLVENT CLEANED PER SSPC-SP1 AND PAINTED AS FOLLOWS:
  INTERMEDIATE – ONE COAT INDUSTRIAL POLYURETHANE (1-1.5 MILS DFT)
  FINISH – ONE COAT INDUSTRIAL POLYURETHANE (.5-1 MILS DFT)
- ALL CARBON STEEL SURFACES TO BE POWER TOOL CLEANED PER SSPC-SP3 AND PAINTED AS FOLLOWS:
  PRIMER – ONE COAT INDUSTRIAL PRIMER (2-4 MILS DFT)
  FINISH – ONE COAT INDUSTRIAL POLYURETHANE (2-4 MILS DFT)
- COLOR – PRECISION TAN.

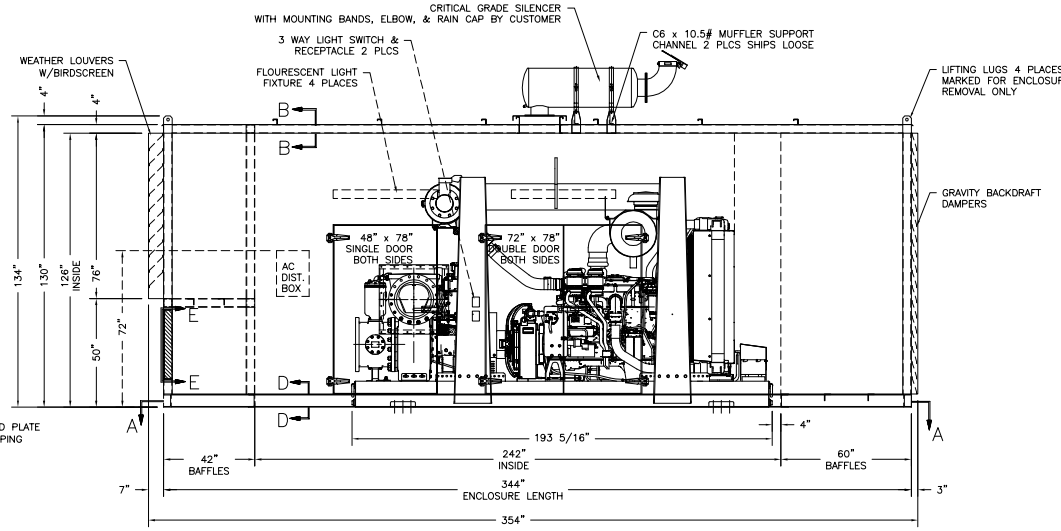
ELECTRICAL:
- SEE DRAWING

ENCLOSURE SHIPPING SIZE & WEIGHT:
- SIZE – 358" L x 149" W x 140" H
- WEIGHT – 19,000 LBS.

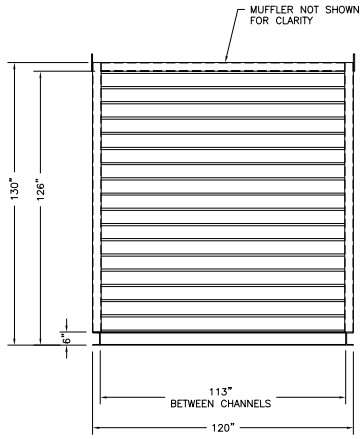
Paint Data Sheets and color chart are forthcoming



FRONT VIEW



ELEVATION VIEW

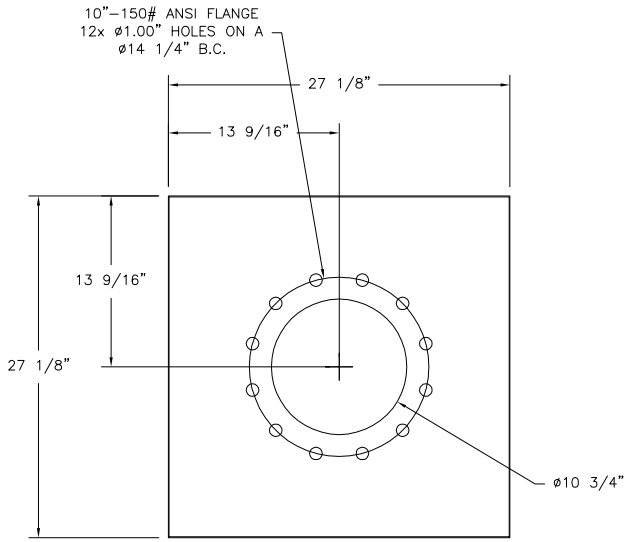


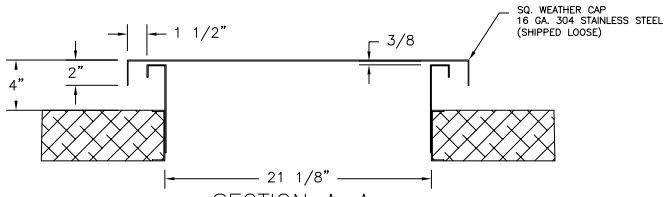
END VIEW

ACOUSTICAL ENCLOSURE

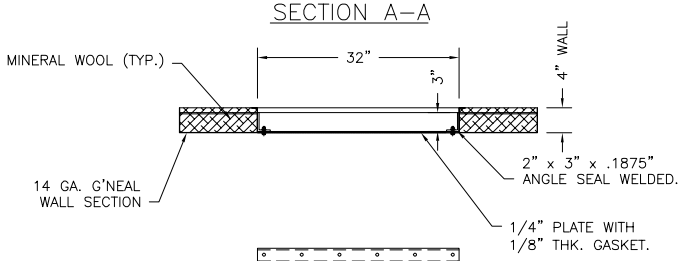
DRAWING NUMBER	SCALE	APPROVED BY	DRAWN BY		PROJECT NAME
H0404184A	NONE		MEP	PUMP	ROCKWALL SQUABBLE CREEK
	DATE 05/02/18		REVISION 0		

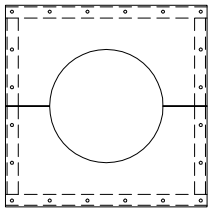
E & C A "CUSTOM FIT"



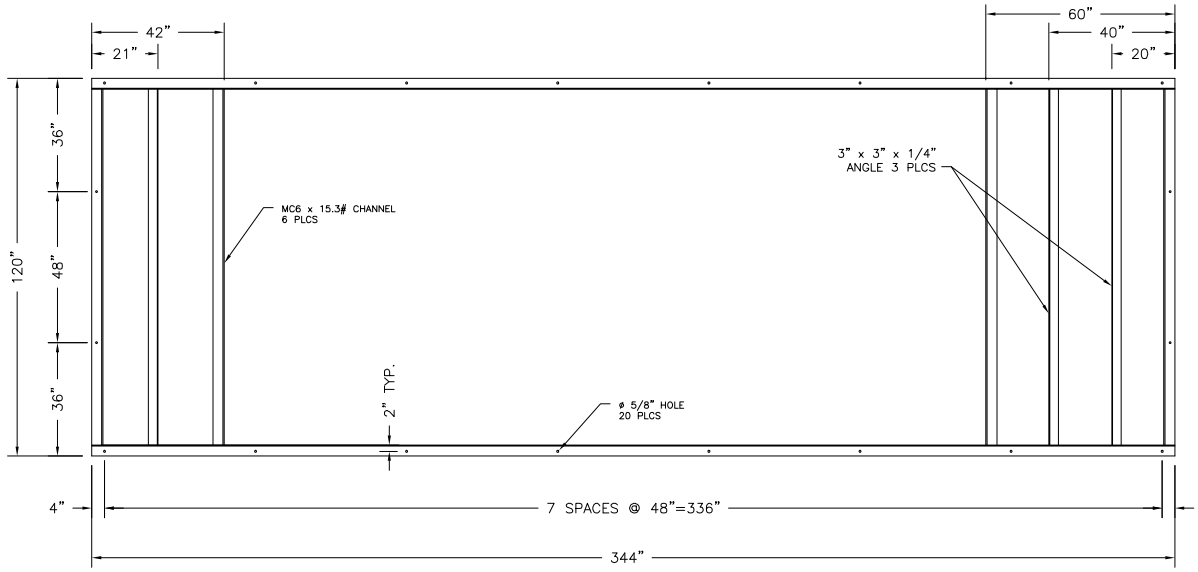


SECTION A–A

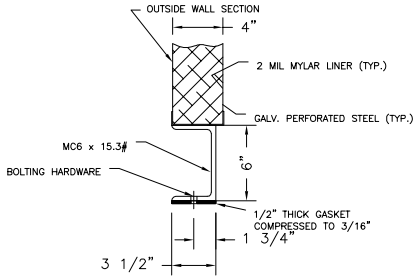




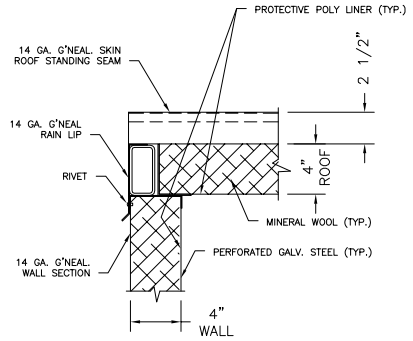
SECTION E–E



SECTION B–B



SECTION D–D



SECTION C–C

SOUND ATTENUATED ENCLOSURE

PUMP

DRAWING NUMBER	SCALE	APPROVED BY	DRAWN BY	PROJECT NUMBER
H0404184B	NONE		MEP	ROCKWALL SQUABBLE CREEK
	DATE 05/07/18		REVISION 0	

Interthane® 990

International

Polyurethane

PRODUCT DESCRIPTION

A two component acrylic polyurethane finish giving excellent durability and long term recoatability.

INTENDED USES

Suitable for use in both new construction and as a maintenance finish which can be used in a wide variety of environments including offshore structures, chemical and petrochemical plants, bridges, pulp and paper mills, and in the power industry.

PRACTICAL INFORMATION FOR INTERTHANE 990

Color	Wide range via the Chromascan® system
Gloss Level	High Gloss
Volume Solids	57% ± 3% (depends on color)
Typical Thickness	2-3 mils (50-75 microns) dry equivalent to 3.5-5.3 mils (88-132 microns) wet
Theoretical Coverage	457 sq.ft/US gallon at 2 mils d.f.t and stated volume solids 11.40 m²/liter at 50 microns d.f.t and stated volume solids
Practical Coverage	Allow appropriate loss factors
Method of Application	Airless Spray, Air Spray, Brush, Roller

Drying Time

			Overcoating Interval with recommended topcoats	
Temperature	**Touch Dry**	**Hard Dry**	*Minimum*	*Maximum*
23°F (-5°C)	8 hours	60 hours	60 hours	Extended[1]
41°F (5°C)	5 hours	24 hours	24 hours	Extended[1]
59°F (15°C)	150 minutes	10 hours	10 hours	Extended[1]
77°F (25°C)	90 minutes	6 hours	6 hours	Extended[1]
104°F (40°C)	60 minutes	3 hours	3 hours	Extended[1]

[1] See International Protective Coatings Definitions & Abbreviations

REGULATORY DATA

Flash Point (Typical)	Part A 93°F (34°C); Part B 120°F (49°C); Mixed 95°F (35°C)	
Product Weight	10.1 lb/gal (1.21 kg/l)	
VOC	3.50 lb/gal (420 g/lt) 341 g/kg	EPA Method 24 EU Solvent Emissions Directive (Council Directive 1999/13/EC)

See Product Characteristics section for further details

Interthane® 990

Polyurethane

SURFACE PREPARATION

All surfaces to be coated should be clean, dry and free from contamination. Prior to paint application, all surfaces should be assessed and treated in accordance with ISO 8504:2000.

Primed Surfaces

Interthane 990 should always be applied over a recommended anti-corrosive coating scheme. The primer surface should be dry and free from all contamination, and Interthane 990 must be applied within the overcoating intervals specified (consult the relevant product data sheet).

Areas of breakdown, damage etc., should be prepared to the specified standard (e.g. SSPC-SP6 or Sa2½ (ISO 8501-1:2007), Abrasive Blasting, or SSPC-SP11, Power Tool Cleaning) and patch primed prior to the application of Interthane 990.

APPLICATION

Mixing

Material is supplied in two containers as a unit. Always mix a complete unit in the proportions supplied. Once the unit has been mixed, it must be used within the working pot life specified.

(1) Agitate Base (Part A) with a power agitator.
(2) Combine entire contents of Curing Agent (Part B) with Base (Part A) and mix thoroughly with power agitator.

Mix Ratio

6 part(s): 1part(s) by volume

Working Pot Life

23°F (-5°C)	41°F (5°C)	59°F (15°C)	77°F (25°C)	104°F (40°C)
26 hours	12 hours	4 hours	2 hours	45 minutes

Airless Spray	Recommended	Tip Range 13-18 thou (0.33-0.45 mm) Total output fluid pressure at spray tip not less than 2204 psi (155 kg/cm²)	
Air Spray (Pressure Pot)	Recommended	Gun Air Cap Fluid Tip	DeVilbiss MBC or JGA 704 or 765 E
Air Spray (Conventional)	Recommended	Use suitable proprietary equipment.	
Brush	Suitable	Typically 1.6-2.0 mils (40-50 microns) can be achieved	
Roller	Suitable	Typically 1.6-2.0 mils (40-50 microns) can be achieved	
Thinner	International GTA713 (or International GTA733 or GTA056)	Do not thin more than allowed by local environmental legislation	

Cleaner

International GTA713 (or International GTA733 or GTA056)

Work Stoppages

Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA713. Once units of paint have been mixed they should not be resealed and it is advised that after prolonged stoppages work recommences with freshly mixed units.

Clean Up

Clean all equipment immediately after use with International GTA713. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays.

All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.

Interthane® 990

Polyurethane

PRODUCT CHARACTERISTICS

Interthane 990 is available in a range of metallic finishes - please consult the separate Interthane 990 Metallic Working Procedures document for further information.

Level of sheen and surface finish is dependent on application method. Avoid using a mixture of application methods whenever possible.

Best results in terms of gloss and appearance will always be obtained by conventional air spray application.

For brush and roller application, and in some colors, two coats of Interthane 990 may be required to give uniform coverage, especially when applying Interthane 990 over dark undercoats, and when using certain lead free bright colors such as yellows and oranges. Best practice is to use a color compatible intermediate or anti-corrosive coating under the Interthane 990.

When overcoating after weathering, or aging, ensure the coating is fully cleaned to remove all surface contamination such as oil, grease, salt crystals and traffic fumes, before application of a further coat of Interthane 990.

Absolute measured adhesion of topcoats to aged Interthane 990 is less than that to fresh material, however, it is adequate for the specified end use.

This product must only be thinned using the recommended International thinners. The use of alternative thinners, particularly those containing alcohols, can severely affect the curing mechanism of the coating.

Surface temperature must always be a minimum of 5°F (3°C) above dew point.

When applying Interthane 990 in confined spaces, ensure adequate ventilation.

Interthane 990 is capable of curing at temperatures below 32°F (0°C). However, this product should not be applied at temperatures below 32°F (0°C) where there is a possibility of ice formation on the substrate. Condensation occurring during or immediately after application may result in a matte finish and an inferior film. Premature exposure to ponding water will cause color change, especially in dark colors and at low temperatures.

This product is not recommended for use in immersion conditions. When severe chemical or solvent splashing is likely to occur, contact International Protective Coatings for information regarding suitability.

A modified version of Interthane 990 is available for use within the Korean marketplace in order to provide improved workability.

Note: VOC values are typical and are provided for guidance purpose only. These may be subject to variation depending on factors such as differences in color and normal manufacturing tolerances.

Low molecular weight reactive additives, which will form part of the film during normal ambient cure conditions, will also effect VOC values determined using EPA Method 24.

SYSTEMS COMPATIBILITY

The following primers/intermediates are recommended for Interthane 990:

Intercure 200	Interseal 670HS
Intercure 200HS	Interzinc 315
Intercure 420	Interzinc 52
Intergard 251	Interzinc 52HS
Intergard 269	Interzone 505
Intergard 345	Interzone 954
Intergard 475HS	Interzone 1000

Interthane 990 is designed to be topcoated with itself.

For other suitable primers/intermediates, consult International Protective Coatings.

Interthane® 990

Polyurethane

ADDITIONAL INFORMATION

Further information regarding industry standards, terms and abbreviations used in this data sheet can be found in the following documents available at www.international-pc.com:

- Definitions & Abbreviations
- Surface Preparation
- Paint Application
- Theoretical & Practical Coverage
- Interthane 990 Metallic Finish Working Procedures

Individual copies of these information sections are available upon request.

SAFETY PRECAUTIONS

This product is intended for use only by professional applicators in industrial situations in accordance with the advice given on this sheet, the Material Safety Data Sheet and the container(s), and should not be used without reference to the Material Safety Data Sheet (MSDS) which International Protective Coatings has provided to its customers.

All work involving the application and use of this product should be performed in compliance with all relevant national, Health, Safety & Environmental standards and regulations.

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation.

If in doubt regarding the suitability of use of this product, consult International Protective Coatings for further advice.

Warning: Contains isocyanate. Wear air-fed hood for spray application.

PACK SIZE

Unit Size	Part A		Part B	
	Vol	Pack	Vol	Pack
20 liter	17.14 liter	20 liter	2.86 liter	3.7 liter
5 US gal	4.29 US gal	5 US gal	0.71 US gal	1 US gal

For availability of other pack sizes contact International Protective Coatings

SHIPPING WEIGHT (TYPICAL)

Unit Size	Part A	Part B
20 liter	23.1 kg	3.5 kg
5 US gal	47.6 lb	7.1 lb

STORAGE

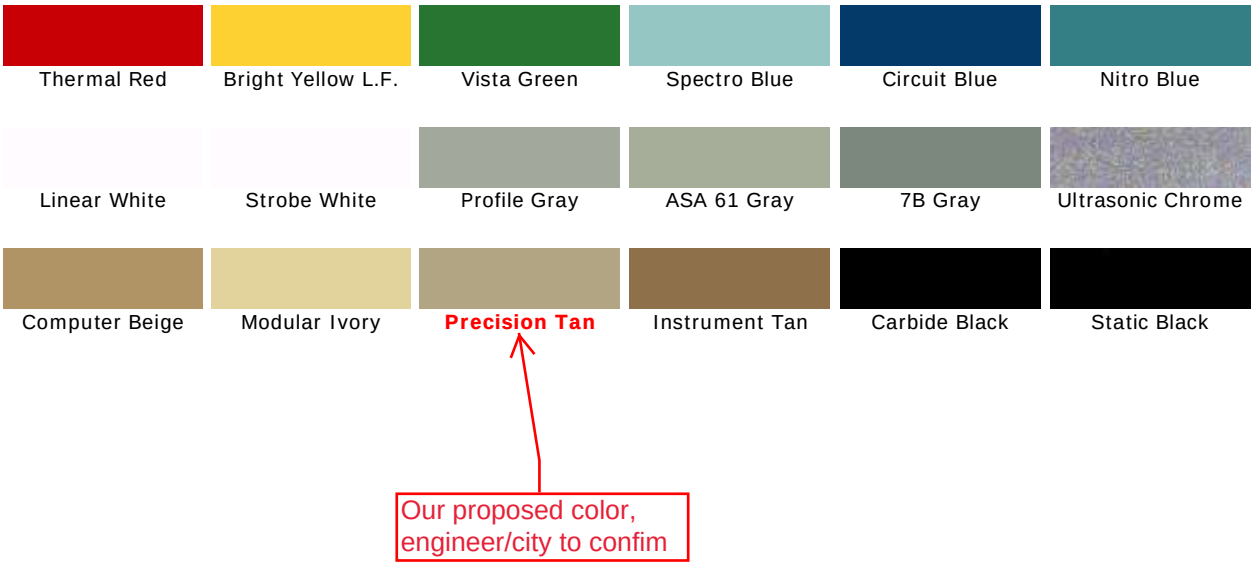
Shelf Life	24 months (Part A) & 12 months (Part B) minimum at 77°F (25°C) Subject to re-inspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.

Disclaimer

www.international-pc.com

Engine & Compressor Accessories
Approximate Color Selector

NOTE: Depending on monitor settings and printer hardware these colors may vary.



PIERCE PUMP
an FCX Performance Company

SECTION - 4

Pump Warranty

WARRANTY COVERAGE

GORMAN-RUPP

PUMPS

The Pump People®

EXTENT AND DURATION OF WARRANTY

COVERAGE

Gorman-Rupp Pumps (herein referred to as "Gorman-Rupp") warrant that its products and parts shall be free from defects in material and workmanship for the various periods specified in Addendum 1 – Warranty Periods beginning: (a) for pumps and parts on the date of purchase by the original end user; or (b) for pump stations, industrial pump packages and fiberglass reinforced polyester enclosures on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first. In addition to defects in material and workmanship, fiberglass reinforced polyester enclosures are warranted to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty. This Limited Warranty shall be valid only when installation is made and use and maintenance is performed in accordance with Gorman-Rupp recommendations. In the case of pump stations and pump packages, in order for this Limited Warranty to be valid, a Start-Up Report completed by an authorized Gorman-Rupp agent must be received by Gorman-Rupp within thirty (30) days of the initial date the unit is placed into service. An extended warranty is available on certain pump models. This extended warranty is an extension of the original warranty limited warranty. All exceptions and limitations of the original warranty, except for duration, apply to the extended warranty.

EXCEPTIONS TO COVERAGE

- This Limited Warranty shall not apply to the following products and parts: engines, motors, trade accessories and other products, components or materials not manufactured by Gorman-Rupp. Any warranty for these products and parts shall be provided by the manufacturer(s) of those products and parts. With respect to submersible pumps, the pump and motor are an integral unit and are therefore warranted as a unit. With respect to Pump Stations, all components installed in the Pump Station by Gorman-Rupp are an integral unit and are therefore warranted as a unit (excludes components provided by others for incorporation into the Pump Station). Items normally consumed in use, and wear and tear resulting from normal use are not covered by this Limited Warranty.
- This Limited Warranty shall not apply to any Gorman-Rupp product or part which: (a) has been subjected to misuse, misapplication, alteration, neglect, or physical damage resulting from these causes (b) has been installed, operated, used, and/or maintained in a manner which is not in accordance with Gorman-Rupp's printed recommendations, including but not limited to operation of equipment without being connected to monitoring components provided with the product or damaged as the result of defective power supply, improper electrical protection, faulty installation, improper installation, ordinary wear and tear, corrosion or chemical attack, an Act of God, an Act of War or Terrorism or has been damaged as the result of the use with equipment not sold by Gorman-Rupp and/or not approved by Gorman-Rupp for use with the product.
- This Limited Warranty does not cover costs for any standard and/or scheduled maintenance, nor does it cover parts that, by nature of their function, require replacement as a result of normal wear (e.g., Wear Parts), unless a determination of defect in material or workmanship is made by Gorman-Rupp. Wear Parts include, but are not limited to, impellers, wear plates, wear rings, seals, volutes, diffusers, oil, grease, and/or other items which are required for operation of the pump or pump station and are subject to regular inspection and maintenance.
- Determination of coverage or exceptions to coverage are solely at the option of Gorman-Rupp.

LIMITATIONS

GORMAN-RUPP'S SOLE AND EXCLUSIVE WARRANTY WITH RESPECT TO ITS PRODUCTS AND PARTS IS THIS LIMITED WARRANTY. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER EXPRESS AND/OR IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

EQUIPMENT SELECTED OR SUPPLIED BY OTHERS AND INCORPORATED INTO A GORMAN-RUPP PUMP STATION OR ENCLOSURE IS NOT COVERED BY THIS LIMITED WARRANTY. ANY WARRANTY APPLICABLE TO EQUIPMENT SELECTED OR SUPPLIED BY OTHERS WILL BE LIMITED SOLELY TO THE WARRANTY, IF ANY, PROVIDED BY THE MANUFACTURER OF THE EQUIPMENT.

EXCLUSIVE REMEDY AND DAMAGES

The sole and exclusive remedy for breach of this Limited Warranty by Gorman-Rupp, and the entire extent of its liability for such breach or for damages arising and/or resulting from the use of the products and parts covered by this Limited Warranty shall be as follows:

- **REPAIR OR REPLACEMENT:** Upon return of the product to Gorman-Rupp, if inspection shows that any Gorman-Rupp product or part covered under this Limited Warranty is defective in materials or workmanship, Gorman-Rupp shall repair or replace the defective product or part(s) at its option, without charge in the percentage indicated in **Addendum 1 – Warranty Periods.** The product or part(s) claimed to be defective must have been properly installed, maintained and used in accordance with the maintenance schedule and/or instructions contained in the manual which comes with the product. No allowance will be made for labor, freight, transportation or other charges incurred in connection with such repair or replacement.
- **TO OBTAIN THE ABOVE REMEDY:**
  - Immediately notify Gorman-Rupp of the claimed defect in materials or workmanship and provide the serial number or date code of the product and/or part(s) and provide a copy of the invoice or bill of sale referencing the product and/or part by no later than the expiration date of the Limited Warranty period.
  - Gorman-Rupp will advise whether inspection of the product and/or part(s) will be necessary and whether and how inspection, repair or replacement will be effected. If inspection is necessary, Gorman-Rupp will, at its discretion, provide field inspection by an authorized agent or require that the product or part(s) be sent freight prepaid to Gorman-Rupp at the applicable address below. If the product or part is returned to Gorman-Rupp for inspection, return shipment of the repaired product or part(s) will be F.O.B. to the applicable address below.
- **DAMAGES:** Gorman-Rupp's liability for damages for breach of this Limited Warranty shall not exceed the amount of the purchase price of the product or part in respect to which damages are claimed. **IN NO EVENT SHALL GORMAN-RUPP BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES FOR BREACH OF THIS LIMITED WARRANTY OTHER THAN AS STATED HEREIN.**

In some instances, the exclusion or limitation of incidental or consequential damages are not allowed. Accordingly, the above may not apply to you. This Limited Warranty gives you specific legal rights, and you may also have other rights which vary.

*For additional copies please visit **www.GRpumps.com/warranty.***

To return product to Gorman-Rupp, ship to:

GORMAN-RUPP PUMPS
100 Rupp Road, Dock 5
Mansfield, OH 44903
USA
419-755-1280

GORMAN-RUPP AFRICA
4 Harold Flight Road
Jet Park
Boksburg, 1459
Republic Of South Africa
+27 011 397 3536

GORMAN-RUPP CANADA
70 Burwell Road
St. Thomas, Ontario N5P 3R7
Canada
519-631-2870

GORMAN-RUPP EUROPE
Bellweg 50
4101 BJ Culemborg
Netherlands
+31 (0) 85 773 0080

ADDENDUM 1 - WARRANTY PERIODS

	PRODUCT	0 – 6 Months[1]	7 – 12 Months[1]	13 – 18 Months[1]	19 – 24 Months[1]	25 – 39 Months[1]	40 – 60 Months[1]	Extended Warranty Available[5]
PUMPS	10 Series®	100%						✔
	30 Series	100%						
	50 Series	100%						
	60 Series	100%						
	80 Series®	100%						✔
	6500 Series®	100%						
	D Series (Diaphragm Pumps)	100%						✔
	G Series (Rotary Gear)	100%						
	HS Series® (Hydraulic Submersible)	100%						
	O Series®	100%						✔
	PA Series® (Prime Aire®)	100%						✔
	PAH Series® (Prime Aire Plus®)	100%						✔
	RD & RS Series (Roto-Prime®)	100%						✔
	S Series	100%						
	S1 1/2 A3 (A), S2C3 (A), S2D3 (A) – (From the OTS Program)	100%						
	SC Series	100%						
	SE Series	100%						
	SE1 1/2 A3 (A), SE2C3 (A), SE2D3 (A) – (From the OTS program)	100%						
	SF Series® – Pump Only	100%						✔
	SF Series® – Permanent Municipal Installation[2]	100%			50%		25%	✔
	SH Series	100%						
	Silent Pump	Warranty period is based on pump model included in product						
	SM Series	100%						✔
	Tankleenor	100%						✔
	T Series®	100%						
	Super T Series®	100%						
	Super U Series®	100%						
	Ultra V Series®	100%						
	VG & VGH Series	100%						
STATIONS	ReliaSource® / Complete Gorman-Rupp Pump & Package Stations[3]	100%						
	Pressure Booster / Partial / Non-Standard Pump & Package Stations[4]	100%						✔
OTHER	ReliaPrime® Back-up System	100%						
	Parts	100%						
	Lift Station Remanufacturing Kits	100%						
	Rotating Assemblies for Super T, Super U & Ultra V series	100%						
	Exchange Stock Product	100%						
	Remanufactured Equipment	Warranty period as agreed to at time of purchase						
	Repairs performed at Gorman-Rupp	Parts and workmanship used in repairs only – warranty period for the remainder of original product warranty or 12 months, whichever is greater						

[1] Proration periods are applied based on months after purchase, acceptance, shipment, or installation, as applicable. Percentages for proration periods define the amount of warranted costs to be borne by Gorman-Rupp.

[2] Approved Permanent Municipal Installations are permanent pump installations and require appropriate controls documents at time of installation.

[3] Pump & Package Stations require submission to Gorman-Rupp of Start-Up Report for this Limited Warranty to be in effect on the complete package. In the event that Start-Up Report is not submitted to Gorman-Rupp, each component in the package will be subject to its individual manufacturer warranty, if available.

[4] Partial / Non-Standard Pump & Package Stations refer to packages using pumps other than those produced by Gorman-Rupp or using components other than those specified by Gorman-Rupp or excluding components specified by Gorman-Rupp.

[5] Extended warranty is an extension of the original limited warranty. All exceptions and limitations of the original warranty, except for duration, apply to the extended warranty.

Contact your Gorman-Rupp Company representative for additional extended warranty pricing, availability and terms & conditions.

Effective Date: 06/15/2017
Supersedes All Previous Warranties

PIERCE PUMP
an FCX Performance Company

SECTION - 5

Pump O&M

OM—06687—02
August 2, 2016
Rev A 11—08—16

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS

PAH SERIES® PUMP

MODEL

PAH16A60C—B—C18

GORMAN-RUPP PUMPS

www.grpumps.com

Printed in U.S.A.

Register your new
Gorman-Rupp pump online at
www.grpumps.com/register.

Valid serial number and e-mail address required.

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

RECORD YOUR PUMP MODEL AND SERIAL NUMBER

Please record your pump model and serial number in the spaces provided below. Your Gorman-Rupp distributor needs this information when you require parts or service.

Pump Model: _____

Serial Number: _____

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

INTRODUCTION

Thank You for purchasing a Gorman-Rupp pump. **Read this manual** carefully to learn how to safely install and operate your pump. Failure to do so could result in personal injury or damage to the pump.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for every aspect of each specific application. Therefore, it is the responsibility of the owner/installer of the pump to ensure that applications not addressed in this manual are performed **only** after establishing that neither operator safety nor pump integrity are compromised by the installation. Pumps and related equipment **must** be installed and operated according to all national, local and industry standards.

If there are any questions regarding the pump or its application which are not covered in this manual or in other literature accompanying this unit, please contact your Gorman-Rupp distributor, or The Gorman-Rupp Company:

The Gorman-Rupp Company
P.O. Box 1217
Mansfield, Ohio 44901—1217
Phone: (419) 755—1011
or:
Gorman-Rupp of Canada Limited
70 Burwell Road
St. Thomas, Ontario N5P 3R7
Phone: (519) 631—2870

For information or technical assistance on the power source, contact the power source manufacturer's local dealer or representative.

HAZARD AND INSTRUCTION DEFINITIONS

The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:

DANGER!

Immediate hazards which WILL result in severe personal injury or death. These instructions describe the procedure required and the injury which will result from failure to follow the procedure.

WARNING!

Hazards or unsafe practices which COULD result in severe personal injury or death. These instructions describe the procedure required and the injury which could result from failure to follow the procedure.

CAUTION

Hazards or unsafe practices which COULD result in minor personal injury or product or property damage. These instructions describe the requirements and the possible damage which could result from failure to follow the procedure.

NOTE

Instructions to aid in installation, operation, and maintenance or which clarify a procedure.

SAFETY - SECTION A

This information applies to Prime Aire® Series pumps. Refer to the manual accompanying the engine or power source before attempting to begin operation.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for each specific application. Therefore, it is the owner/installer's responsibility to ensure that applications not addressed in this manual are performed only after establishing that neither operator safety nor pump integrity are compromised by the installation.

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut down the engine and disconnect the positive battery cable to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure the pump is cool before opening any covers, plates, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

This pump is equipped with an automatic starting system, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

Do not attempt to disengage any part of an overheated pump unit. Vapor pressure within the pump casing can eject these parts with great force when they are disengaged. Allow the pump to completely cool before servicing it.

This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.

Death or serious personal injury and damage to the pump or components can occur if proper lifting procedures are not observed. Make certain that hoists, chains, slings or cables are in good working condition and of sufficient capacity and that they are positioned so that loads will be balanced and the pump or components will not be damaged when lifting. Suction and discharge hoses and piping must be removed from the pump before lifting. Lift the pump or component only as high as necessary and keep personnel away from suspended objects.

After the pump has been installed, make

certain that the pump and all piping or hose connections are tight, properly supported and secure before operation.

Do not operate the pump against a closed discharge valve. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode. Momentary closure of a discharge valve is acceptable only when required for startup or shutdown procedures.

Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to cool completely before servicing.

This pump may be used to handle materials which could cause illness through direct exposure or emitted fumes. Wear adequate protective clothing when working on the pump or piping.

Do not operate the pump without guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers or tools, causing severe injury to personnel.

Make sure the pump is level. Lower jack stands and chock the wheels, if so equipped. Use caution when positioning the skid-mounted unit to prevent damage to the fuel tank.

Do not operate an internal combustion engine in an explosive atmosphere. When operating an internal combustion engine in an enclosed area, make sure exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless and odorless.

Fuel used by internal combustion engines presents an extreme explosion and fire hazard. Make certain that all fuel lines are securely connected and free of leaks. Never refuel a hot or running engine. Avoid overfilling the fuel tank. Always use the correct type of fuel.

Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. Refer to the performance curve, page E—1, for the maximum continuous operating speed for this pump.

INSTALLATION – SECTION B

Review all SAFETY information in Section A.

Since pump installations are seldom identical, this section offers only general recommendations and practices required to inspect, position, and arrange the pump and piping.

Most of the information pertains to a standard **static lift** application where the pump is positioned above the free level of liquid to be pumped.

If installed in a **flooded suction application** where the liquid is supplied to the pump under pressure, some of the information such as mounting, line configuration, and priming must be tailored to the specific application. Since the pressure supplied to the pump is critical to performance and safety, **be sure** to limit the incoming pressure to 50% of the maximum permissible operating pressure as shown on the pump performance curve.

For further assistance, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Pump Dimensions

See Figure 1 for the approximate physical dimensions of this pump.

OUTLINE DRAWING

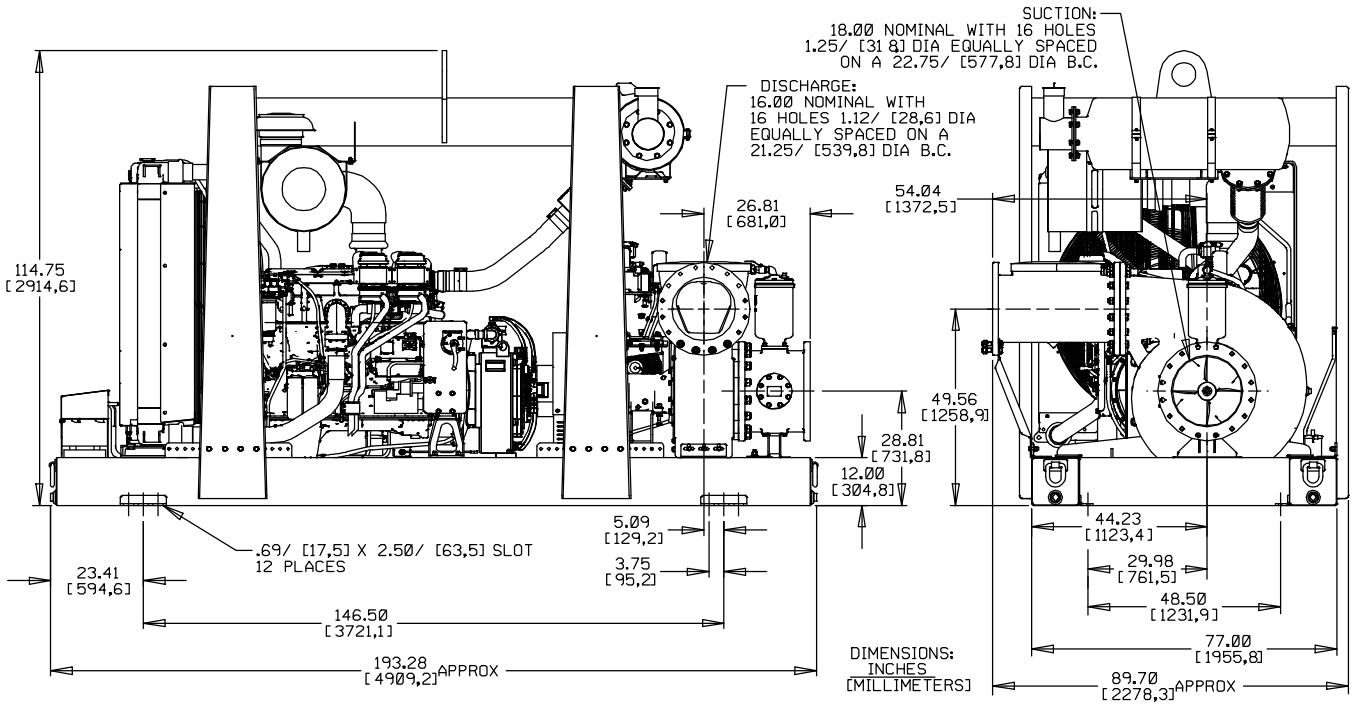


Figure 1. Pump Model PAH16A60C–B–C18

PREINSTALLATION INSPECTION

The pump assembly was inspected and tested before shipment from the factory. Before installation, inspect the pump for damage which may have occurred during shipment. Check as follows:

a. Inspect the pump for cracks, dents, damaged threads, and other obvious damage.

b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.

c. Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated. Note that the pump shaft rotates in the required direction.

CAUTION

Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Otherwise, the impeller could become loosened from the shaft and seriously damage the pump.

d. Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **Maintenance and Repair Manual** and perform duties as instructed.

e. If the pump has been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum shelf life. These **must be inspected or replaced** to ensure maximum pump service.

If the maximum shelf life has been exceeded, or if anything appears to be abnormal, contact your Gorman-Rupp distributor or the factory to determine the repair or updating policy. **Do not** put the pump into service until appropriate action has been taken.

Battery Installation

Unless otherwise specified on the pump order, the engine battery is **not** included with engine driven units.

Refer to the information accompanying the battery and/or electrolyte solution for activation and charging instructions.

Before installing the battery, clean the positive and negative cable connectors, and the battery terminals. Secure the battery by tightening the holddown brackets. The terminals and clamps may be coated with petroleum jelly to retard corrosion. Connect and tighten the positive cable first, then the negative cable.

POSITIONING PUMP

Lifting

Pump unit weights will vary depending on the mounting and drive provided. Check the shipping tag on the unit packaging for the actual weight, and use lifting equipment with appropriate capacity. Drain the pump and remove all customer-installed equipment such as suction and discharge hoses or piping before attempting to lift existing, installed units.

WARNING!

Death or serious personal injury and damage to the pump or components can occur if proper lifting procedures are not observed. Make certain that hoists, chains, slings or cables are in good working condition and of sufficient capacity and that they are positioned so that loads will be balanced and the pump or components will not be damaged when lifting. Suction and discharge hoses and piping must be removed from the pump before lifting. Lift the pump or component only as high as necessary and keep personnel away from suspended objects.

Mounting

Locate the pump in an accessible place as close as practical to the liquid being pumped. Level mounting is essential for proper operation. The pump may have to be supported or shimmed to provide for level operation and eliminate vibration.

For engine driven units, the pump **must** be positioned as level as possible to ensure sufficient lubrication and fuel supply to the engine.

If the pump has been mounted on a moveable base, make certain the base is stationary by setting the brake and blocking the wheels before attempting to operate the pump.

WARNING!

If the pump has been mounted on a movable base, do not attempt to operate the pump unless the unit is level. Be sure the leveling stands are positioned on a solid surface, and the wheels are chocked.

SUCTION AND DISCHARGE PIPING

Pump performance is adversely effected by increased suction lift, discharge elevation, and friction losses. See the performance curve and operating range shown on Page E-1 to be sure your overall application allows pump to operate within the safe operation range.

Materials

Either pipe or hose maybe used for suction and discharge lines; however, the materials must be compatible with the liquid being pumped. If hose is used in suction lines, it must be the rigid-wall, reinforced type to prevent collapse under suction. Using piping couplings in suction lines is not recommended.

Line Configuration

Keep suction and discharge lines as straight as possible to minimize friction losses. Make minimum use of elbows and fittings, which substantially increase friction loss. If elbows are necessary, use the long-radius type to minimize friction loss.

Connections to Pump

Before tightening a connecting flange, align it exactly with the pump port. Never pull a pipe line into place by tightening the flange bolts and/or couplings.

Lines near the pump must be independently supported to avoid strain on the pump which could cause excessive vibration, decreased bearing life, and increased shaft and seal wear. If hose-type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

Gauges

The pump is drilled and tapped for installing discharge pressure and vacuum suction gauges. It is recommended that gauges be installed to monitor pump performance. Seal the gauge threads with pipe dope to ensure an airtight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

SUCTION LINES

To avoid air pockets which could affect pump priming, the suction line must be as short and direct as possible. When operation involves a suction lift, the line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

Fittings

Suction lines should be the same size as the pump inlet. If reducers are used in suction lines, they should be the eccentric type, and should be installed with the flat part of the reducers uppermost to avoid creating air pockets. Valves are not normally used in suction lines, but if a valve is used, install it with the stem horizontal to avoid air pockets.

Strainers

Be certain to use the strainer furnished with the pump; any spherical solids which pass through the strainer will also pass through the pump itself.

If a strainer not furnished with the pump is installed by the pump user, make certain that the total area of the openings in the strainer is at least three or four times the cross section of the suction line, and that the openings will not permit passage of solids larger than the solids handling capability of the pump.

This pump is designed to handle up to 4 inch (101,6 mm) diameter spherical solids.

Sealing

Since even a slight leak will affect priming, head, and capacity, especially when operating with a high suction lift, all connections in the suction line should be sealed with pipe dope to ensure an air-tight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

Suction Lines In Sumps

If a single suction line is installed in a sump, it should be positioned away from the wall of the sump at a distance equal to 1 1/2 times the diameter of the suction line.

If there is a liquid flow from an open pipe into the sump, the flow should be kept away from the suction inlet because the inflow will carry air down into the sump, and air entering the suction line will reduce pump efficiency.

If it is necessary to position inflow close to the suction inlet, install a baffle between the inflow and the suction inlet at a distance 1-1/2 times the diameter of the suction pipe. The baffle will allow entrained air to escape from the liquid before it is drawn into the suction inlet.

If two suction lines are installed in a single sump, the flow paths may interact, reducing the efficiency of one or both pumps. To avoid this, position the suction inlets so that they are separated by a distance equal to at least 3 times the diameter of the suction pipe.

Suction Line Positioning

The depth of submergence of the suction line is critical to **efficient** pump operation. Figure 2 shows recommended minimum submergence vs. velocity.

Although not recommended, the vacuum assisted priming feature allows the pump to be operated temporarily in a "slurping" application with varying water levels.

NOTE

The pipe submergence required may be reduced by installing a standard pipe increaser fitting at the end of the suction line. The larger opening size will reduce the inlet velocity. Calculate the required submergence using the following formula based on the increased opening size (area or diameter).

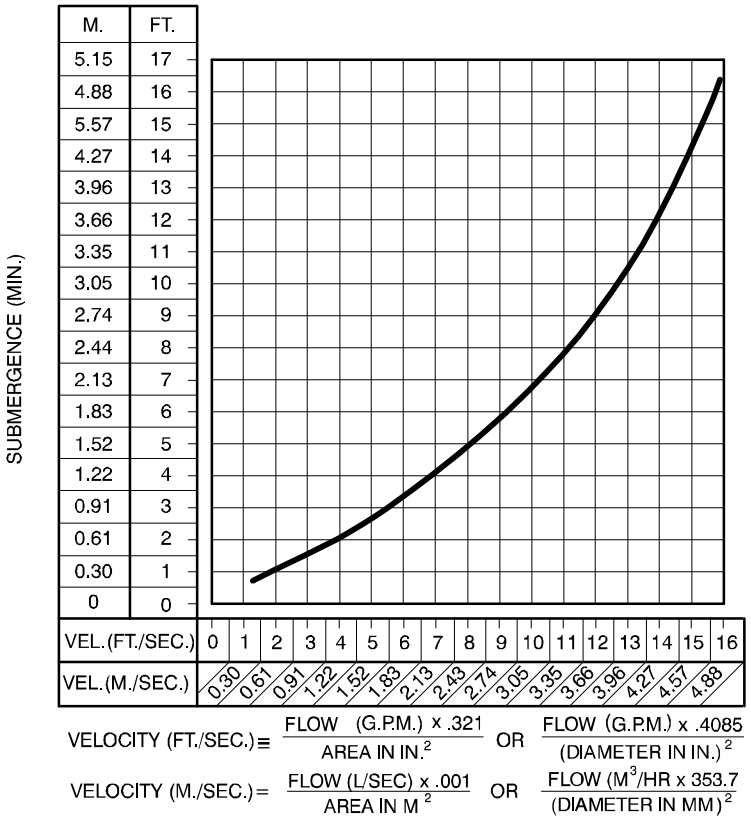


Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity

DISCHARGE LINES

Siphoning

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action causing damage to the pump could result.

Valves

This pump is designed with a check valve in the discharge line.

If a throttling valve is desired in the discharge line, use a valve as large as the largest pipe to minimize friction losses. Never install a throttling valve in a suction line.

With high discharge heads, it is recommended that a throttling valve be installed in the discharge line to protect the pump from excessive shock pressure and reverse rotation when it is stopped.

CAUTION

If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

ALIGNMENT

The alignment of the pump and gear reducer is critical for trouble-free mechanical operation. The gear reducer and pump must be mounted so that their shafts are aligned with and parallel to each other. It is imperative that alignment be checked after the pump and piping are installed, and before operation.

NOTE

Check **Rotation***, Section C, before final alignment of the pump.*

When mounted at the Gorman-Rupp factory, the gear reducer and pump shafts are aligned before shipment. Misalignment will occur in transit and

handling. Pumps **must** be checked and realigned before operation. Before checking alignment, tighten the pump casing feet and/or pedestal feet.

WARNING!

When checking alignment, shut down the engine and disconnect the positive battery cable to ensure that the pump will remain inoperative.

CAUTION

Adjusting the alignment in one direction may alter the alignment in another direction. check each procedure after altering alignment.

Coupled Drives

When using couplings, the axis of the power source must be aligned to the axis of the pump shaft in both the horizontal and vertical planes. Most couplings require a specific gap or clearance between the driving and the driven shafts. Refer to the coupling manufacturer's service literature.

Align spider insert type couplings by using calipers to measure the dimensions on the circumference of the outer ends of the coupling hub every 90°. The coupling is in alignment when the hub ends are the same distance apart at all points (see Figure 3).

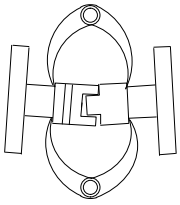


Figure 3. Aligning Spider-Type Couplings

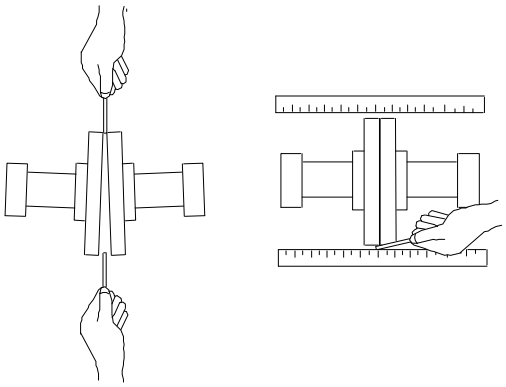


Figure 4. Aligning Non-Spider Type Couplings

Align non-spider type couplings by using a feeler gauge or taper gauge between the coupling halves every 90°. The coupling is in alignment when the hubs are the same distance apart at all points (see Figure 4).

Check parallel adjustment by laying a straightedge across both coupling rims at the top, bottom, and side. When the straightedge rests evenly on both halves of the coupling, the coupling is in horizontal parallel alignment. If the coupling is misaligned, use a feeler gauge between the coupling and the straightedge to measure the amount of misalignment.

DANGER!

Do not operate the pump without the guard in place over the rotating parts. exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.

AUTO-START

The standard pump is equipped with an auto-start control system which allows the pump to start and stop as the liquid level in the wet well or sump rises and falls.

Refer to the information which follows for installation details for the liquid level sensing system provided with your pump.

Float Switch Installation

The Float Switch autostart system employs either a single or double float switch, where a bulb raises or

lowers (floats) with the liquid level, thus activating an enclosed miniature switch. The floats are equipped with a socket type connector that plugs into a matching receptacle on the auto-start control box.

Standard floats are equipped with 50 feet (15,2 m) of cable.

When installing the floats, note the following:

a. **Be sure** to provide sufficient room in the wet well or sump so that floats do not get obstructed or drawn into the suction line. If a flexible suction hose is used, it may be extended to lay along the bottom of the wet well or sump and the float can be attached to the hose above the point where it bends along the bottom. Direct the suction line toward the flow, and the float(s) away from the flow. If a standpipe is available, attach the float switch cable to the standpipe in the sump at the approximate desired liquid level.

b. In a single float system, the cable can be tethered to the suction line or standpipe approximately 6 inches (152 mm) above the float. This setting allows approximately 9 inches (229 mm) of liquid rise between pump start/stop. The start/stop interval may be increased by extending the float end of the cable. The liquid level in the sump will increase approximately 8 inches (203 mm) between start/stop intervals for every 6 inches (152 mm) of cable increase.

c. If a double float switch system is used, position the “Start” float at the desired high water level in the sump, and the “Stop” float at the desired low water level in the pump.

d. Refer to Figure 5 for additional float switch data.

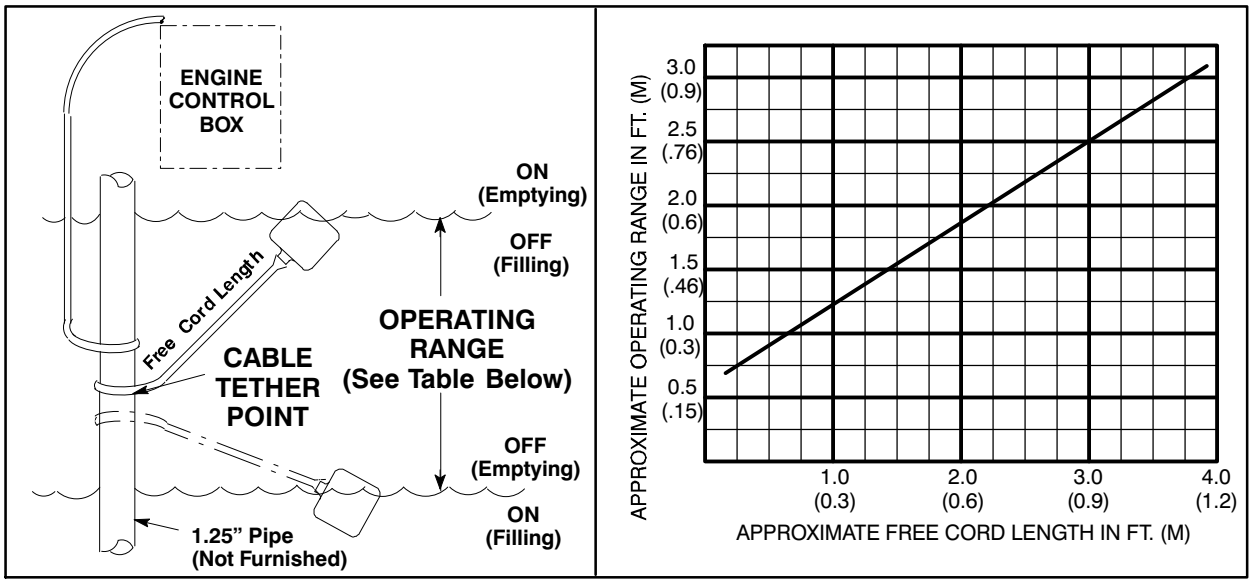


Figure 5. Float Switch Data

COLD WEATHER INSTALLATION

If the pump is to be installed in an environment where sub-freezing temperatures will occur during operation, consideration must be given to prevent the pump and components from freezing when the pump is idle between pumping cycles. With Gorman-Rupp priming assisted pumps, there are two methods of accomplishing this.

One method is through the use of an optional heated priming chamber, which is available as a factory-installed option or as a retrofit kit for most models (consult the factory). This method pumps heated liquid from the engine cooling system through the priming chamber to heat the chamber and its contents. This method is particularly effective where pumping cycles are short enough to ensure that the liquid in the priming chamber never fully freezes.

The second method involves configuring the pumping system to drain both the priming chamber and pump casing after each pumping cycle.

With no liquid remaining in the system, freezing cannot occur.

To configure the pump to drain between pumping cycles, the first step is to remove the check valve from the line that runs between the top of the priming hopper and the priming venturi. This check valve is located close to the venturi end of the line. Remove the check valve, then reconnect the line directly to the venturi. This will allow air to enter the pump through the top of the priming hopper when the pump shuts off, providing for complete drainage of the pump and priming hopper.

Next, install a drain line between the pump drain and the wet well or sump. This line must remain submerged in the liquid below the pump down level of the liquid level control device; otherwise, the pump may not prime. If the application involves liquids that could clog the drain line, make sure to check the line periodically to ensure it remains open; otherwise, liquid could remain in the casing, resulting in freezing and potential damage to the pumping system.

Configuring the system to drain between cycles will help ensure that the pump will not freeze during cold weather applications. **However, it should be noted that the time required for the pump to begin to discharge liquid will increase, as the pump will have to fully re-prime at the beginning of each pumping cycle.**

OPERATION – SECTION C

OPERATION

WARNING!

This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids and corrosives. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the performance curve in Section E on page E–1.

STARTING

Check the fuel level and oil levels in the engine, air compressor, pump bearings and seal housing.

Make sure the pump is level. Lower the jack stands and chock the wheels, if so equipped.

CAUTION

Make sure the pump is level. Lower jack stands and chock the wheels, if so equipped. Use caution when positioning the skid-mounted unit to prevent damage to the fuel tank.

WARNING!

This pump is equipped with automatic liquid level controls, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

Consult the engine operations manual before attempting to start the unit.

Manual Starting

On initial start-up, set the engine speed at in the half-throttle position. Turn the keyswitch to 'MANUAL'. After the engine starts and the unit is fully primed, adjust the engine RPM until the desired flow rate is achieved.

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the curve on Page E-1.

Automatic Starting

With the float system installed, follow the procedures outlined for manual starting and throttle adjustment. Switch the keyswitch to 'OFF' until the water level rises above the on point for the float system, then turn the keyswitch to the 'AUTO' setting. The unit will run until the float signals the control that the water in the wet well is at the float off point, at which time the unit will shut down automatically. When the float signals the control that the water in the wet well is at the float on point, the unit will restart automatically, repeating the cycle.

Review all SAFETY information in Section A.

Follow the instructions on all tags, labels and decals attached to the pump.

DANGER!

Do not operate an internal combustion

engine in an explosive atmosphere. When operating an internal combustion engine in an enclosed area, make sure exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless and odorless.

PRIMING

The pump will begin to prime upon startup. The air in the suction line will be discharged from the eductor discharge line. Complete priming is indicated by a positive discharge pressure reading.

If full priming is not achieved, the discharge check valve may be malfunctioning. If this occurs, shut down the pump and consult **Maintenance and Repair,** Section E for further details.

ROUTINE OPERATION

DANGER!

Do not operate an internal combustion engine in an explosive atmosphere. When operating an internal combustion engine in an enclosed area, make sure exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless and odorless.

Adjust the engine speed to achieve the desired output. Do not exceed the factory set engine speed and system operating pressure. Do not operate below the recommended operating speed (if applicable).

WARNING!

Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. Refer to the Performance Curve in Section E for the maximum continuous operating speed for this pump.

OPERATION IN EXTREME HEAT

The safety shutdown system will automatically stop the unit if engine operating temperature exceeds design limits. If engine over-temperature shutdown occurs, allow the unit to cool before restarting.

If engine overheating continues, check the engine lubricant level and viscosity. Consult the engine operation manual for the recommended lubricant for operation in extreme heat.

If the unit is being operated in the **automatic** mode, adjust the float(s) to allow shorter run and longer cooling periods, if possible.

WARNING!

This pump is equipped with automatic liquid level controls, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the battery before performing any maintenance. Failure to do so may result in serious personal injury.

OPERATIONAL CHECKS

Leakage

Once the pump is fully primed, no leakage should be visible at pump mating surfaces, or at pump connections or fittings. Keep all line connections and fittings tight to maintain maximum pump efficiency.

Pump Vacuum Check

Read the vacuum gauge with the pump primed and at operation speed. Shut off the pump. The vacuum gauge reading will immediately drop proportionate to static suction lift, and should then stabilize. If the vacuum reading falls off rapidly after stabilization, an air leak exists. Before checking for the source of the leak, check the point of installation of the vacuum gauge.

Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 160°F (71°C). Do not apply it at a higher operating temperature.

Overheating can occur if operated with the valves in the suction or discharge lines closed. Operating against closed valves could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode. If overheating occurs, stop the pump immediately and allow it to completely cool before servicing it. **Approach any over-heated pump cautiously**.

WARNING!

Allow an over-heated pump to completely cool before servicing. Do not remove plates, covers, gauges, or fittings from an overheated pump. Liquid within the pump can reach boiling temperatures, and vapor pressure within the pump can cause parts being disengaged to be ejected with great force. After the pump cools, drain the liquid from the pump by removing the casing drain plug. Use caution when removing the plug to prevent injury to personnel from hot liquid.

Strainer Check

Check the strainer regularly, and clean it as necessary. The strainer should also be checked if pump flow rate begins to drop. Monitor and record the vacuum suction gauge readings regularly to detect strainer blockage.

Never introduce air or steam pressure into the pump casing or piping to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, **liquid pressure** must be limited to 50% of the maximum permissible operating pressure shown on the pump performance curve.

STOPPING

Manual Stopping

Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly. Reduce the throttle speed slowly and allow the engine to idle briefly before stopping.

In the manual mode, reduce the throttle speed slowly, and allow the engine to idle briefly before switching the HAND-OFF-AUTO switch to 'OFF'.

CAUTION

If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

After stopping the pump, switch off the engine ignition and remove the key to ensure that the pump will remain inoperative.

Automatic Stopping

In the automatic mode, the pump will stop when the liquid in the wet well or sump lowers and activates the "Off" float switch(s). The pump will restart automatically when the liquid rises and activates the "On" float switch(s).

Safety Shutdown System

The unit is equipped with a safety system to automatically shut down the engine under certain conditions. The engine will automatically shut down:

1. If the engine exceeds its safe operating temperature.
2. If the engine oil pressure drops below design limits.
3. If the engine fails to start within a pre-set period of time.
4. If the engine speed exceeds the safe operating range.
5. If the engine fan belt breaks.

Lights on the control panel will indicate which of the safety features has caused the engine to shut down.

Should any of the safety features cause the engine to shut down, **the cause must be determined and corrected** before putting the unit back into service. The engine **will not restart** until the key switch has

been returned to the 'OFF' position for at least 10 seconds.

All safety shutdown features are pre-set at the factory for optimum performance and safety; **do not** attempt to adjust these settings.

WARNING!

Never disconnect any of the safety shutdown features; this will void the warranty and could result in serious damage to the unit and/or injury to personnel. Safety shutdown features are pre-set at the factory; do not attempt to adjust any of the settings. Determine the cause of shutdown before putting the unit back into service. Consult the factory for additional information.

PERIODIC CHECKS

Seal Cavity And Bearing Lubrication

Both the seal and bearing cavities were fully lubricated at the factory. Check the lubrication levels before startup, and regularly thereafter as indicated in Section E, **Maintenance and Repair**. When lubrication is required, use **only** SAE No. 30 non-detergent oil.

Bearing Temperature Check

Bearings normally run at higher than ambient temperatures because of heat generated by friction. Temperatures up to 160°F (71°C) are considered normal for bearings, and they can operate safely to at least 180°F (82°C).

Checking bearing temperatures by hand is inaccurate. Bearing temperatures can be measured accurately by placing a contact-type thermometer against the housing. Record this temperature for future reference.

A sudden increase in bearing temperatures is a warning that the bearings are at the point of failing to operate properly. Make certain that the bearing lubricant is of the proper viscosity and at the correct level (see **LUBRICATION** in Section E, **Maintenance and Repair**). Bearing overheating can also be caused by shaft misalignment and/or excessive vibration.

When pumps are first started, the bearings may seem to run at temperatures above normal. Continued operation should bring the temperatures down to normal levels.

Engine Fuel Filter

Consult the manual accompanying the engine, and change the fuel filter periodically as indicated. If operated under extremely dusty and/or humid conditions, change the filter more frequently. Irregular performance and loss of power usually indicate a dirty fuel filter.

Engine Oil

The engine was lubricated for test at the factory. However, **always** check the lubrication level before startup.

Consult the manual accompanying the engine, and change the oil filter periodically as indicated. If operated under extremely dusty conditions, change the filter more frequently.

COLD WEATHER PRESERVATION

If the pump will be idle for an extended period of time in below freezing conditions, drain the pump and priming hopper to prevent damage from freezing. Also, clean out any solids by flushing with a hose. Operate the pump for approximately one minute; this will remove any remaining liquid that could freeze the pump rotating parts. If the pump will be idle for more than a few hours, or if it has been pumping liquids containing a large amount of solids, drain the pump, and flush it thoroughly with clean water. To prevent large solids from clogging the drain port and preventing the pump from completely draining, insert a rod or stiff wire in the drain port, and agitate the liquid during the draining process. Clean out any remaining solids by flushing with a hose.

If the pump is to be installed in an environment where sub-freezing temperatures will occur during operation, consideration must be given to prevent the pump and components from freezing when the pump is idle between pumping cycles. Refer to **COLD WEATHER INSTALLATION** in the **Installation** section of this manual for details.

TROUBLESHOOTING — SECTION D

Review all SAFETY information in Section A.

WARNING!

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut down the engine and disconnect the positive battery cable to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure pump is cool before opening any covers, plates, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Discharge check valve contaminated, damaged, or unable to seat.	Clean or replace check valve.
	Air compressor head 180° out.	Consult factory.
	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Suction lift or discharge head too high.	Check piping installation and install bypass line if needed. See **INSTALLATION**.
	Air compressor damaged or belts broken.	Check and repair/replace.
	Strainer clogged.	Check strainer and clean if necessary.
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Eductor clogged.	Check and clean eductor.
	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (cont.)	Strainer clogged.	Check strainer and clean if necessary.
	Discharge check valve clogged.	Check and clean check valve.
	Suction intake not submerged at proper level or sump too small.	Check installation and correct submergence as needed.
	Impeller or other wearing parts worn or damaged.	Replace worn or damaged parts. Check that impeller is properly centered and rotates freely.
	Impeller clogged.	Free impeller of debris.
	Discharge head too high.	Install bypass line.
	Suction lift too high.	Measure lift w/vacuum gauge. Reduce lift and/or friction losses in suction line.
	Pump speed too slow.	Check engine output; consult engine operation manual.
	Belt or flexible coupling broken.	Check and replace as necessary.
PUMP REQUIRES TOO MUCH POWER	Pump speed too high.	Check engine output.
	Extreme ambient temperature.	Reduce pump output.
	Discharge head too low.	Adjust discharge valve.
	Fuel filter clogged.	Check & replace often in extreme operating conditions.
	Liquid solution too thick.	Dilute if possible.
	Fuel contaminated.	Check and replace as required.
	Pump or jack shaft bearing(s) frozen.	Disassemble, check and replace bearing(s) as required..
PUMP CLOGS FREQUENTLY	Discharge flow too slow.	Open discharge valve fully to increase flow rate, and run engine at maximum governed speed.
	Suction check valve or foot valve clogged or binding.	Clean valve.
	Liquid solution too thick.	Dilute if possible.
EXCESSIVE NOISE	Cavitation in pump.	Reduce suction lift and/or friction losses in suction line. Record vacuum and pressure gauge readings and consult local representative or factory.
	Pumping entrained air.	Locate and eliminate source of air bubble.
	Pump or drive not securely mounted.	Secure mounting hardware.
	Impeller clogged or damaged.	Clean out debris; replace damaged parts.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
BEARINGS RUN TOO HOT	Bearing temperature is high, but within limits.	Check bearing temperature regularly to monitor any increase.
	Low or incorrect lubricant.	Check for proper type and level of lubricant.
	Suction and discharge lines not properly supported.	Check piping installation for proper support.
	Drive misaligned.	Align drive properly.
	Excessive tension on drive belt.	Check belt tension. Adjust as required.

PREVENTIVE MAINTENANCE

Since pump applications are seldom identical, and pump wear is directly affected by such things as the abrasive qualities, pressure and temperature of the liquid being pumped, this section is intended only to provide general recommendations and practices for preventive maintenance. Regardless of the application however, following a routine preventive maintenance schedule will help assure trouble-free performance and long life from your Gorman-Rupp pump. For specific questions concerning your application, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Record keeping is an essential component of a good preventive maintenance program. Changes in suction and discharge gauge readings (if so equipped) between regularly scheduled inspections can indicate problems that can be corrected before system damage or catastrophic failure occurs. The appearance of wearing parts should also be documented at each inspection for comparison as well. Also, if records indicate that a certain part (such as the seal) fails at approximately the same duty cycle, the part can be checked and replaced before failure occurs, reducing unscheduled down time.

For new applications, a first inspection of wearing parts at 250 hours will give insight into the wear rate for your particular application. Subsequent inspections should be performed at the intervals shown on the chart below. Critical applications should be inspected more frequently.

Preventive Maintenance Schedule

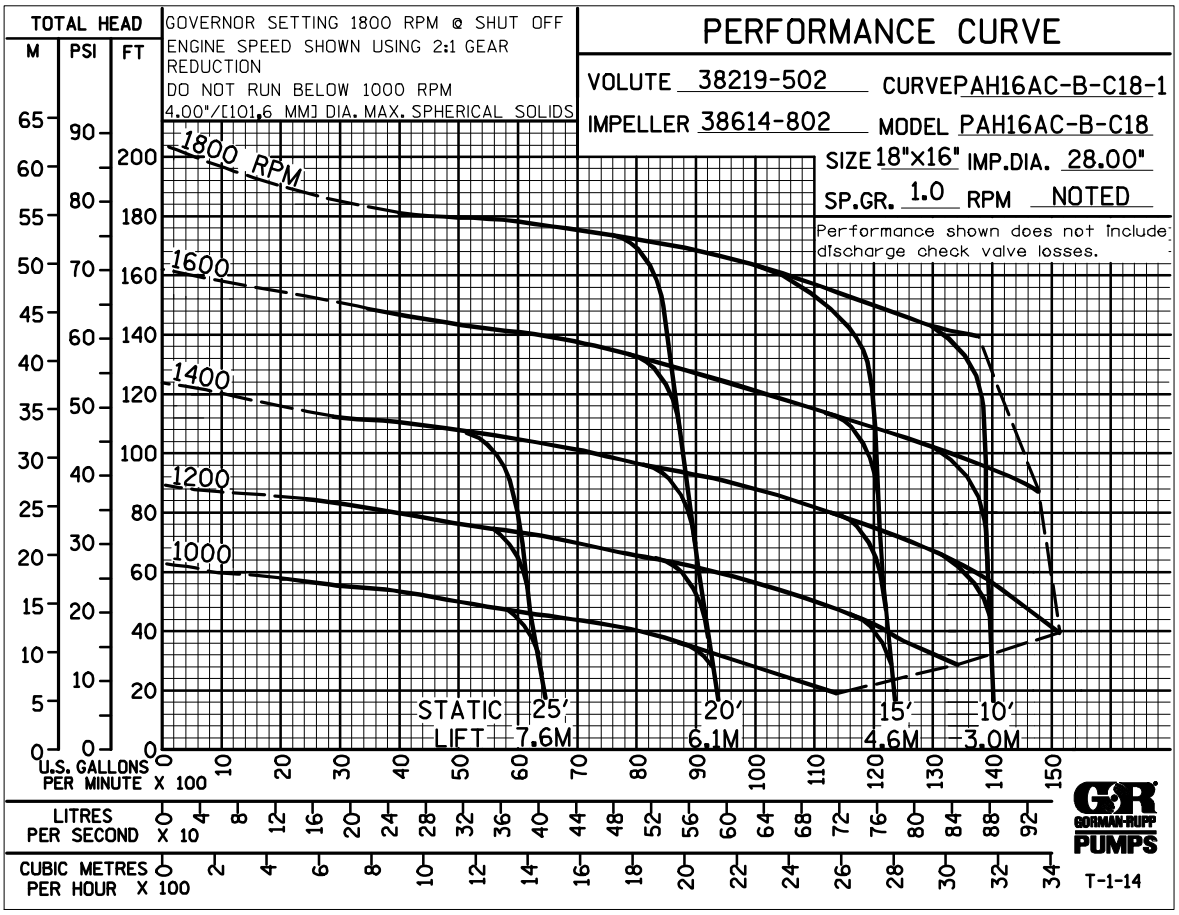
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication		I			R
Seal Lubrication (And Packing Adjustment, If So Equipped)		I			R
V-Belts (If So Equipped)			I		
Air Release Valve Plunger Rod (If So Equipped)			I	C	
Front Impeller Clearance (Wear Plate)				I	
Rear Impeller Clearance (Seal Plate)				I	
Check Valve					I
Pressure Relief Valve (If So Equipped)					C
Pump and Driver Alignment					I
Shaft Deflection					I
Bearings					I
Bearing Housing					I
Piping					I
Driver Lubrication – See Mfgr's Literature					

Legend:
I = Inspect, Clean, Adjust, Repair or Replace as Necessary
C = Clean
R = Replace

* Service interval based on an intermittent duty cycle equal to approximately 4000 hours annually. Adjust schedule as required for lower or higher duty cycles or extreme operating conditions.

PUMP MAINTENANCE AND REPAIR – SECTION E

MAINTENANCE AND REPAIR OF THE WEARING PARTS OF THE PUMP WILL MAINTAIN PEAK OPERATING PERFORMANCE.



✳ **STANDARD PERFORMANCE FOR PUMP MODEL PAH16A60C–B–C18**

✳ Based on 70°F (21°C) clear water at sea level with minimum suction lift. Since pump installations are seldom identical, your performance may be different due to such factors as viscosity, specific gravity, elevation, temperature, and impeller trim.

If your pump serial number is followed by an "N", your pump is **NOT** a standard production model. Contact the Gorman-Rupp Company to verify performance or part numbers.

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the curve.

ILLUSTRATION

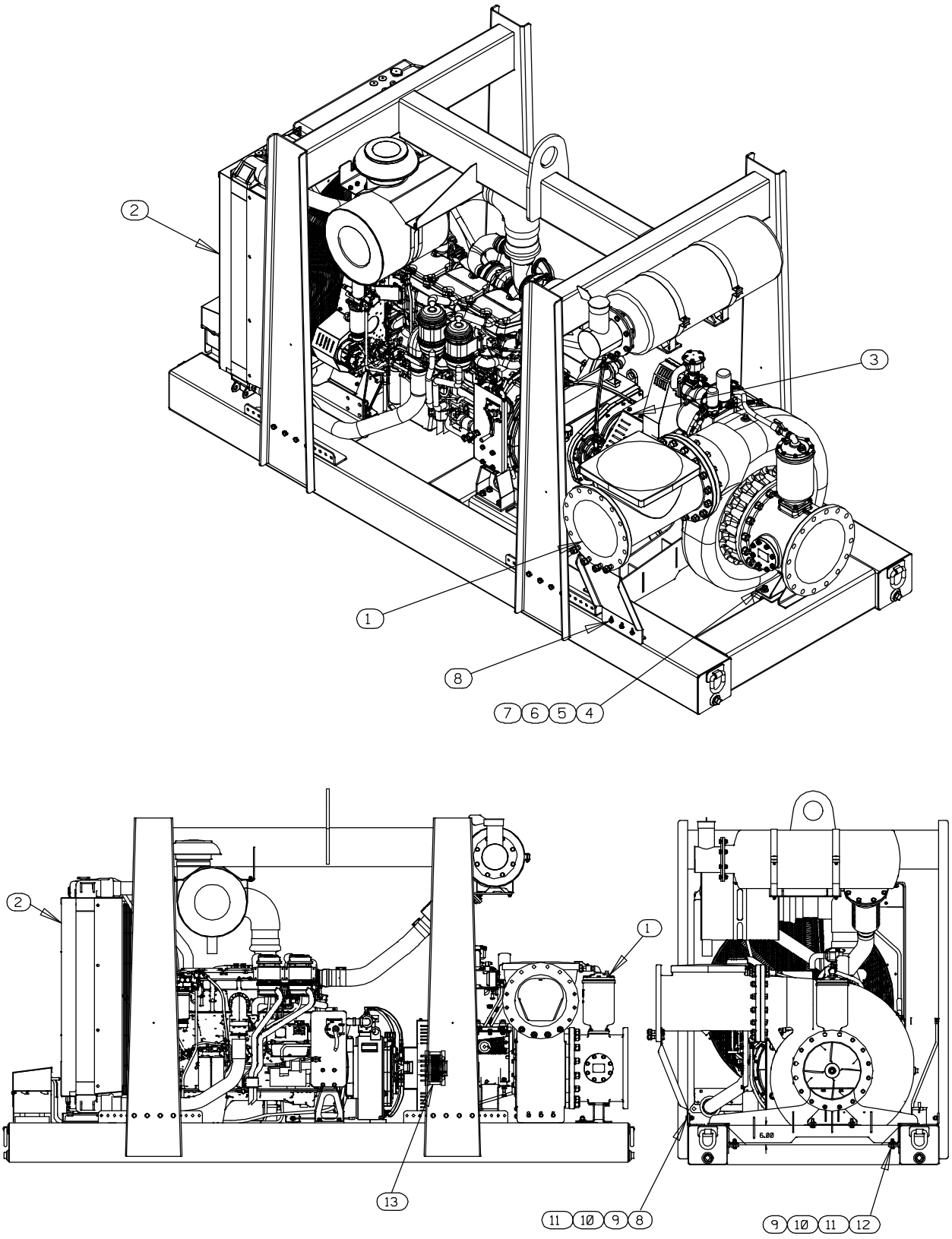


Figure 1. Pump Model PAH16A60C–B–C18

PARTS LIST

Pump Model PAH16A60C–B–C18

(From S/N 1618325 Up)

If your pump serial number is followed by an “N”, your pump is **NOT** a standard production model. Contact the Gorman-Rupp Company to verify performance or part numbers.

ITEM NO.	PART NAME	PART NUMBER	QTY
1	PUMP END ASSEMBLY	46183–076	1
2	C18 POWER UNIT	46143–174	1
3	GUARD ASSEMBLY COUPLING	42341–057	1
4	HEX HEAD CAP SCREW	B1209 15991	2
5	HEX NUT	D12 15991	2
6	LOCK WASHER	J12 15991	2
7	FLAT WASHER	K12 15991	4
8	HEX HEAD CAP SCREW	B1008 15991	3
9	FLAT WASHER	K10 15991	7
10	LOCK WASHER	J10 15991	5
11	HEX NUT	D10 15991	5
12	HEX HEAD CAP SCREW	B1010 15991	2
13	COUPLING ASSEMBLY	24360–301	1
NOT SHOWN:			
	PRIME AIRE PLUS DECAL	38812–110	2
	G-R DECAL 6 IN	GR–06	2
	CAUTION DECAL	38816–169	1

ILLUSTRATION

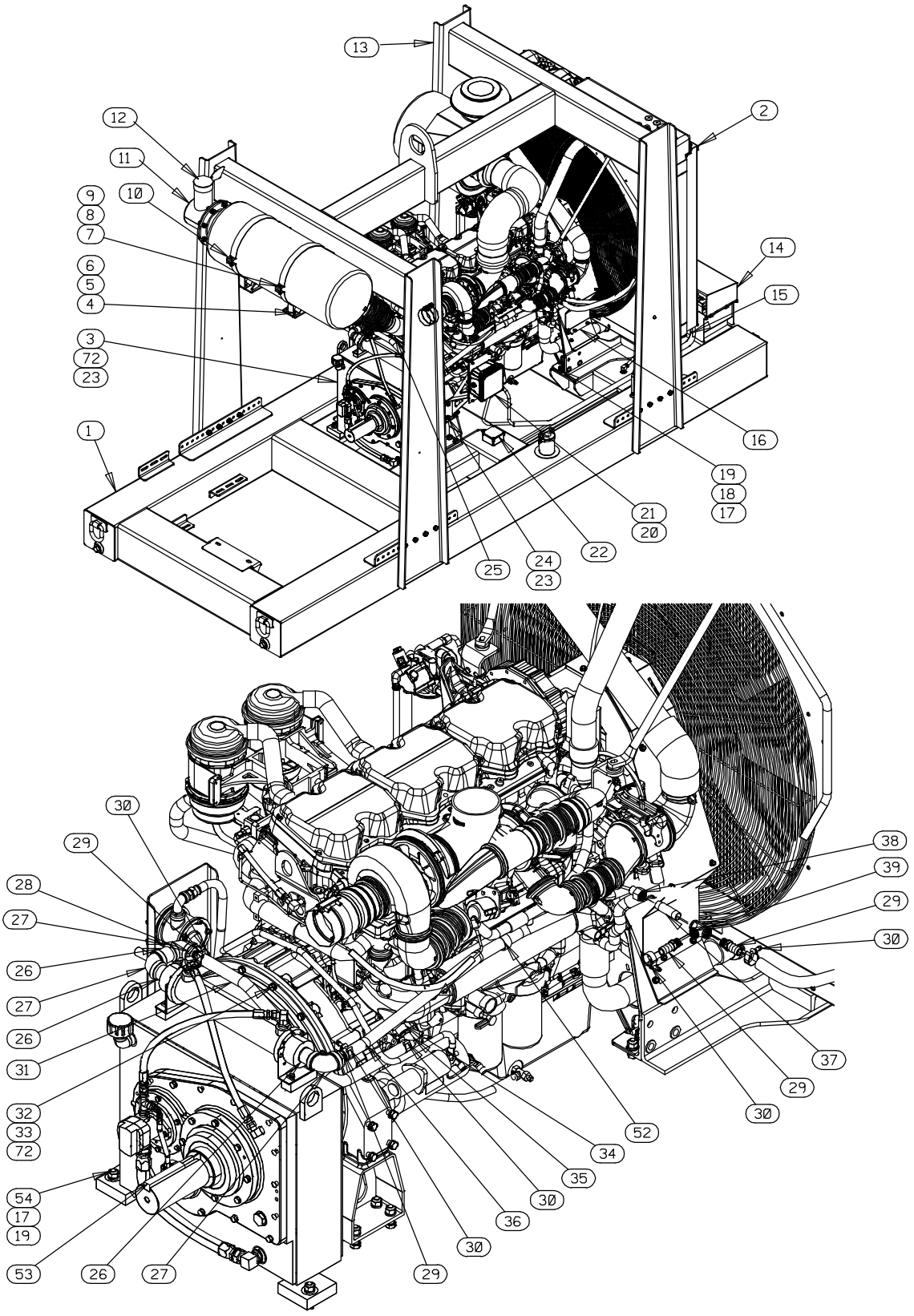


Figure 2. 46143—174 Power Unit

PARTS LIST

46143–174 Power Unit

ITEM NO.	PART NAME	PART NUMBER	QTY
1	BASE/FUEL TANK ASSY	41553–049 24150	1
2	CAT ENGINE C18 755HP	29236–481	1
3	GEAR BOX	24572–210	1
4	HEX HEAD CAP SCREW	B0705 15991	4
5	LOCK WASHER	J07 15991	4
6	HEX NUT	D07 15991	4
7	HEX HEAD CAP SCREW	B0610 15991	2
8	HEX NUT	D06 15991	2
9	LOCK WASHER	J06 15991	2
10	MUFFLER BRCKT ASSY	41121–408 24150	2
11	EXHAUST OUTLET ASSY	46281–008 24150	1
12	WEATHER CAP	29334–317	1
13	LIFTING ASSEMBLY	44715–052	1
14	BATTERY BOX ASSY	42432–011	2
15	NYLON SLEEVE X 112" LG	25141–263	1
16	GUARD ASSEMBLY	42354–519	1
17	HEX NUT	D12 15991	16
18	HEX HEAD CAP SCREW	B1208 15991	3
19	LOCK WASHER	J12 15991	16
20	CONTROL BRACKET ASSY	41888–305 24150	1
21	CONTROL BOX	48122–569	1
22	FUEL SENDING UNIT	48122–939	1
23	LOCK WASHER	J10 15991	10
24	HEX HEAD CAP SCREW	B1006 15991	4
25	EXHAUST PIPE	31962–002	1
26	PIPE NIPPLE	T2412 15079	3
27	PIPE ELBOW	R24 11999	3
28	REDUCER PIPE BUSHING	AP2412 11999	2
29	HOSE BARB FITTING	26523–397	4
30	T-BOLT CLAMP 1.5 IN	26518–181	5
31	1" ID X 38" LG HOSE	18513–321	1
32	HEX HEAD CAP SCREW	B0808 15991	14
33	LOCK WASHER	J08 15991	20
34	ADAPTOR	26525–181	1
35	HOSE BARB ELBOW	26523–513	1
36	1" ID X 53" LG HOSE	18513–321	1
37	PIPE NIPPLE	T1214 14990	1
38	ADAPTER	26525–182	1
39	TEE 3/4"	U12 14990	1
40	BAND CLAMP ASSY	29334–422	2
41	HEX NUT	D08 15991	4
42	HEX HEAD CAP SCREW	B0805 15991	4
43	MOUNTING BRACKET	34613–116 15120	1
44	ENGINE OIL DRAIN KIT	46346–389	1
45	HEX HEAD CAP SCREW	B1210 15991	11
46	4/O CABLE SUB ASS'Y	47311–700	1
47	4/O CABLE SUB ASS'Y	47311–703	1
48	SOC HD CAP SCREW	BD1011 15991	6
49	8D BATTERY	29331–541	2
50	4/O CABLE SUB ASS'Y	47311–701	1
51	4/O CABLE SUB ASS'Y	47311–704	1
52	CLAMP	27111–348	1
53	KEY	N1624 15990	1
54	HEX HEAD CAP SCREW	B1212 15991	2
55	CLAMP W/CUSHION	27111–347	1
56	1/2" ID X 72" LG HOSE	18513–303	1
57	HOSE BARB FTG	26523–047	2
58	90° ELBOW ADAPTER	26571–071	1
59	90° ADAPTER ELBOW	26571–053	1
60	ADAPTER	26571–091	1
61	ADAPTER	26345–001	1
62	AIR VENT	S1703	1
63	HOSE BARB FITTING	26523–447	1
64	CABLE TIE	27111–218	1
65	1/2" ID X 48" LG HOSE	18513–303	1
66	1/2" ID X 24" LG HOSE	18513–303	1
67	REDUCER PIPE BUSHING	AP0806 15079	1
68	HOSE BARB FITTING	26523–389	1
69	HOSE BARB	26525–020	2
70	FUEL PICKUP	29332–149	2
71	WING NUT	BB06 15991	4
72	HEX HD CAP SCREW	B0806 15991	2
NOT SHOWN:			
	INSTRUCTION DECAL	38818–144	2
	ENGINE OPERATE DECAL	38816–347	1
	WARNING DECAL	2613FE	2
	WARNING DECAL	38816–203	6
	FUEL DECAL	38816–196	1
	ENGINE START-UP TAG	38816–269	1
	G-R DECAL	GR–06	2
	FLOAT SWITCH	48312–980	1
	WARNING DECAL	38817–101	4
	WARNING DECAL	38816–102	1

ILLUSTRATION

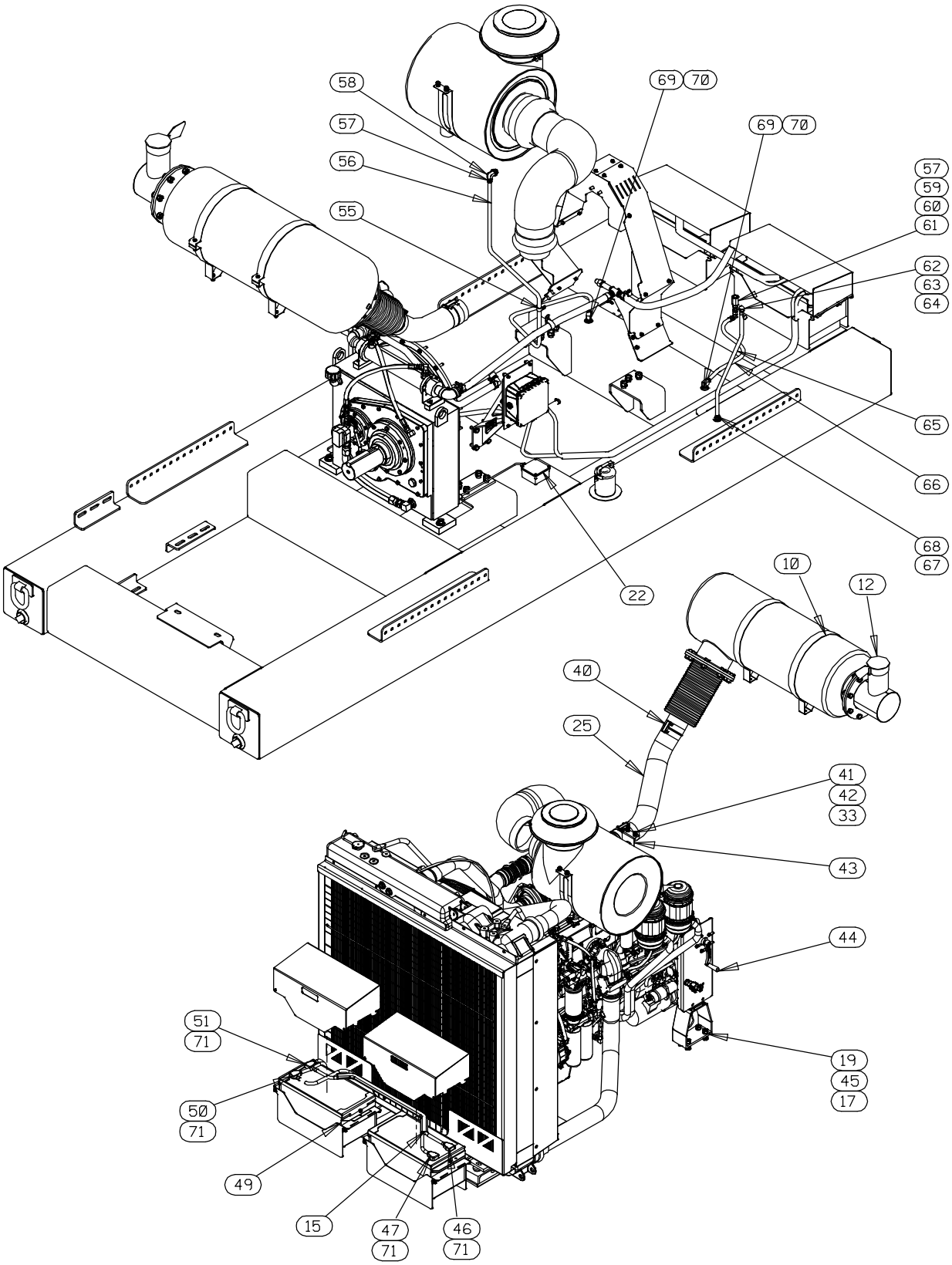


Figure 3. Power Unit Con't

PARTS LIST

Power Unit Con't

ITEM NO.	PART NAME	PART NUMBER	QTY
1	BASE/FUEL TANK ASSY	41553–049 24150	1
2	CAT ENGINE C18 755HP	29236–481	1
3	GEAR BOX	24572–210	1
4	HEX HEAD CAP SCREW	B0705 15991	4
5	LOCK WASHER	J07 15991	4
6	HEX NUT	D07 15991	4
7	HEX HEAD CAP SCREW	B0610 15991	2
8	HEX NUT	D06 15991	2
9	LOCK WASHER	J06 15991	2
10	MUFFLER BRCKT ASSY	41121–408 24150	2
11	EXHAUST OUTLET ASSY	46281–008 24150	1
12	WEATHER CAP	29334–317	1
13	LIFTING ASSEMBLY	44715–052	1
14	BATTERY BOX ASSY	42432–011	2
15	NYLON SLEEVE X 112" LG	25141–263	1
16	GUARD ASSEMBLY	42354–519	1
17	HEX NUT	D12 15991	16
18	HEX HEAD CAP SCREW	B1208 15991	3
19	LOCK WASHER	J12 15991	16
20	CONTROL BRACKET ASSY	41888–305 24150	1
21	CONTROL BOX	48122–569	1
22	FUEL SENDING UNIT	48122–939	1
23	LOCK WASHER	J10 15991	10
24	HEX HEAD CAP SCREW	B1006 15991	4
25	EXHAUST PIPE	31962–002	1
26	PIPE NIPPLE	T2412 15079	3
27	PIPE ELBOW	R24 11999	3
28	REDUCER PIPE BUSHING	AP2412 11999	2
29	HOSE BARB FITTING	26523–397	4
30	T-BOLT CLAMP 1.5 IN	26518–181	5
31	1" ID X 38" LG HOSE	18513–321	1
32	HEX HEAD CAP SCREW	B0808 15991	14
33	LOCK WASHER	J08 15991	20
34	ADAPTOR	26525–181	1
35	HOSE BARB ELBOW	26523–513	1
36	1" ID X 53" LG HOSE	18513–321	1
37	PIPE NIPPLE	T1214 14990	1
38	ADAPTER	26525–182	1
39	TEE 3/4"	U12 14990	1
40	BAND CLAMP ASSY	29334–422	2
41	HEX NUT	D08 15991	4
42	HEX HEAD CAP SCREW	B0805 15991	4
43	MOUNTING BRACKET	34613–116 15120	1
44	ENGINE OIL DRAIN KIT	46346–389	1
45	HEX HEAD CAP SCREW	B1210 15991	11
46	4/O CABLE SUB ASS'Y	47311–700	1
47	4/O CABLE SUB ASS'Y	47311–703	1
48	SOC HD CAP SCREW	BD1011 15991	6
49	8D BATTERY	29331–541	2
50	4/O CABLE SUB ASS'Y	47311–701	1
51	4/O CABLE SUB ASS'Y	47311–704	1
52	CLAMP	27111–348	1
53	KEY	N1624 15990	1
54	HEX HEAD CAP SCREW	B1212 15991	2
55	CLAMP W/CUSHION	27111–347	1
56	1/2" ID X 72" LG HOSE	18513–303	1
57	HOSE BARB FTG	26523–047	2
58	90° ELBOW ADAPTER	26571–071	1
59	90° ADAPTER ELBOW	26571–053	1
60	ADAPTER	26571–091	1
61	ADAPTER	26345–001	1
62	AIR VENT	S1703	1
63	HOSE BARB FITTING	26523–447	1
64	CABLE TIE	27111–218	1
65	1/2" ID X 48" LG HOSE	18513–303	1
66	1/2" ID X 24" LG HOSE	18513–303	1
67	REDUCER PIPE BUSHING	AP0806 15079	1
68	HOSE BARB FITTING	26523–389	1
69	HOSE BARB	26525–020	2
70	FUEL PICKUP	29332–149	2
71	WING NUT	BB06 15991	4
72	HEX HD CAP SCREW	B0806 15991	2
NOT SHOWN:			
	INSTRUCTION DECAL	38818–144	2
	ENGINE OPERATE DECAL	38816–347	1
	WARNING DECAL	2613FE	2
	WARNING DECAL	38816–203	6
	FUEL DECAL	38816–196	1
	ENGINE START-UP TAG	38816–269	1
	G-R DECAL	GR–06	2
	FLOAT SWITCH	48312–980	1
	WARNING DECAL	38817–101	4
	WARNING DECAL	38816–102	1

ILLUSTRATION

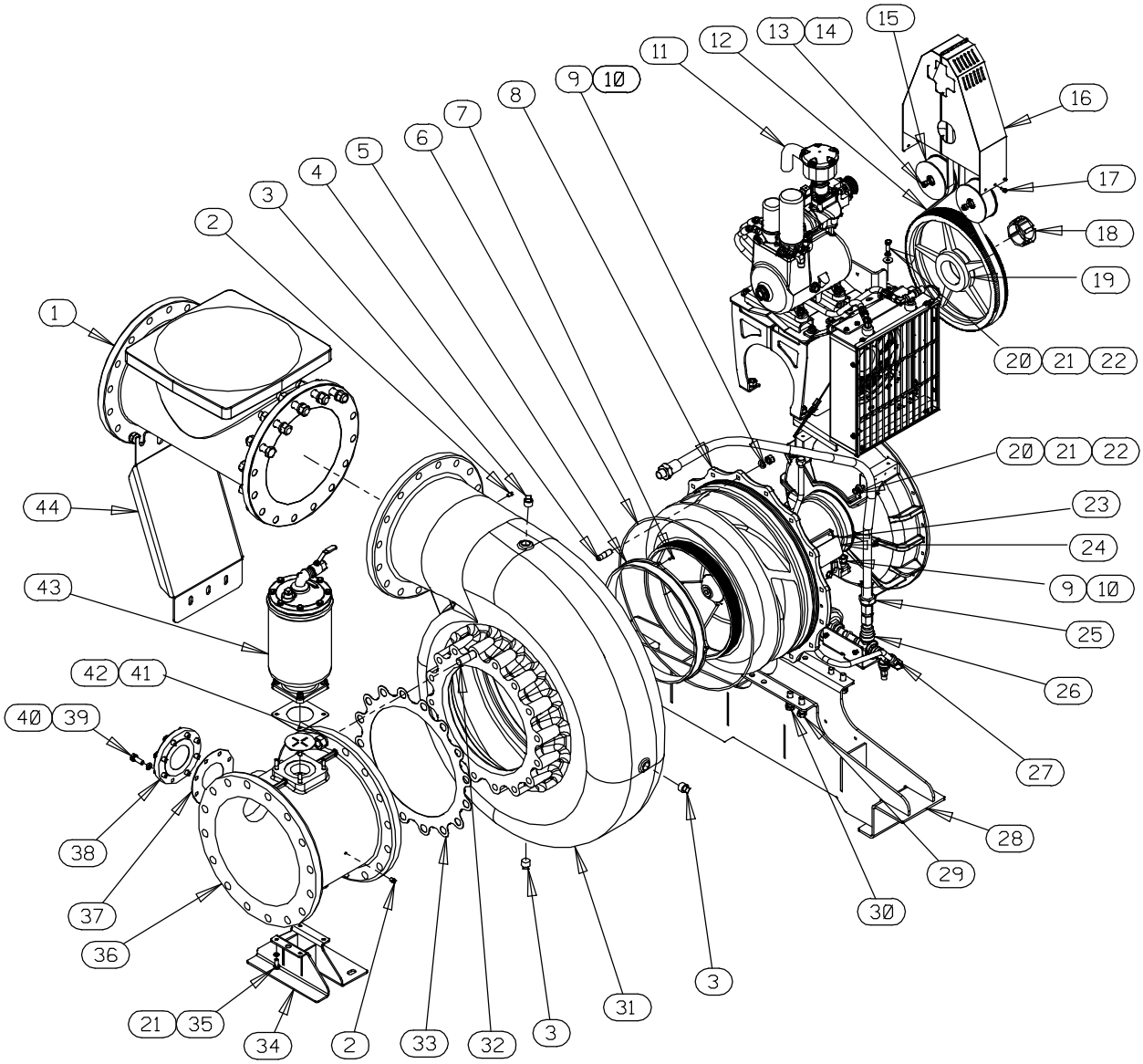


Figure 4. Pump End Assembly

PARTS LIST
Pump End Assembly

ITEM NO.		PART NAME	PART NUMBER	QTY
1		CHECK VALVE KIT 16”	48274–010	1
		–CHECK VALVE 16”	26642–131	1
	✳	–FLAPPER	26688–017	1
	✳	–GASKET	26688–018	1
	✳	–DISCHARGE GASKET	25113–043	1
		–HEX NUT	D16 15991	24
		–LOCKWASHER	J16 15991	24
		–THREADED ROD	31345–018 15991	4
		–HEX CAP SCREW	B1618 15991	16
2		PIPE PLUG	P04 15079	2
☞ 3		PIPE PLUG	P16 15079	3
☞ 4		STUD	C1211 15991	16
☞ 5	✳	WEAR RING	38691–370 11010	1
☞ 6	✳	O-RING	25152–478	1
7		FLAT HEAD CAP SCREW	F0403 17090	4
8		REPAIR ROTATING ASSY	44163–672	1
9		LOCK WASHER	J12 15991	20
10		HEX NUT	D12 15991	20
11		AIR COMPRESSOR ASSY	46181–914	1
12	✳	BELT	24186–019	1
13		HEX HEAD CAP SCREW	21632–952	2
14		NYLOCK HEX NUT	21765–161	2
15		TENSIONER	24211–001	2
16		BELT GUARD ASSEMBLY	42351–523	1
17		FLANGED CAPSCREW	21634–505	6
18		BUSHING	24131–440	1
19		SPROCKET	24271–126	1
20		HEX HEAD CAP SCREW	B0806 15991	6
21		LOCK WASHER	J08 15991	10
22		FLAT WASHER	K08 15991	6
23		DRIVE SCREW	BM#04–03 17000	4
24		NAMEPLATE BLANK	38819–002 13000	1
25		VACUUM HOSE ASSY	46341–021	1
26		VENTURI ASSEMBLY	48227–403	1
27		HOSE ASSEMBLY	46341–035	1
28		SUPPORT ASSEMBLY	41888–328 24150	1
29		HEX HEAD CAP SCREW	B1211 15991	2
30		HEX HEAD CAP SCREW	B1210 15991	6
☞31		PUMP CASING	SEE NOTE BELOW	1
32		STUD	C1818 15991	16
33	✳	GASKET	38685–809 18000	1
34		SUCTION SUPPORT ASSY	41888–327 24150	1
35		HEX HEAD CAP SCREW	B0805 15991	4
36		18” SPOOL FLANGE	38642–624 10000	1
37	✳	GASKET	25113–034	1
38		4” BLIND FLANGE ASSY	42111–358	1
39		HEX HEAD CAP SCREW	B1007 15991	8
40		LOCK WASHER	J10 15991	8
41		LOCK WASHER	J18 15991	16
42		HEX NUT	D18 15991	16
43		PRIMING CHAMBER KIT	48275–006	1
44		SUPPORT BRACKET	34837–005 15080	1
NOT SHOWN:				
		DISCHARGE STICKER	6588BJ	1
		SUCTION STICKER	6588AG	1
		PRIME AIRE PLUS DECAL	38812–099	1
		WARNING DECAL	2613FE	1
		INSTRUCTION TAG	38817–104	1
		G-R DECAL	GR–06	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

☞	INCLUDED WITH REPAIR PUMP CASING ASSY	46474–369	1

ILLUSTRATION

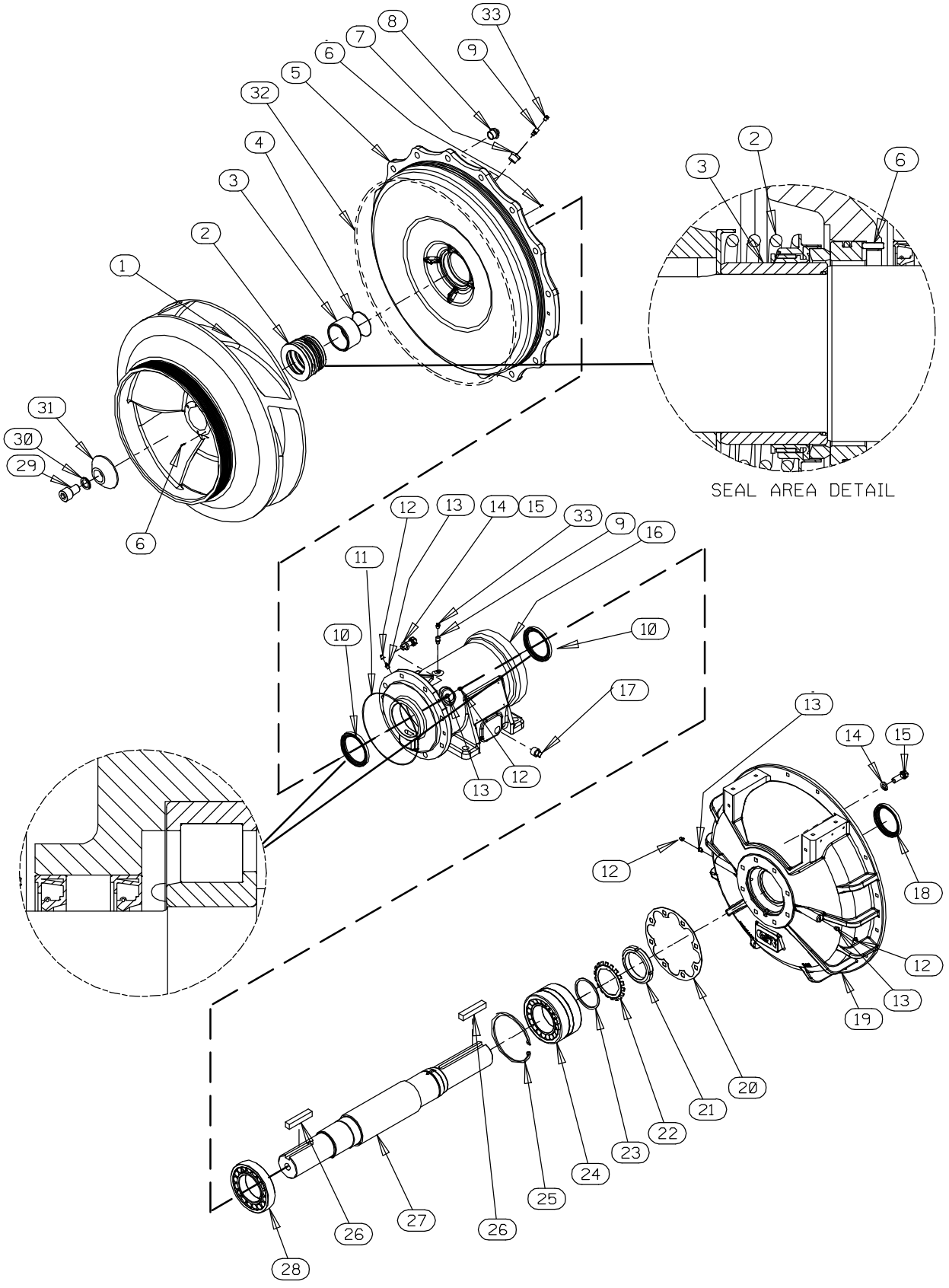


Figure 5. Repair Rotating Assembly

PARTS LIST
Repair Rotating Assembly

ITEM NO.		PART NAME	PART NUMBER	QTY
1		IMPELLER	38614–802 11010	1
2	✳	3 3/4" MECH SEAL	25285–825	1
3	✳	SHAFT SLEEVE	31163–025 17000	1
4	✳	O-RING	25154–042	1
5		SEAL PLATE	38272–721 11010	1
6		ROLL PIN	S2197	2
7		REDUCER PIPE BUSHING	AP1202 15079	1
8		SIGHT GAUGE	S1471	2
9		AIR VENT	S1530	2
10	✳	OIL SEAL	25227–936	2
11	✳	O-RING	25152–177	1
12		CAP PLUG	25141–151	4
13		LUBE FITTING	S186	4
14		LOCK WASHER	J10 15991	16
15		HEX HEAD CAP SCREW	B1007 15991	16
16		PEDESTAL	38257–317 10000	1
17		PIPE PLUG	P12 15079	3
18	✳	OIL SEAL	25227–934	1
19		DRIVE FLANGE – SAE 0	38545–026 10000	1
20	✳	GASKET	38683–668 19060	1
21		BEARING LOCK NUT	23962–022	1
22		BEARING LOCK WASHER	23962–522	1
23		BEARING SPACER	31131–105 15120	1
24	✳	BEARING	23761–001	1
25		RETAINING RING	24121–088	1
26	✳	KEY	N1216 15990	2
27	✳	IMPELLER SHAFT	38512–541 1600X	1
28	✳	BEARING	23529–010	1
29		SOCKET HEAD CAP SCREW	DM1608S 15991	1
30		WASHER NORD–LOCK 1"	21177–229	1
31		IMPELLER WASHER	31167–043 15030	1
32	✳	O-RING	25152–478	1
33		SHIPPING PLUG	11495C 15079	2
NOT SHOWN:				
		INSTRUCTION TAG	6588U	1
		LUBRICATION DECAL	38817–103	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

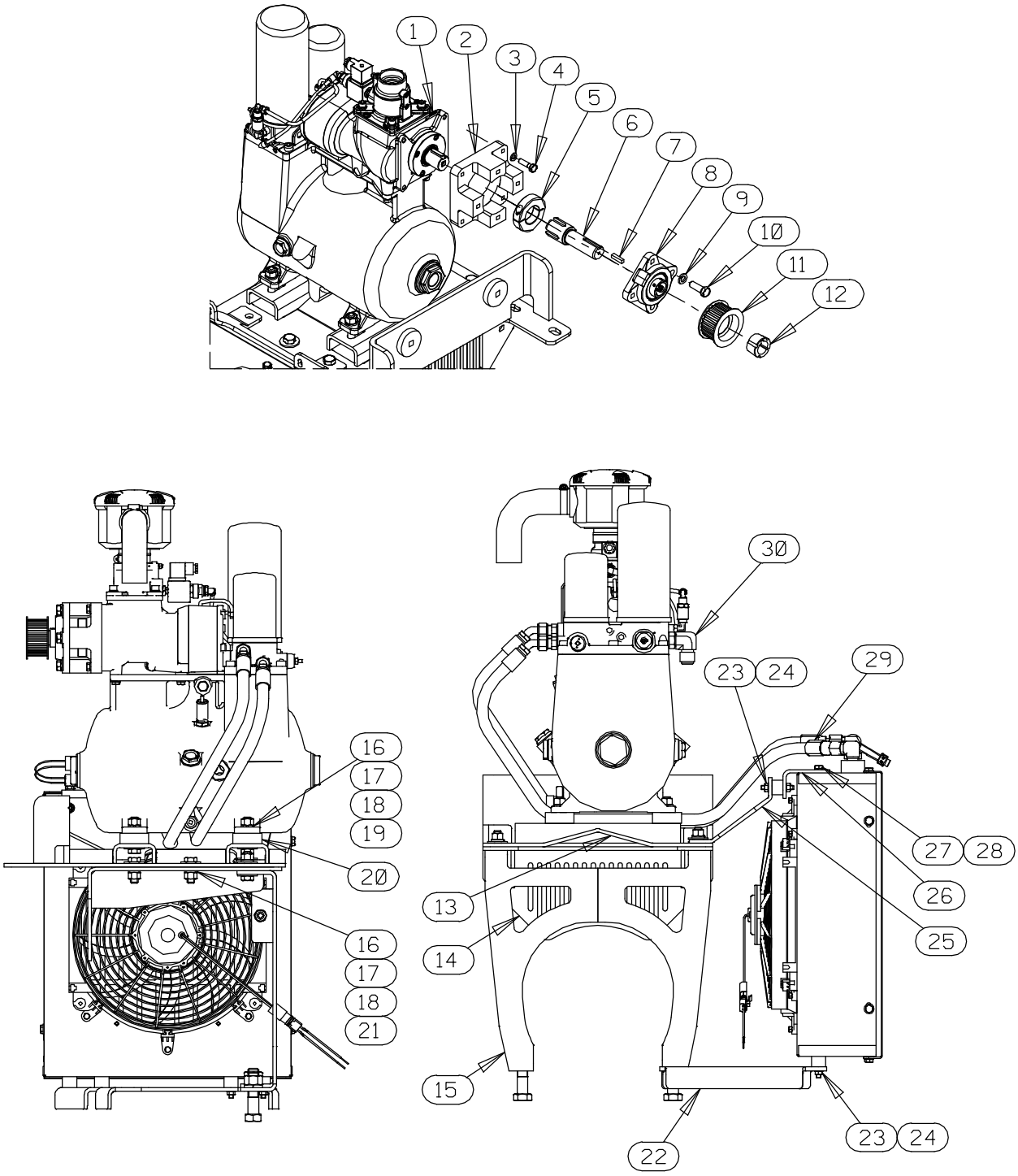


Figure 6. Air Compressor Assembly

PARTS LIST
Air Compressor Assembly

ITEM NO.	PART NAME	PART NUMBER	QTY
1	VANAIR 60 CFM COMPRESSOR	26813–114	1
2	MOUNTING BRACKET	38138–090 13000	1
3	LOCK WASHER	21171–510	4
4	HEX HEAD CAP SCREW	22645–135	4
5	SHAFT COLLAR	24118–035	1
6	ADAPTER SHAFT	38513–420 16040	1
7	KEY	N0404 15990	1
8	FLANGE BEARING	23918–101	1
9	LOCK WASHER	J07 15991	4
10	HEX HEAD CAP SCREW	B0705 15991	4
11	SPROCKET	24271–127	1
12	BUSHING 1108 X 1	24131–209	1
13	BRACKET ASSEMBLY	41888–312 24150	1
14	BRACKET ASSEMBLY	41888–313 24150	1
15	SUPPORT BRACKET ASSEMBLY	41888–414	1
16	LOCK WASHER	J08 15991	8
17	FLAT WASHER	K08 15991	7
18	HEX NUT	D08 15991	8
19	HEX HEAD CAP SCREW	B0809 15991	4
20	SPACER	31131–107 15000	4
21	HEX HEAD CAP SCREW	B0806 15991	4
22	MOUNTING BRACKET	34455–025 15080	1
23	HEX NUT W/FLG	21765–312	12
24	RUBBER ISOLATOR MOUNT	24631–015	8
25	MOUNTING BRACKET	34335–198 15080	1
26	MOUNTING BRACKET	34225–086 15080	1
27	HEX HEAD CAP SCREW	B0503–1/2 15991	4
28	LOCK WASHER	J05 15991	4
29	HOSE ASSEMBLY	46341–034	2
30	90° ELBOW	26523–151	1

ILLUSTRATION

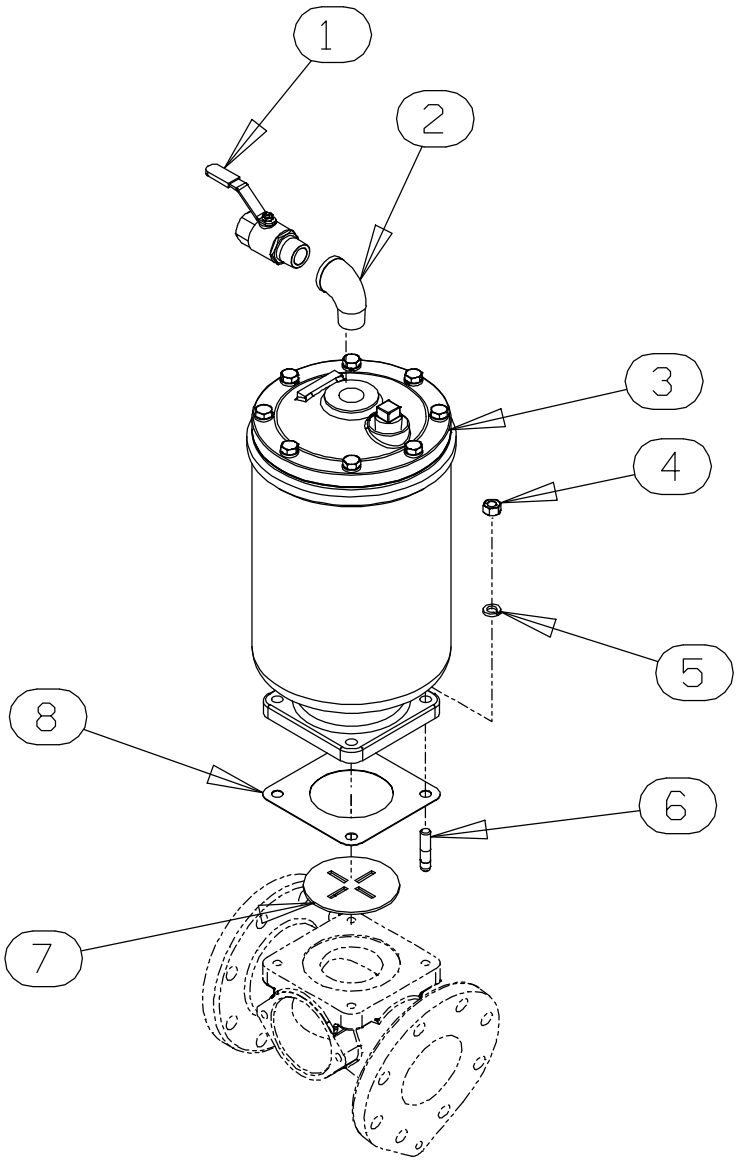


Figure 7. Priming Chamber Kit

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	QTY
1		BALL VALVE	26631−054	1
2		STREET ELBOW	RS16 11999	1
3		PRIMING CHAMBER ASSEMBLY	46112−709	1
4		HEX NUT	D08 15991	4
5		LOCK WASHER	J08 15991	4
6		STUD	C0809 15991	4
7		BAFFLE	31113−011 17000	1
8	✳	GASKET	38687−053 19060	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

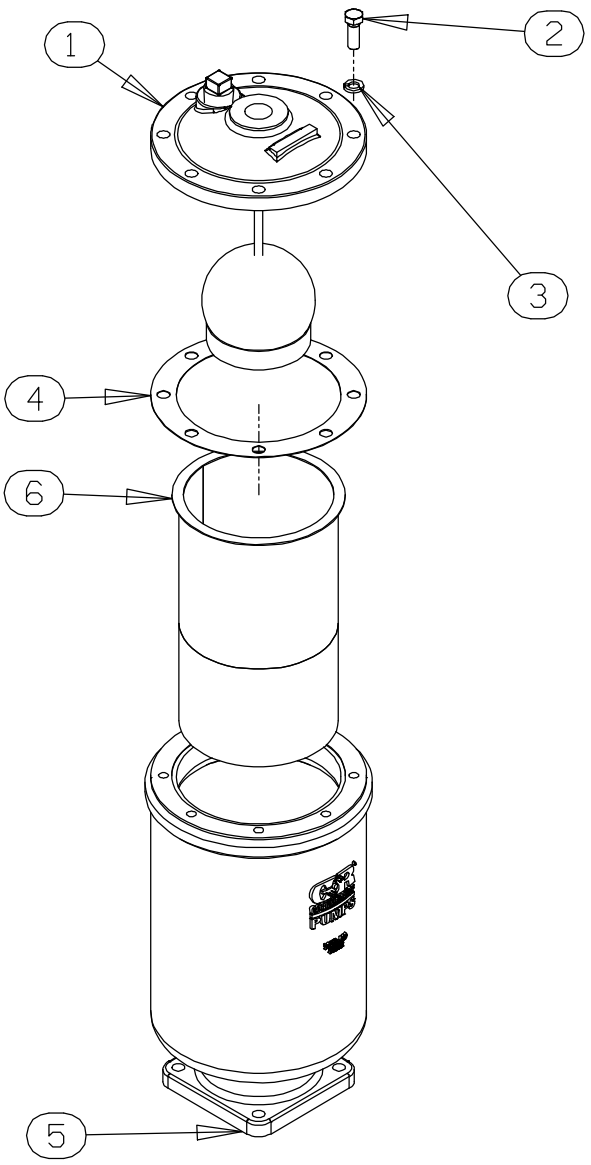


Figure 8. Priming Chamber Assembly

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	QTY
1		PRIMING VALVE	26664–007	1
		–ORIFICE BUTTON	26688–021	1
2		HEX HD CAPSCREW	B0806 15991	8
3		LOCKWASHER	J08 15991	8
4	✳	PRIMING VALVE GASKET	38683–657 19060	1
5		PRIMING CHAMBER	38343–020 10000	1
6		STRAINER ASSY	46641–222 17000	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

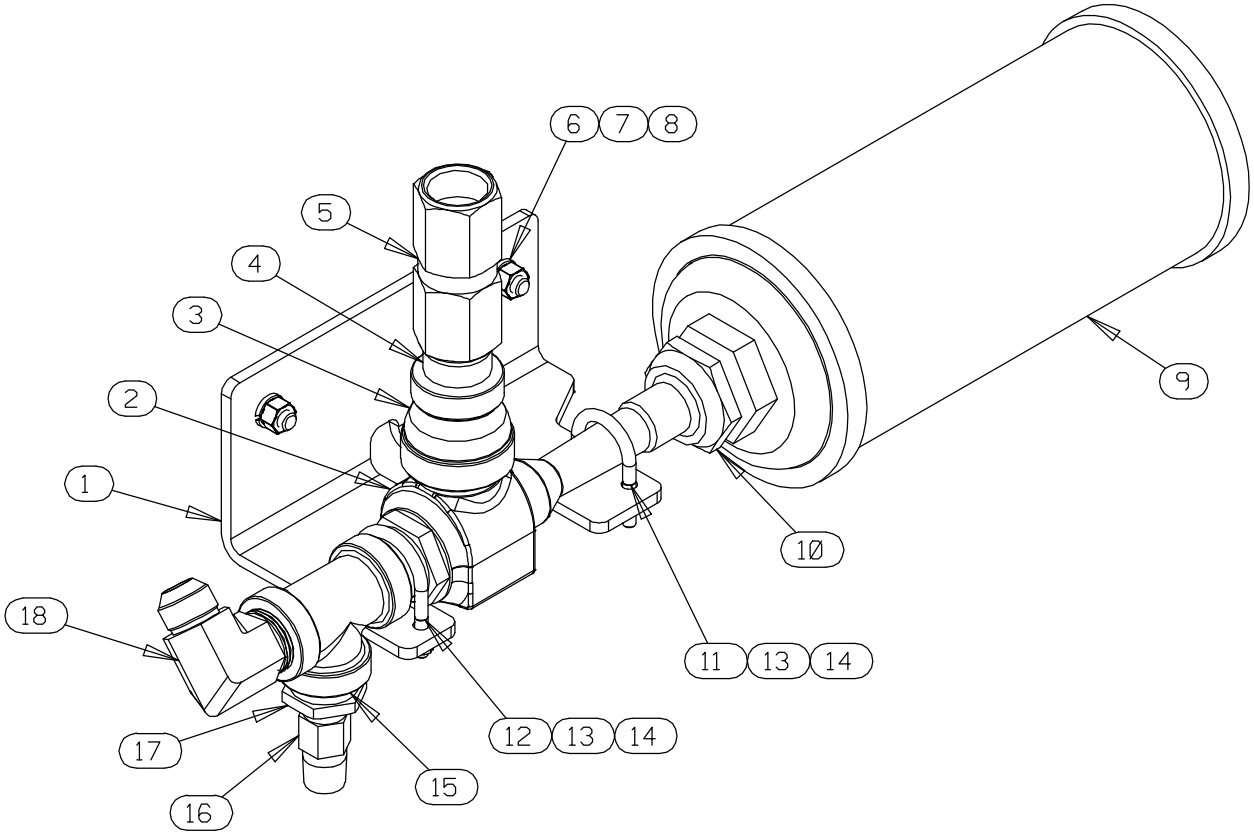


Figure 9. Venturi Assembly

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	QTY
1		BRACKET	34266−075 15080	1
2	✳	VENTURI	26817−007	1
3		REDUCER PIPE COUPLING	AE2016 15079	1
4		PIPE NIPPLE	T1608 15079	1
5	✳	CHECK VALVE	26641−093	1
6		LOCK WASHER	J06 15991	2
7		HEX NUT	D06 15991	2
8		HEX HEAD CAP SCREW	B0605 15991	2
9	✳	MUFFLER	29334−092	1
10		REDUCER PIPE BUSHING	AP2420 11999	1
11		U BOLT	21751−028	1
12		U BOLT	21751−019	1
13		LOCK WASHER	J04 15991	4
14		HEX NUT	D04 15991	4
15		PIPE TEE	U16 11999	1
16	✳	PRESSURE RELIEF VALVE	26662−028	1
17		REDUCER PIPE BUSHING	AP1608 11999	1
18		90° ELBOW ADAPTER	26523−141	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Review all SAFETY information in Section A.

Follow the instructions on all tags, label and decals attached to the pump.

This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions which are keyed to the illustrations (see Figures 1 through 9) and the corresponding parts lists. Instructions for the air compressor are covered separately in specific literature available from the manufacturer.

Some pump service functions may be performed without separating the pump end assembly from the power source. However, the priming chamber (43, Figure 4) and discharge check valve assembly (1, Figure 4) must be removed to service most pump components. The following instructions assume complete disassembly of the pump is required.

Before attempting to service the pump, lock out or disconnect the power source and take precautions to ensure that it will remain inoperative. Close all valves in the suction and discharge lines and drain the pump casing by removing the lowermost pipe plug (3, Figure 4). Clean and reinstall the pipe plug.

WARNING!

This manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed instructions and precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that only safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed only after establishing that neither personal safety nor pump integrity are compromised by such practices.

WARNING!

This pump is equipped with an automatic starting system, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

WARNING!

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Lock out or disconnect the power source to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure it is cool before opening any covers, plates, gauges, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

WARNING!

Death or serious personal injury and damage to the pump or components can occur if proper lifting procedures are not observed. Make certain that hoists, chains, slings or cables are in good working condition and of sufficient capacity and that they are positioned so that loads will be balanced and the pump or components will not be

damaged when lifting. Suction and discharge hoses and piping must be removed from the pump before lifting. Lift the pump or component only as high as necessary and keep personnel away from suspended objects.

CAUTION

Use **only** replacement parts provided or approved by Gorman-Rupp. Use of non-authorized parts may result in damage to the equipment and/or injury to personnel and **will** invalidate the warranty.

Priming Chamber Removal and Disassembly

(Figure 7)

Disconnect both the suction piping and the air discharge tubing from the priming chamber assembly (1). Support the priming chamber assembly using a sling and a suitable lifting device. Remove the hardware (4 and 5) and separate the priming chamber assembly, gasket (8) and baffle (7) from the suction spool (36, Figure 4).

(Figure 8)

Remove the hardware (2 and 3) securing the priming valve (1) to the priming chamber (5). Carefully lift the valve components from the priming chamber. Remove the gasket (4) and clean the mating surfaces.

If the priming valve float is stuck or the strainer (6) is clogged, it can usually be cleaned without further disassembly.

The only serviceable part of the priming valve is the orifice button (not shown). If liquid continues to bypass through the priming chamber after adjusting the orifice button (see **Priming Chamber Reassembly and Installation** for adjustment), the button may require replacement. To replace the orifice button, remove one of the “e-clips” from the pivot pin closest to the orifice button and remove the pivot pin. This will allow the linkage to be raised high enough to access the orifice button.

Remove the hex nut and lock washer securing the orifice button to the linkage bar and unscrew the orifice button from the linkage bar.

Discharge Check Valve Removal and Disassembly

(Figure 4)

Support the discharge check valve assembly (1) using a sling and a suitable lifting device. Remove the mounting hardware (not shown) and separate the discharge check valve assembly and gasket from the pump assembly (31).

The flapper and cover O-ring are the only serviceable parts of the check valve. If the flapper requires replacement, remove the hardware securing the cover. Separate the cover and O-ring and remove the flapper.

Pump Casing and Wear Ring Removal

(Figure 4)

The wear ring (5) may be serviced by removing the pump casing (31).

It is not necessary to remove the suction spool (36) from the pump casing unless replacement of the spool or gasket (33) is required. To remove the suction spool, disengage the hardware (41 and 42) securing it to the pump casing. Disengage the hardware (21 and 35) securing the suction spool to the suction support (34). Use a sling and suitable lifting device to remove the suction spool. Remove the gasket and clean the mating surfaces.

Disengage the hardware (9 and 10) and use a suitable lifting device to separate the pump casing from the rotating assembly (8).

Inspect the wear ring for excessive wear or damage. The wear ring is secured in the pump casing by a press fit. If replacement is required, remove the screws (7) and install four 3/8−16 UNC−2B capscrews (not supplied) at least 2 inches long in the holes in the wear ring. Tighten the capscrews in an alternating sequence to “jack” the wear ring from the pump casing.

Removing Air Compressor

(Figure 4)

Further disassembly of the pump requires removing the air compressor assembly (11) from the rotating assembly (8).

Disengage the hardware (17) and remove the belt guard assembly (16).

(Figure 6)

Remove the hardware (16, 17, 18 and 19) securing the air compressor assembly to the bracket (13). Use a pry bar to raise the air compressor high enough to remove the spacers (20). Remove the belt (12, Figure 4) from the air compressor sprocket (11) and drive sprocket (19, Figure 4).

Disconnect all hoses and fittings from the air compressor and use a suitable hoist and sling to remove the air compressor assembly.

Impeller Removal

(Figure 5)

The rotating assembly (2, Figure 2) must be separated from the gear reducer (3, Figure 2) in order to remove the impeller (1). Separate the halves of the coupling (13, Figure 1) and remove the coupling half from the impeller shaft (27, Figure 5).

Before attempting to remove the impeller (1) position a **clean** container (2 gallons [8 liters] minimum capacity) under the seal cavity drain plug (17). Remove the plug and drain the oil from the seal cavity into the container. For shorter drain time, remove the air vent (9). Clean and reinstall the drain plug and air vent. Inspect the oil for water, dirt or a cloudy condition which could indicate seal failure.

Use a long piece of heavy bar stock and the lathe dog on the drive end of the shaft as shown in Figure 10 to block shaft rotation. **Use caution** not to damage the shaft or keyway.

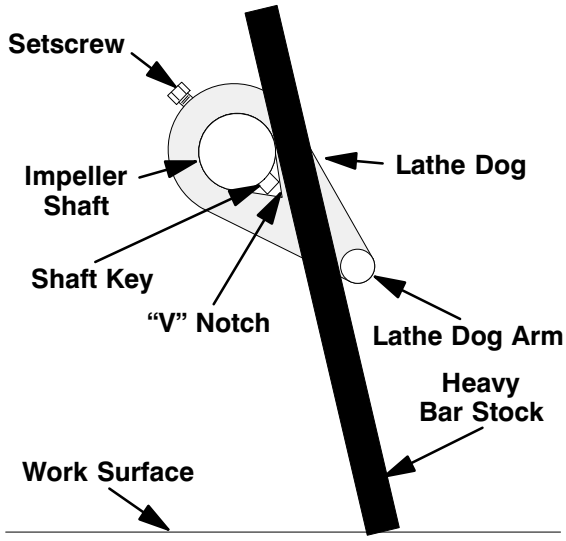


Figure 10. Blocking Shaft Rotation

Remove the impeller capscrew (29) and washers (30 and 31). Remove the lathe dog from the shaft.

Install three 3/4−16 UNC−2B capscrews (not supplied) in the tapped holes in the impeller. Attach a suitable puller to the capscrews and use the puller to remove the impeller and key (26) from the shaft. Remove the puller and the screws from the impeller.

NOTE

An alternate method of removing the impeller is to insert a pair of wedges 180° apart between the impeller and seal plate (5). Tap the wedges evenly in an alternating pattern to "walk" the impeller off the shaft.

Inspect the impeller and replace if cracked or badly worn.

If no further disassembly is required, refer to **Impeller Installation**.

Seal Removal

(Figures 5 and 12)

Carefully remove the spring retainer and seal spring. Slide the rotating portion of the seal assembly and shaft sleeve (3) off the shaft as a single unit. Remove the shaft sleeve O-ring (4). Apply oil to the shaft sleeve and work it up under the rubber bellows. Slide the rotating portion of the seal assembly off the shaft sleeve.

Slide a pair of stiff wires with hooked ends along the shaft and hook the stationary seat from the back side. Pull the stationary seat and O-ring from the seal plate (5).

An alternate method of removing the stationary seal components is to remove the hardware (14 and 15) and separate the seal plate from the pedestal (16). Position the seal plate on a flat surface with the impeller side down. Use a wooden dowel or other suitable tool to press on the back side of the stationary seat until the seat and O-ring can be removed.

Remove the seal plate O-ring (11).

If no further disassembly is required, refer to **Seal Reassembly And Installation**.

Shaft and Bearing Removal and Disassembly

(Figure 5)

When the pump is properly operated and maintained, the shaft and bearings should not require disassembly. Disassemble the shaft and bearings **only** when there is evidence of wear or damage.

CAUTION

Shaft and bearing disassembly in the field is not recommended. These operations should be performed only in a properly equipped shop by qualified personnel.

If not removed with the seal assembly, remove the hardware (14 and 15) and separate the seal plate and O-ring (11) from the pedestal (16).

Disengage the hardware (14 and 15) and remove the drive flange (19), gasket (20) and oil seal (18). Press the oil seal from the drive flange.

Place a block of wood against the impeller end of the shaft (27) and tap the shaft and assembled bearings (24 and 28) from the bearing housing.

Press the oil seals (10) from the bearing housing.

After removing the shaft and bearings, clean and inspect the bearings **in place** as follows.

CAUTION

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

Clean the pedestal, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage and replace as necessary.

WARNING!

Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

Clean the bearings thoroughly in **fresh** cleaning solvent. Dry the bearings with filtered compressed air and coat with light oil.

CAUTION

Bearings must be kept free of all dirt and foreign material. Failure to do so will greatly shorten bearing life. **Do not** spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

Rotate the bearings by hand to check for roughness or binding and inspect the bearing balls. If rotation is rough or the bearing balls are discolored, replace the bearings.

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the pedestal. Replace the bearings, shaft or pedestal if the proper bearing fit is not achieved.

If bearing replacement is required, straighten the tab on the bearing lock washer (22). Use a spanner

wrench to remove the bearing lock nut (21) and bearing spacer (23). Remove the bearing lock washer.

Use a bearing puller to remove the inboard and outboard bearings from the shaft.

Shaft and Bearing Reassembly and Installation

(Figure 5)

Clean and inspect the bearings as indicated in **Shaft and Bearing Removal and Disassembly**.

CAUTION

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

Inspect the shaft (27) for distortion, nicks or scratches. Dress small nicks and burrs with a fine file or emery cloth. Replace the shaft if defective.

The bearings may be heated to ease installation. An induction heater, hot oil bath, electric oven, or hot plate may be used to heat the bearing. The bearings should **never** be heated with a direct flame or directly on a hot plate.

NOTE

*If a hot oil bath is used to heat the bearings, both the oil and the container must be **absolutely** clean. If the oil has been previously used, it must be **thoroughly** filtered.*

NOTE

*Position the outboard bearing (24) on the shaft with the retaining ring on the bearing O.D. **toward the drive end of the shaft**. The inboard bearing (28) is equipped with a flange ring that is shipped loose with the bearing. Install the flange ring on the shaft prior to heating and installing the bearings.*

Heat the bearings to a uniform temperature **no higher than** 250°F (120°C) and slide them one at a time onto the shaft until fully seated against the shaft shoulders. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.

CAUTION

When installing the bearings onto the shaft, **never** press or hit against the outer race, rollers, or cage. Press **only** on the inner races.

After installation, pack the bearings by hand with lithium EP2 grease until fully lubricated.

Slide the shaft and assembled bearings into the pedestal until the inboard bearing is fully seated against the bearing retaining ring.

CAUTION

It is recommended that a new bearing lock washer (27) be installed any time the shaft and bearings are disassembled. Re-use of an old lock washer may create a pre-load condition on the bearing, resulting in premature bearing failure.

Install the bearing lockwasher (27) and screw the bearing locknut (26) onto the shaft until tight. Torque the bearing lock nut to 150 ft. lbs. 20,8 m. kg.). After torquing, locate the tab on the lock washer that aligns with a slot in the lock nut and bend the tab over into the slot.

Apply a light coating of oil to the lip of the inboard oil seal (19) and press it into the pedestal bore with the lip positioned as shown in Figure 5. Press the oil seal into the pedestal until the face is **just flush** with the machined surface on the pedestal.

It is recommended that a sleeve be positioned against the inboard oil seal to prevent the lip of the oil seal from rolling as the shaft and bearings are installed in the pedestal. The O.D. of the sleeve should be just smaller than the bearing housing bore, while the I.D. of the sleeve should be just larger than the O.D. of the lip seal area of the shaft.

With the lip seal sleeve in place, lubricate the lip seal area of the shaft and slide the shaft and assembled bearings into the bearing housing until

the retaining ring on the outboard bearing seats against the pedestal. Remove the lip seal sleeve.

CAUTION

When installing the shaft and bearings into the bearing bore, push against the outer race. **Never** hit the rollers or cage.

Apply a light coating of oil to the lip of the outboard oil seal (10) and press it into the pedestal with the lip positioned as shown in Figure 5. The face of the oil seal should be **just flush** with the outer face of the bearing cap.

Install the shaft key (26) in the shaft keyway. Slide the bushing and sprocket (18 and 19) onto the shaft to the dimension shown in Figure 11. Install the bushing setscrews and tighten the setscrews in an alternating sequence to secure the sprocket to the shaft. Torque the setscrews to 66.7 ft. lbs. (800 in. lbs. or 9,2 m. kg.).

Apply a light coating of oil to the lip of the oil seal (18) and press it into the drive flange (19) with the lip positioned as shown in Figure 5. The face of the oil seal should be just flush with the outer face of the bearing cap. Inspect and remove any sealant shavings from the O.D. of the lip seal.

Install the gasket (20) and slide the assembled drive flange and oil seal over the impeller shaft. Use caution not to cut or roll the lip of the oil seal (18) on the shaft keyway. Secure the drive flange to the pedestal with the hardware (14 and 15). Torque the capscrews (15) initially to 80 ft. lbs. (11 m. kg.) in a criss-cross pattern, then torque the capscrews again to 110 ft. Lbs (15,2 m. kg.) in a criss-cross pattern, going around the bolt circle 1-1/2 times.

Lubricate the pedestal as indicated in **LUBRICATION** at the end of this section.

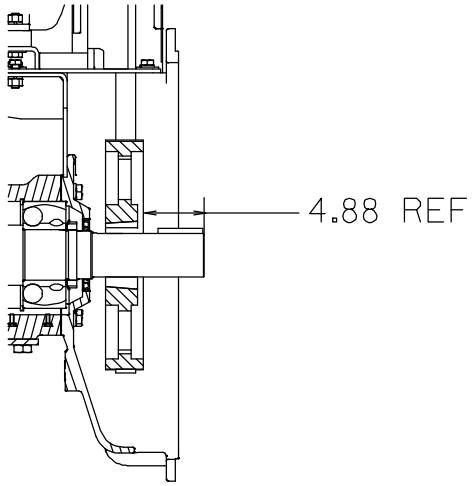


Figure 11. Drive Sprocket Positioning

Securing Rotating Assembly to Gear Reducer

(Figure 4)

Position the drive belt (12) over the sprocket (19) and slide it up through the slot in the drive flange (19, Figure 5).

Using a suitable lifting device, position the assembled pedestal on the pedestal support (28) and secure the pedestal with the attaching hardware (29 and 30). Be sure to install any leveling shims used under the pedestal feet.

(Figure 6)

Position the air compressor drive belt between the belt tensioners (15, Figure 4) and slide the belt over the air compressor sprocket (11). Use a pry bar to raise the air compressor high enough to install the spacers (20). Secure the air compressor to the bracket (13) with the previously removed hardware (16, 17, 18 and 19).

Reconnect all hoses and fittings to the air compressor.

Reinstall the half of the coupling (13, Figure 1) onto the impeller shaft. Realign and secure the coupling halves to the pump and gearbox shafts as indicated in **Installation, Section B**.

Seal Reassembly and Installation

(Figures 5 and 12)

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent. Inspect the stationary seat bore in the seal plate for dirt, nicks and burrs,

and remove any that exist. The stationary seat bore **must** be completely clean before installing the seal.

WARNING!

Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

CAUTION

A new seal assembly should be installed **any time** the old seal is removed from the pump. Wear patterns on the finished faces cannot be realigned during reassembly. Reusing an old seal could result in premature failure.

Handle the seal parts with extreme care to prevent damage. Be careful not to contaminate precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Clean and polish the shaft sleeve, or replace it if there are nicks or cuts on either end. If any components are worn, replace the complete seal; **never mix old and new seal parts**.

Remove the seal from the container and inspect the precision finished faces to ensure that they are free of any foreign matter.

To ease installation of the seal, lubricate the stationary seat O-ring, the I.D. Of the bellows and the O.D. of the shaft sleeve (3) with "P—80® Emulsion" or water. **Do not** use oil or any substitute lubricant other than water. Apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 12).

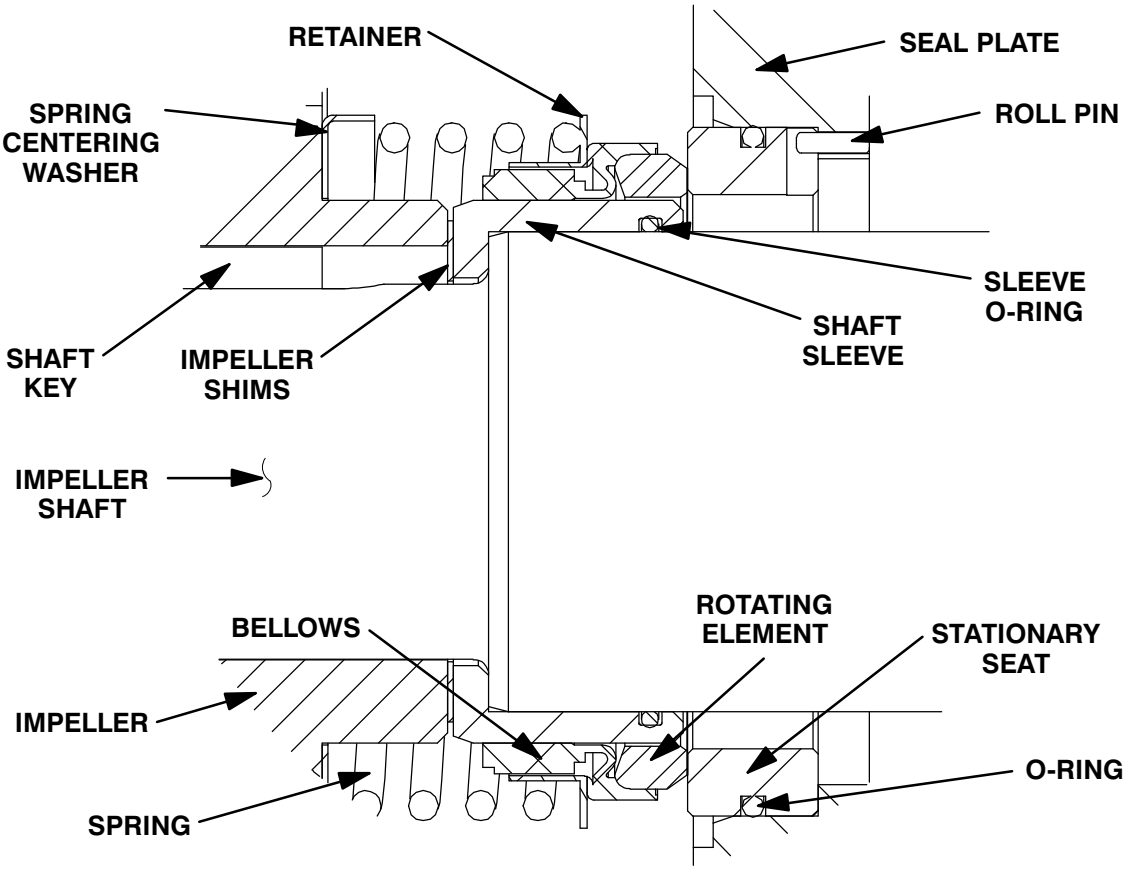


Figure 12. Seal Assembly

CAUTION

This seal is not designed for operation at temperatures above 160°F (71°C). Do not use at higher operating temperatures.

Inspect the seal plate (5), shaft sleeve (3) and the impeller shaft for burrs or sharp corners, and remove any that exist.

If the wear ring (5, Figure 4) was removed, press the replacement ring into the seal plate until fully seated. Apply "Loctite Threadlocker No. 243" or equivalent compound to the threads of the setscrews (7, Figure 4) and install them in the holes in the wear ring until snug.

CAUTION

The wear ring **must** seat squarely in the seal plate bore; otherwise binding and/or excessive wear will occur as the shaft turns.

Position the seal plate over the pedestal shoulder and secure the seal plate to the pedestal with the previously removed hardware (14 and 15). If a new seal plate is being installed, position the roll pin (6) in the hole in the seal plate bore and tap it into place with a hammer until fully seated.

Align the notch in the stationary seal seat with the roll pin (6) and press the stationary seat and its O-ring into the seal plate until fully seated in the seal plate bore. A push tube cut from a length of plastic pipe would aid this process. The I.D. of the tube should be slightly larger than the O.D. of the shaft sleeve (3).

Install the shaft sleeve O-ring (4) in the groove in the I.D. of the sleeve. Lubricate the O-ring and the O.D. of the shaft sleeve with "P—80® Emulsion" or water. **Do not** use oil or any substitute lubricant other than water.

Slide the rotating subassembly (consisting of the rotating element, retainer and bellows) onto the sleeve until the rotating element is **just flush** with the chamfered end of the sleeve. Slide the shaft sleeve and rotating subassembly onto the shaft until the seal faces contact and the shaft sleeve seats against the shoulder on the impeller shaft. Install the seal spring and spring centering washer.

After the impeller has been installed, lubricate the seal as indicated in **LUBRICATION**.

Impeller Installation

(Figure 5)

Inspect the impeller and replace it if cracked or badly worn. If removed, install the roll pin (6) in the hole in the impeller hub.

Install the impeller key (26) in the shaft keyway. Align the keyway in the impeller with the impeller key and press the impeller onto the shaft until fully seated.

Use a piece of soft bar stock or a wood block to prevent impeller rotation. Align the hole in the impeller washer (31) with the roll pin in the impeller and install the washers. Apply "Loctite Threadlocker No. 243" or equivalent compound to the threads of the impeller screw (29). Install the impeller screw and torque the screw to 500 ft. lbs. (69,2 m. kg.). Remove the wood block or metal bar used to prevent impeller rotation.

Pump Casing and Wear Ring Installation

(Figure 4)

If the wear ring (5) was removed, align the holes in the wear ring for the screws (7) with those in the pump casing and press the replacement ring into the pump casing until fully seated. Apply "Loctite Threadlocker No. 243" or equivalent compound to the threads of the screws (7) and install them in the holes in the wear ring until snug.

CAUTION

The wear ring **must** seat squarely in the pump casing or binding and/or excessive wear will result.

Lubricate the O-ring (6) with light grease and install it in the groove in the O.D. of the seal plate.

Carefully position the pump casing over the impeller. Install the hardware (9 and 10) on the studs (4) and use the hardware to draw the pump casing over the seal plate shoulder until tight.

If removed at disassembly, install the gasket (33) over the studs in the pump casing and secure the suction spool (36) to the pump casing with the previously removed hardware (41 and 42).

Secure the suction spool to the support assembly (34) with the previously removed hardware (21 and 35).

Discharge Check Valve Reassembly and Installation

(Figure 4)

If the discharge check valve (1) was disassembled to replace the flapper or cover O-ring, position the flapper in the valve body and check to ensure free movement.

Install the valve cover O-ring and secure the cover to the body with the previously removed hardware.

Apply a small amount of light grease to the discharge flange gasket to hold it in place and position it against the pump casing flange. Support the discharge check valve assembly using a sling and a suitable lifting device. Using the previously removed hardware, secure the discharge check valve assembly and flange gasket to the pump assembly (31). Secure the discharge check valve to its support bracket using the previously removed hardware.

Priming Chamber Assembly and Installation

(Figure 8)

Clean and inspect the components of the priming valve (1). Inspect the linkage and ensure the orifice button (not shown) squarely engages the valve seat. Replace the orifice button if required (see **Priming Chamber Removal and Disassembly** for orifice button removal).

If the orifice button was removed, screw the new orifice button into the linkage bar until fully seated. Align the hole in the linkage bar with the holes in the bracket and reinstall the pivot pin. Secure the pivot pin with the previously removed “e-clip”.

Adjust the orifice button seating as necessary by screwing the orifice button into or out of the linkage bar. Proper adjustment is achieved when the orifice button fully seats against the orifice before the linkage bar on the float bottoms against the threads on the orifice button. When adjustment is complete, install and tighten the lock washer and hex nut securing the orifice button.

Install the strainer (6) and priming valve gasket (4).

Lower the float into the priming chamber (5) and secure the priming valve with the previously removed hardware (2 and 3).

(Figure 7)

Install the baffle and gasket (7 and 8) and use a sling and suitable lifting device to position the priming chamber assembly on the pump suction spool (36, Figure 4). Secure the priming chamber assembly with the hardware (4 and 5).

Reconnect both the suction piping and the air discharge tubing to the priming chamber assembly.

LUBRICATION

Seal Assembly

(Figure 5)

Before starting the pump, remove the air vent and reducer bushing (9 and 7) and fill the seal cavity with approximately 160 ounces (4,7 liters) of SAE No. 30 non-detergent oil to the middle of the sight gauges (8) and maintain it at the middle of the gauges. Clean and reinstall the air vent and bushing. Maintain the oil at this level.

Bearings

(Figure 5)

The pedestal was fully lubricated when shipped from the factory. The grease fittings (13) are protected from contamination by the cap plugs (12). Remove the cap plugs and clean the grease fittings **thoroughly** before adding grease. After lubricating the bearings, clean the fittings and reinstall the cap plugs.

Under normal conditions, re-lubricate the bearings after every 1500 hours of use by adding 1 oz. (28 g.) of lithium EP2 grease to the impeller end bearing and 2 oz. (56 g.) of grease to the drive end bearing. **Do not** over-lubricate. Over-lubrication can

cause the bearings to over-heat, resulting in premature bearing failure.

When lubricating a **new** bearing pedestal, pack the bearings by hand with lithium EP2 grease until fully lubricated prior to installing the shaft and bearings into the pedestal. After installing the shaft and bearings into the pedestal, lubricate the bearings as follows:

Impeller End Bearing: 6 oz. (170 g) each fitting
Drive End Bearing: 11 oz. (312 g) each fitting

Engine

Consult the literature supplied with the engine, or contact your local engine representative.

For Warranty Information, Please Visit
www.grpumps.com/warranty
or call:
U.S.: 419—755—1280
Canada: 519—631—2870
International: +1—419—755—1352

PIERCE PUMP
an FCX Performance Company

SECTION - 6

Service Contact Information

PIERCE PUMP
an FCX Performance Company

SERVICE CONTACT INFORMATION

ADDRESS: 9010 John W. Carpenter Freeway

Dallas, TX 75247

Phone: 214.320.3604 *

Fax: 214.328.5665

Contact: David Chandler – Service Manager

* For Service issues after business hours, caller may be directed to an after hours phone number.

Sales Contact: Kyle W. Lewis
817-773-1690
klewis@piercepumpco.com

www.piercepump.com

ppcsales@piercepumpco.com

PIERCE PUMP
an FCX Performance Company

SECTION - 7

CONTROLS MANUAL

Product Manual

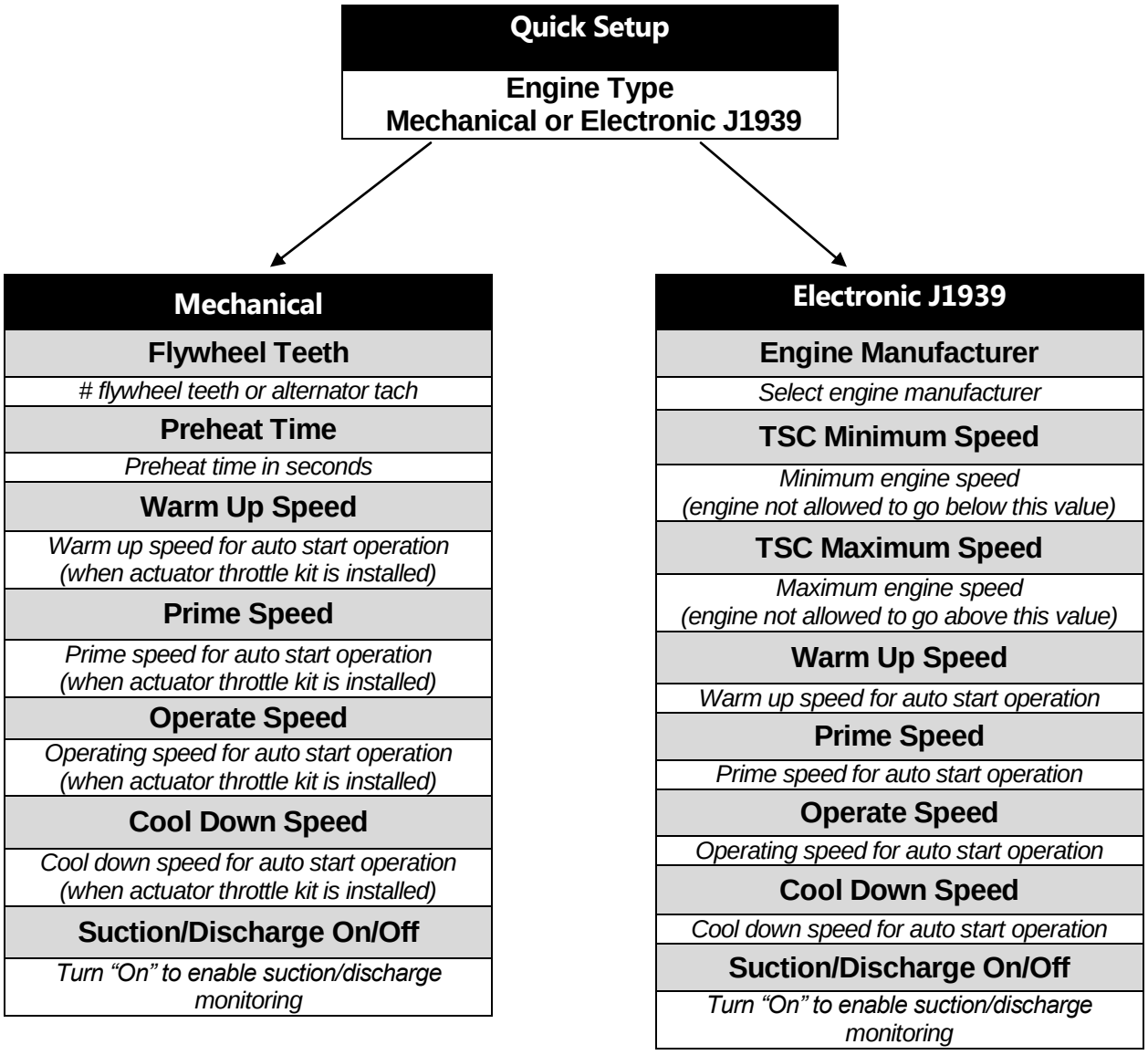
Part Number: 29284-085
Revision: 1.1

P.O. Box 368 • Sharon Center, OH 44274
Phone 330.239.4345 • Fax 330.239.2845 • www.controlsinc.com

TABLE OF CONTENTS

QUICK SETUP

A ***Quick Setup menu*** is available for initial panel installation.



PRIOR TO STARTING ENGINE

Prior to starting the engine, select the required START/STOP and THROTTLE settings.
Reference the tables below to determine the appropriate operating modes. Details on each setting are provided on the following pages.

MANUAL OPERATION SETTINGS

#	Start/Stop Mode	Throttle Mode	Throttle Description
1	Manual Key Start	TSC Vernier	UP and DOWN via panel buttons (set min and max speeds)
2	Manual Key Start	Multistate	UP and DOWN via panel buttons (up to four separate operating speeds)

AUTOMATIC OPERATION SETTINGS (Key in Auto Position)

#	Start/Stop Mode	Throttle Mode	Throttle Description
3	Floats (single or dual)	Single Speed	Select warm up, prime, operating and cool down speeds
4	Floats (single or dual)	Linear	Engine speed adjusts between selected min and max speeds in relation to selected min and max level or pressures
5	Floats (single or dual)	Target	Engine speed adjusts to maintain selected level or pressure
6	Pressure Transducer	Single Speed	Select warm up, prime, operating and cool down speeds
7	Pressure Transducer	Linear	Engine speed adjusts between selected min and max speeds in relation to selected min and max level or pressures
8	Pressure Transducer	Target	Engine speed adjusts to maintain selected level or pressure
9	Level Transducer	Single Speed	Select warm up, prime, operating and cool down speeds
10	Level Transducer	Linear	Engine speed adjusts between selected min and max speeds in relation to selected min and max level or pressures
11	Level Transducer	Target	Engine speed adjusts to maintain selected level or pressure

A **fail safe float backup option** is available for pressure and level modes should the pressure or level transducer fail to operate.

AUTO START/STOP SETTINGS

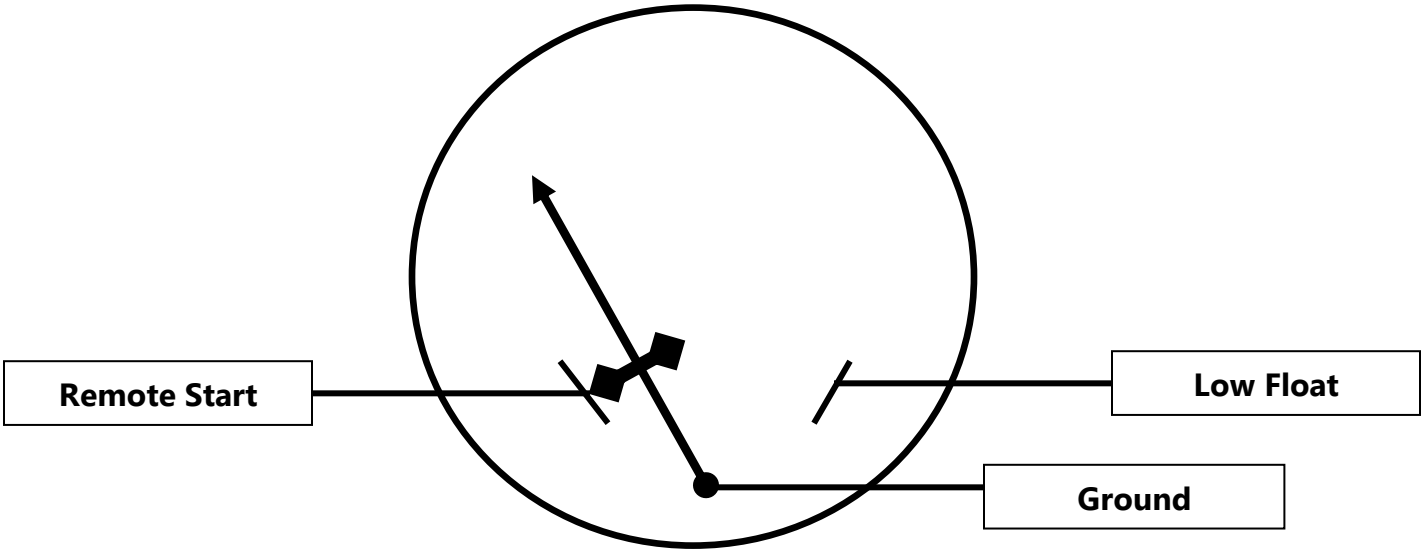
The following auto start/stop options are available for when the key is placed in the AUTO position.

SINGLE FLOAT START/STOP

DUAL FLOAT START/STOP

PRESSURE SWITCH START/STOP

Wiring for a pressure start/stop switch.



TRANSDUCER START/STOP

In the ***Transducer Configuration Menu***:

1) set the ***Transducer Type*** to "Pressure or Level"
2) set the ***Signal Type*** to "4-20ma or 0-5VDC or Ratiometric"
3) set the ***Scale*** to "min and max reading for the transducer"
    a. Example: for a 0 to 100 psi transducer, min = 0 and max = 100
4) the ***Zero Trim Calibration*** calibrates the transducer to the static air reading
    a. Example: a 4-20mA transducer in static air should be adjusted to 400 (mA x 100)

In the ***Auto Operations Settings Menu***:

1) set the ***Start/Stop Input*** to "Transducer"

FAIL SAFE FLOAT START/STOP

An optional fail safe float can also be used as a backup to the transducer. To enable the failsafe float:

In the ***Auto Operations Menu***:

1) set ***Failsafe Float*** to "ON"
2) set the ***Failsafe Speed*** to "Desired engine speed if fail safe float is tripped"
3) set the ***Failsafe Float Time Delay*** for "the minimum amount of time the engine runs if the failsafe float is tripped"

MANUAL THROTTLE SETTINGS

The following **bolded** settings are required for manual throttle operation in the ***Throttle Configuration menu***.

VERNIER THROTTLE (DEFAULT)

Vernier throttle is standard up and down throttle between the minimum and maximum selections. The ramp rate is the rate of acceleration in rpm's per second. The control panel uses J1939 throttle, also called "torque speed control" or TSC1.

Throttle Configuration Menu	**Throttle Type - Throttle Type Selection (Default = Vernier)**
	E-Throttle Mode Selection
	TSC Mode Selection
	TSC Min Speed Selection (Default = 800 rpm)
	TSC Max Speed Selection (Default = 2400 rpm)
	TSC Ramp Rate Selection (Default = 100 rpm/sec)
	Throttle Curve Selection
	Multistate Speed 1 Selection
	Multistate Speed 2 Selection
	Multistate Speed 3 Selection
	Multistate Speed 4 Selection

MULTISTATE THROTTLE

Multistate throttle provides for one, two, three or four specific operating speeds. Pressing the up and down buttons adjusts engine speed between the selected multistate speed selections.

Throttle Configuration Menu	**Throttle Type - Throttle Type Selection (Select Multistate)**
	E-Throttle Mode Selection
	TSC Mode Selection
	TSC Min Speed Selection (Default = 800 rpm)
	TSC Max Speed Selection (Default = 2400 rpm)
	TSC Ramp Rate Selection (Default = 100 rpm/sec)
	Throttle Curve Selection
	Multistate Speed 1 Selection
	Multistate Speed 2 Selection
	Multistate Speed 3 Selection
	Multistate Speed 4 Selection

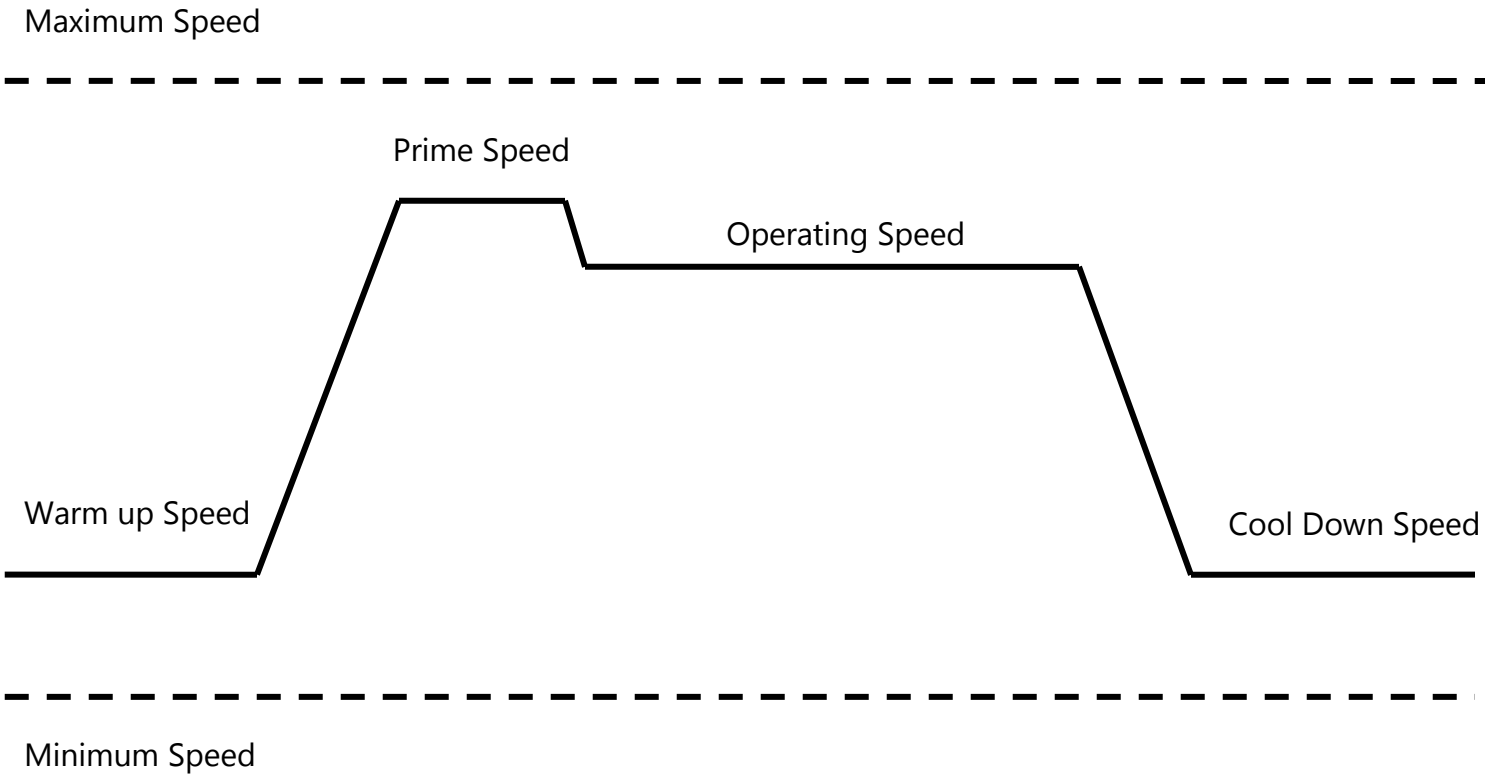
AUTOMATIC THROTTLE SETTINGS

The following auto start/stop throttle options are available for when the key is placed in the AUTO position.

SINGLE SPEED (PROFILE) THROTTLE

Single speed allows the engine to run according to a predetermined speed profile. Select the desired engine speed for the following.

1) Warm Up Speed
2) Prime Speed (Optional)
3) Operating Speed
4) Cool Down Speed



For single speed operation, the **highlighted menu settings are required**.

Auto Operation Settings Menu	Start/Stop Input (**Floats**, Transducer)
	Throttle Mode (**Single Speed**, Linear, Target)
	Operate Speed (**Select Operating Speed**)

Transducer Configuration Menu	Transducer Type (**None/Float**, Level, Pressure)

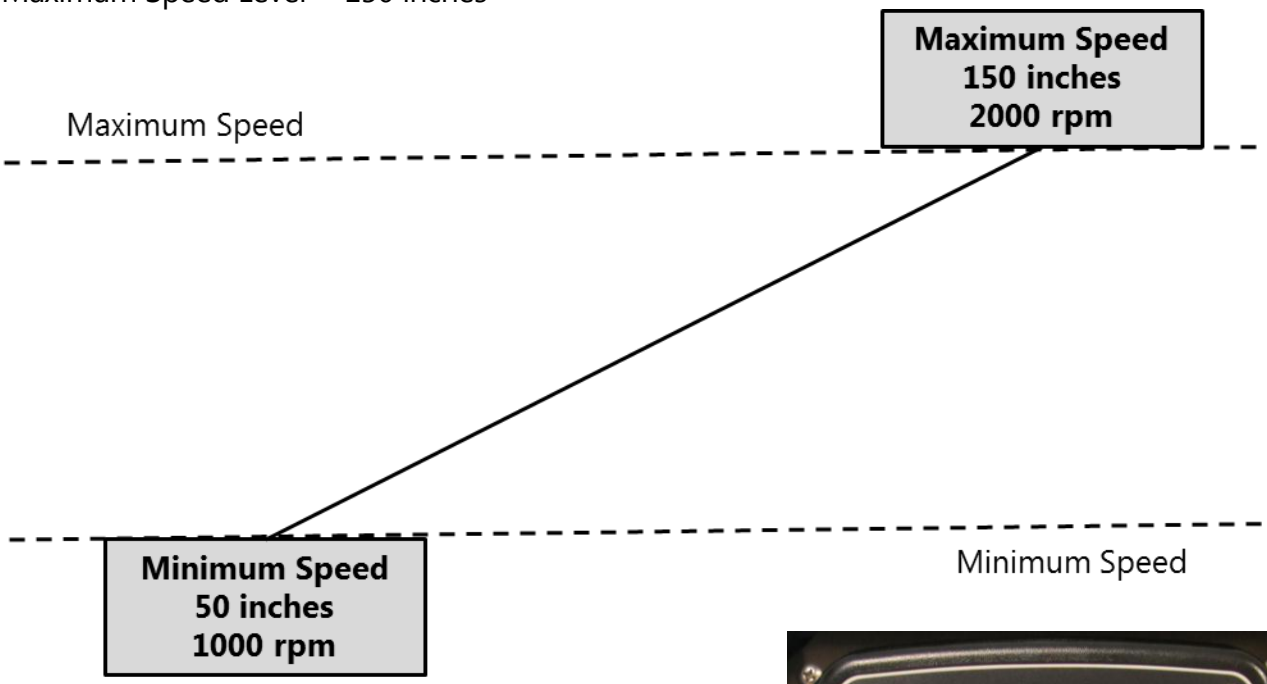
Auto Start Configuration Menu	Auto Start Delay (Default = 10 seconds)
	Pre Heat Time (Default = 0 seconds)
	Crank Time (Default = 10 seconds)
	Crank Rest Time (Default = 10 seconds)
	Warm Up Speed (Default = 800 rpm)
	Warm Up Time (Default = 10 seconds)
	Prime Speed (Default = 800 rpm)
	Prime Time (Default = 0 seconds)
	Cool Down Speed (Default = 650 rpm)
	Cool Down Time (Default = 10 seconds)
	Crank Cycles (Default = 5)
	Fault Bypass Period (Default = 10 seconds)
	Crank Hold Delay (Default = 0)
	Recharge Monitor (Default = Off)
	Recharge Voltage Selection
	Recharge Delay Selection
	Recharge Run Time Selection
	Next Recharge Time Interval Selection

If any auto start configuration settings are not required (such as warm up speed), set the time to 0:00 seconds for that parameter.

LINEAR THROTTLE

With linear throttle, the minimum and maximum engine speeds and the corresponding minimum and maximum level or pressures are selected. Engine speed adjusts according to the linear relationship as shown below.

Example: Level Transducer (0 to 200 inch range)
Minimum Speed = 1000 rpm
Maximum Speed = 2000 rpm
Minimum Speed Level = 50 inches
Maximum Speed Level = 150 inches



Operation
If level = 50 inches, engine speed = 1000 rpm
If level = 100 inches, engine speed = 1500 rpm
If level = 150 inches, engine speed = 2000 rpm

Screen will alternate between standard 6 up display and the Speed to Level screen

Linear throttle can be combined with any of the automatic engine start/stop modes. If any automatic speeds settings are not required (such as warm up), set the time delay to 0:00 seconds for that parameter.

For linear throttle operation, **the highlighted menu settings are required**.

Auto Operation Settings Menu	Start/Stop Input (Floats, **Transducer**)
	Fail Safe Float (On, Off)
	Fail Safe Speed (Default = 2400 rpm)
	Fail Safe Off Delay (Default = 0:00 seconds)

Transducer Configuration Menu	**Transducer Type (None/Float, Level, Pressure)**
	Transducer Scale (4-20mA, 0-5VDC, Ratiometric)
	Min Transducer Reading (inches or psi)
	Max Transducer Reading (inches or psi)
	Current Level or Pressure (current transducer reading)
	Zero Trim Calibration Setting

Auto Start Configuration Menu	Auto Start Delay (Default = 10 seconds)
	Pre Heat Time (Default = 0 seconds)
	Crank Time (Default = 10 seconds)
	Crank Rest Time (Default = 10 seconds)
	Warm Up Speed (Default = 800 rpm)
	Warm Up Time (Default = 10 seconds)
	Prime Speed (Default = 800 rpm)
	Prime Time (Default = 0 seconds)
	Cool Down Speed (Default = 650 rpm)
	Cool Down Time (Default = 10 seconds)
	Crank Cycles (Default = 5)
	Fault Bypass Period (Default = 10 seconds)
	Crank Hold Delay (Default = 0)
	Recharge Monitor (Default = Off)
	Recharge Voltage Selection
	Recharge Delay Selection
	Recharge Run Time Selection
	Next Recharge Time Interval Selection

If any auto start configuration settings are not required (such as warm up speed), set the time to 0:00 seconds for that parameter.

LEVEL/PRESSURE MAINTAIN THROTTLE

With level/pressure maintain throttle, engine speed adjusts to maintain the selected level or pressure.

Example: Pressure Transducer (0 to 50 psi range)
Target Pressure = 30 psi
Minimum Speed = 1000 rpm
Maximum Speed = 2000 rpm

Operation
If pressure = 20 psi, engine speed increases up to 2000 rpm until 30 psi is reached.
If pressure = 40 psi, engine speed decreases down to 1000 rpm until 30 psi is reached
If pressure = 30 psi, engine speed holds

Screen will alternate between standard 6 up display and the Speed to Pressure screen

The throttle response time can be increased or decreased by adjusting the "Gain Trim Setting" in the ***Transducer Configuration menu***.

Level/pressure maintain throttle can be combined with any of the automatic engine start/stop modes. If any automatic speeds settings are not required (such as warm up), set the time delay to 0:00 seconds for that parameter.

For level/pressure maintain operation, the highlighted menu settings are required.

Auto Operation Settings Menu	Start/Stop Input (Floats, **Transducer**)
	Fail Safe Float (On, Off)
	Fail Safe Speed (Default = 2400 rpm)
	Fail Safe Off Delay (Default = 0:00 seconds)

Transducer Configuration Menu	Transducer Type (None/Float, **Level, Pressure**)
	Transducer Scale (4-20mA, 0-5VDC, Ratiometric)
	Min Transducer Reading (inches or psi)
	Max Transducer Reading (inches or psi)
	Current Level or Pressure (current transducer reading)
	Zero Trim Calibration Setting

Auto Start Configuration Menu	Auto Start Delay (Default = 10 seconds)
	Pre Heat Time (Default = 0 seconds)
	Crank Time (Default = 10 seconds)
	Crank Rest Time (Default = 10 seconds)
	Warm Up Speed (Default = 800 rpm)
	Warm Up Time (Default = 10 seconds)
	Prime Speed (Default = 800 rpm)
	Prime Time (Default = 0 seconds)
	Cool Down Speed (Default = 650 rpm)
	Cool Down Time (Default = 10 seconds)
	Crank Cycles (Default = 5)
	Fault Bypass Period (Default = 10 seconds)
	Crank Hold Delay (Default = 0)
	Recharge Monitor (Default = Off)
	Recharge Voltage Selection
	Recharge Delay Selection
	Recharge Run Time Selection
	Next Recharge Time Interval Selection

If any auto start configuration settings are not required (such as warm up speed), set the time to 0:00 seconds for that parameter.

PANEL OPERATION

MANUAL OPERATION

1) **Engine Start - Turn key to CRANK position**
2) **Engine Stop - Turn key to OFF position**
3) **Engine Throttle - Push up and down buttons**

   Throttle operation based on manual throttle settings

AUTO START/STOP OPERATION

1) **Engine Start - Turn key to AUTO position**

   Engine start/stop based on auto start/stop settings. Panel display shows "Auto Start ARMED" message.

2) **Engine Throttle**

   Throttle operation based on auto throttle settings

SLEEP MODE

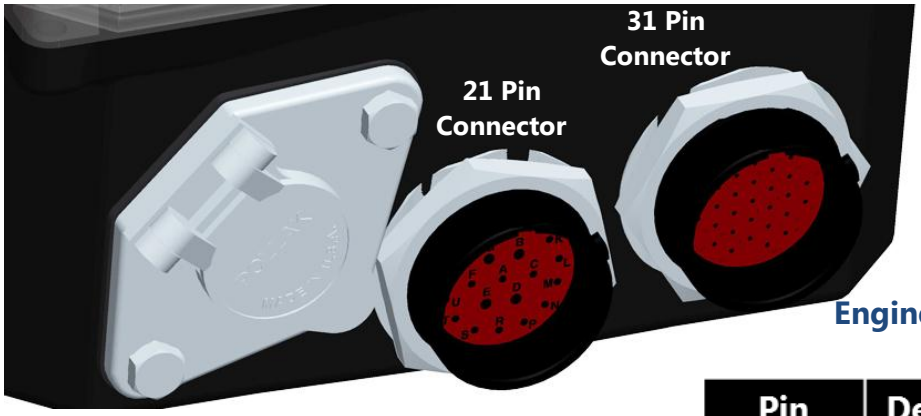
To minimize current draw, the panel goes into a sleep mode two minutes after being set in auto mode. In sleep mode, the display goes blank and the red lamp blinks once every ten seconds. The engine ECU is also turned off.

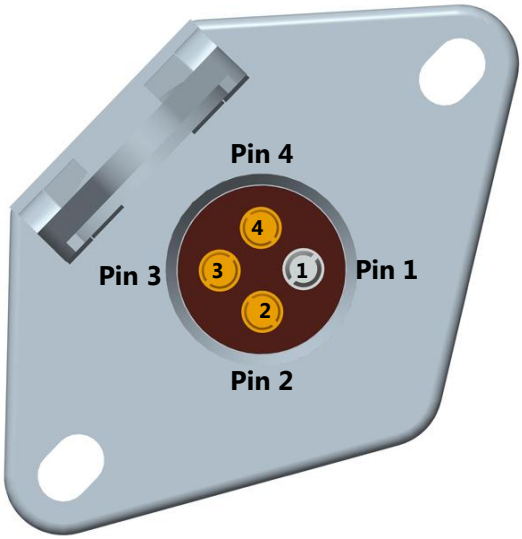
Upon receiving a signal from a float or transducer the panel wakes up, the display turns back on and normal operation commences.

Pushing any of the four buttons wakes up the panel and turns the display on. It will return to sleep mode after a two minute period.

For service purposes, to keep engine ECU powered, access the menu system. The engine ECU remains on when the menu system is active.

PANEL CONNECTORS





Dual Float Set Up

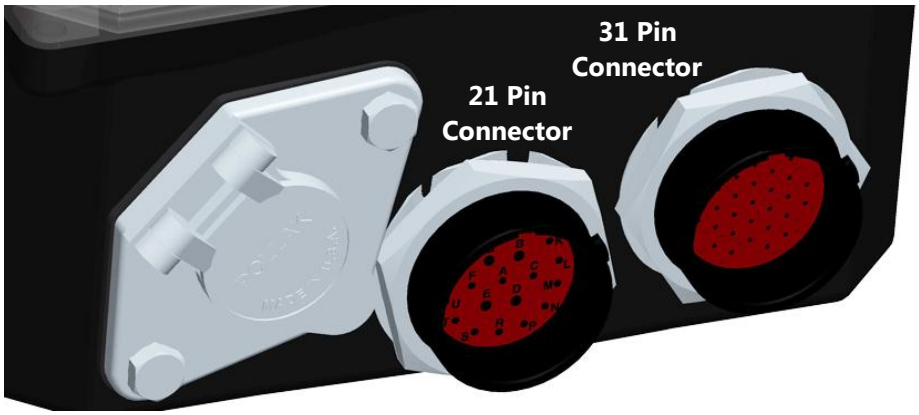
Pin 1 Low Float Common
Pin 2 Low Float Normally Open
Pin 3 High Float Normally Open
Pin 4 High Float Common

Single Float Set Up

Pin 1 Float Common
Pin 2 Not Used
Pin 3 Float Normally Open
Pin 4 Not Used

Engine Harness Connector
21 Pin

Pin	Description
A	OPEN
B	Battery Positive
C	MPU-
D	Crank Signal
E	Battery Negative
F	CAN Shield
G	Fuel Solenoid/ECU Signal
H	Temperature Sender Input
J	Alternator Excite
K	Speed Signal/MPU+
L	Pre Heat Signal
M	Throttle Down
N	Fuel Level Sender Return
P	Fuel Level Sender Input
R	OPEN
S	OPEN
T	OPEN
U	CAN Bus Low
V	CAN Bus High
W	Throttle Up
X	Oil Pressure Sender Input



Accessory Harness Connector
31 Pin

Pin	Description
3	Transducer Signal Input (A#1)
4	Discharge Pressure Input (A#2)
11	Suction Pressure Input (A#3)
13	Modbus A (DI#9)
14	Modbus B (DI#8)
15	Relay 8 Common
18	Low Water Level Input (DI#3)
19	Low Oil Level Alarm Input (DI#4)
20	Low Fuel Level Alarm Input (DI#5)
21	Emergency Stop Input (DI#6)
22	External Shutdown Input (DI#7)
23	Relay 8 N/O
26	CAN High
27	CAN Low
28	Discharge Pressure Battery Positive
29	Suction Pressure Battery Positive
30	Transducer Battery Positive
31	Transducer Battery Negative

TRANSITION HARNESS FOR MECHANICAL ENGINES

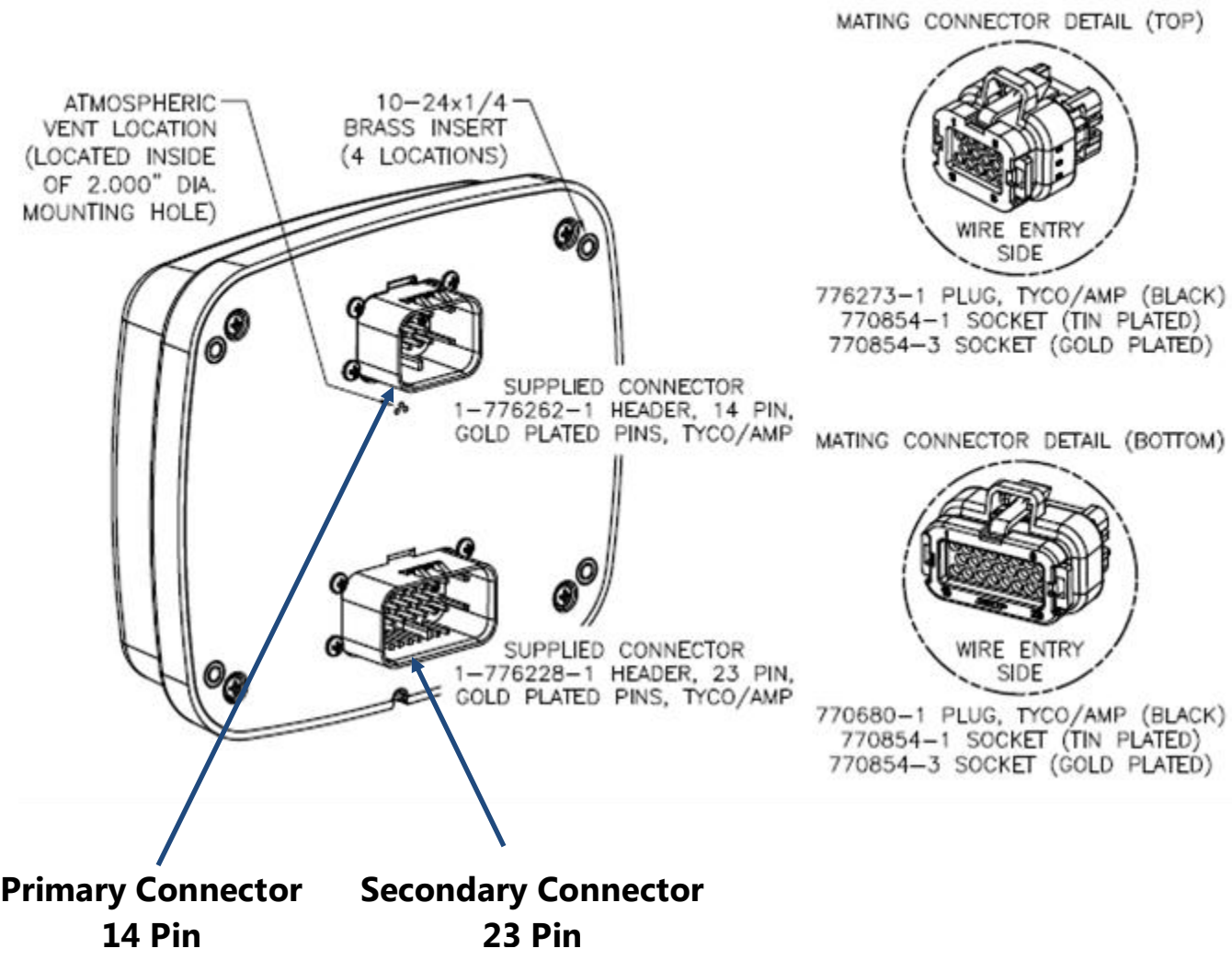
The accessory harness for mechanical engines is part number 29284-086. The harness goes from the 21 pin engine harness connector to a 16 pin engine harness connector.

Engine Harness Connector
16 Pin

29284-086
21 pin to 16 pin connector

Pin	Description
A	MPU-
B	Throttle Down
C	Oil Pressure Sender Input
D	Crank Signal
E	Throttle Up
F	Battery Negative
G	Alternator Excite
H	Temperature Sender Input
J	Pre Heat Signal
K	Fuel Level Sender Return
L	Fuel Level Sender Input
M	OPEN
N	OPEN
P	MPU+/Alternator Tach Signal Input
R	Fuel/Run Signal to Engine
S	Battery Positive

MODULE CONNECTORS



Primary Connector 14 Pin

Secondary Connector 23 Pin

Primary Connector (14 Pin)

Pin	Function	Pin	Function
1	Fuel Solenoid/ECU Signal	8	J1939 Low
2	Start Warning Signal	9	Battery Positive
3	Pre Heat Signal	10	Key Auto Detect
4	Battery Positive	11	Battery Positive
5	Crank Signal	12	Battery Negative
6	Battery Positive	13	Fuel Level Sender Input
7	J1939 High	14	Auto Start Input

CAUTION:
Maximum current draw for signal circuits is 5 amps

Secondary Connector (23 Pin)

Pin	Function	Pin	Function	Pin	Function
1	Throttle Up Output	9	Battery Positive	16	Throttle Down Output
2	Oil Pressure Input	10	Coolant Temperature Input	17	Low Float Input
3	Not Used	11	Suction Pressure Input	18	Low Water Level Alarm
4	Discharge Pressure Input	12	Not Used	19	Low Oil Level Alarm
5	Speed Sensor Input	13	Modbus A	20	Low Fuel Level Alarm
6	Not Used	14	Modbus B	21	Emergency Stop
7	Not Used	15	Battery Pos. (Horn Common)	22	External Shutdown
8	Pre Alarm/Alarm/Horn Output			23	Not Used (Relay 8 NO)

CAUTION:
Maximum current draw for signal/alarm circuits is 5 amps

ENGINE ALARMS, CODES AND MESSAGES

ENGINE ECU ALARMS/DE-RATE/SHUT DOWNS

It is important to understand panel operation with respect to engine safety protections, alarms, and fault codes. The panel operates with J1939 engines. These engines have an ECU (engine control unit) which is essentially a computer that runs the engine. When engine parameters are out of normal operating ranges, the ECU takes specific actions which can include the following:

1) Broadcast a trouble code
2) Broadcast a red or yellow lamp
3) De-rate the engine
4) Shut down the engine
5) Turn on alarm horn

It is the engine ECU that de-rates or shuts down the engine when it is not operating within normal parameters. This includes more common shut downs like high engine temperature and low oil pressure but can encompass a large range of parameters depending on the ECU.

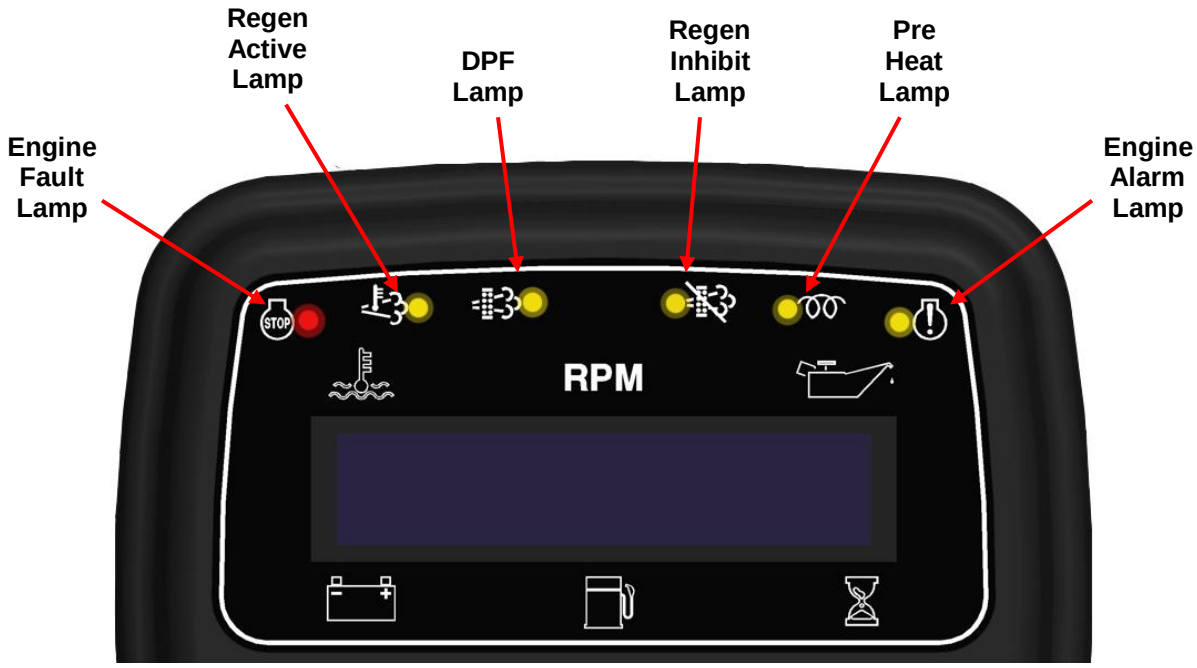
PANEL ALARM ANNUNCIATION AND CODE READER

This panel is configured to operate with standard J1939 engines where engine de-rate and shutdowns are managed by the engine ECU. The panel communicates with the engine ECU and serves as a trouble code reader. When the engine ECU broadcasts a trouble code (called an SPN.FMI code) the panel does the following:

1) Illuminates the appropriate LED indicator lamp
    a. Yellow Lamp = Alarm
    b. Red Lamp = Engine Shut Down
2) Displays the trouble code (standard SPN.FMI code)
3) Displays a code description on the LCD screen
4) Displays the occurrence count of the code

INDICATION LAMPS

The panel has six lamp indicators.



ACTIVE AND STORED ENGINE ECU CODES

The panel also provides the ability to check the engine ECU for all ACTIVE and STORED engine ECU codes. These codes can be viewed via the Active Codes and Stored Codes menus. In addition, the control panel has its own Alarm Event Log menu that shows the last 16 engine ECU alarms as well as any control panel specific alarms.

CONTROL PANEL SPECIFIC ALARMS AND SHUT DOWNS

The panel has its own engine safety alarms and shut downs that can be enabled. These alarms and shut downs are managed by the control panel independent from the engine ECU. The available options are listed below and can be accessed via the Engine Safety Configuration menu.

*The panel is shipped from the factory with the **highlighted** printed parameters enabled. The other parameters must be enabled to activate.*

Heading	Default	Range	Units
Sender Check Bypass	0:10	0:05 – 1:00	Min:Sec
Fuel Level Check	Off	Off / Always / Run	
Low Fuel Pre Alarm	20	0 - 100	%
Low Fuel Alarm	1	0 - 100	%
Fuel Alarm Delay	0:05	0:01 – 1:40	Sec
Oil Pressure Check	**Run**	Off / Always / Run	
Low Oil Press Pre Alarm	**15**	0 - 100	PSI
Low Oil Press Alarm	**10**	0 - 100	PSI
Oil Press Alarm Delay	**5**	0:01 – 1:40	Sec
Temperature Check	**Run**	Off / Always / Run	
Low Temp Pre Alarm	**0**	0 - 300	Deg F
Low Temp Alarm	**0**	0 - 300	Deg F
High Temp Pre Alarm	**220**	150 - 300	Deg F
High Temp Alarm	**230**	150 - 300	Deg F
Temp Alarm Delay	**0:05**	0:01 – 1:40	Min:Sec
Battery Volts Check	Off	Off / Always / Run	
Low Battery Pre Alarm	12.0	0.0 – 40.0	Volts
Hi Battery Pre Alarm	15.0	0.0 – 40.0	Volts
Over Speed Check	Off	Off / Always / Run	
Over Speed Alarm	3000	650 - 5000	RPM
Over Speed Alarm Delay	0:05	0:01 – 1:40	Min:Sec

1) Off / Always / Run – Describes when the parameter will be monitored for alarm conditions. Run refers to when the engine is running. Off disables the alarm conditions. Always enables the alarm constantly regardless of engine state.

2) Alarm Delay – The time period, after Sender Check Bypass, that the parameter must be on the alarm condition before the alarm becomes latched.

CONTROL PANEL ANALOG AND DIGITAL INPUTS

The panel provides the analog and digital inputs defined below.

*The panel is shipped from the factory with the **highlighted** inputs pre-wired and enabled in the panel. Inputs not in bold print need to be wired and enabled to be used.*

Analog Inputs

Input	Heading	Default	Connector	Pin
Fuel Level	Function	Fuel Level	21 Pin Connector	**P**
Oil Pressure	Function	Oil Pressure	21 Pin Connector	**X**
Engine Temperature	Function	Water Temperature	21 Pin Connector	**H**
Speed Sense	Function	Speed Sensor	21 Pin Connector	**K**
Flex Analog 2	Function	Suction Pressure 4-20mA	31 Pin Accessory Connector	11
Flex Analog 3	Function	Discharge Pressure 4-20mA	31 Pin Accessory Connector	4

Suction/Discharge Inputs
The suction and discharge monitoring must be turned "on" in the ***Quick Setup menu*** (or the ***Module Configuration menu***).

Digital Inputs

Input	Heading	Default	Connector	Pin
Digital 1	Normally	Open	Float Connector	**3**
	Function	High Float		
	Message	None		
	Check	Always		
Digital 2	Normally	Open	Float Connector	**2**
	Function	Low Float		
	Message	None		
	Check	Always		
Digital 3	Normally	Open	31 Pin Accessory Connector	**18**
	Function	Alarm		
	Message	Low Water Level		
	Check	Off		
Digital 4	Normally	Open	31 Pin Accessory Connector	**19**
	Function	Alarm		
	Message	Low Oil Level		
	Check	Off		
Digital 5	Normally	Open	31 Pin Accessory Connector	**20**
	Function	Alarm		
	Message	Low Fuel Level		
	Check	Off		
Digital 6	Normally	Open	31 Pin Accessory Connector	**21**
	Function	Alarm		
	Message	Emergency Stop		
	Check	Off		
Digital 7	Normally	Open	31 Pin Accessory Connector	**22**
	Function	Alarm		
	Message	External Shutdown		
	Check	Off		

CONTROL PANEL RELAY OUTPUTS

The panel provides the analog and digital inputs defined below. The relays are rated at 5 amps.

*The panel is shipped from the factory with the **bold** print outputs enabled and pre-wired in the panel.*

Relay	Heading	Default	Connector	Pin
Relay 1	**Function**	**Start Warning**	Internal Horn	N/A
	Polarity	Positive		
	Initial State	Off		
Relay 2	**Function**	**Fuel/Run**	21 Pin Connector	**G**
	Polarity	Positive		
	Initial State	On		
Relay 3	**Function**	**Pre Heat**	21 Pin Connector	**L**
	Polarity	Positive		
	Initial State	Off		
Relay 4	**Function**	**Crank**	21 Pin Connector	**D**
	Polarity	Positive		
	Initial State	Off		
Relay 5	**Function**	**Throttle Up**	21 Pin Connector	**W**
	Polarity	Positive		
	Initial State	Off		
Relay 6	**Function**	**Throttle Down**	21 Pin Connector	**M**
	Polarity	Positive		
	Initial State	On		
Relay 7	**Function**	**Pre-Alarm & Alarm**	Internal Horn	N/A
	Polarity	Positive		
	Initial State	Off		
Relay 8	**Function**	**Not Used**		
	Polarity			
	Initial State			

SUCTION & DISCHARGE TRANSDUCER WIRING

The panel is configured for suction and discharge transducers. Each is a two wire, 4-20mA transducer. The signal and power wires for each transducer is listed in the table below.

Transducer Specifications

Suction = 4-20mA (-30 in. of mercury to 30 psi)
Discharge = 4-20mA (0 to 300 psi)

31 Pin Module Connector	
Signal	**Pin**
Discharge Signal Input	**4**
Discharge Power	**28**
Suction Signal Input	**11**
Suction Power	**29**

Suction/Discharge Inputs

The suction and discharge monitoring must be turned "on" in the ***Quick Setup menu*** (or the ***Module Configuration menu***).

MENU SYSTEM

The menu system provides access to information and product settings and selections. It consists of two menu rings. The first is a viewing menu ring that provides access to engine codes, other engine information and product information. The second is a configuration (or settings) ring where settings and selections can be made. Both rings can be viewed without a password. A password is required to make changes in the configuration ring.

Menu Enter/Exit/Navigation

Below are the instructions for menu entry/exit, navigation and changing settings.

To Enter Menu System

Hold MENU button and press ENTER button.

Menu Navigation

Press MENU button to scroll menu options.

Press UP arrow button to enter menu.

Press DOWN arrow button to reverse.

Exit Menu System

Hold MENU button and press ENTER button.

To Change a Setting

Press ENTER button to bring up brackets [ ].

Press UP arrow button and DOWN arrow button to change setting.

Press ENTER button to make selection, brackets disappear.

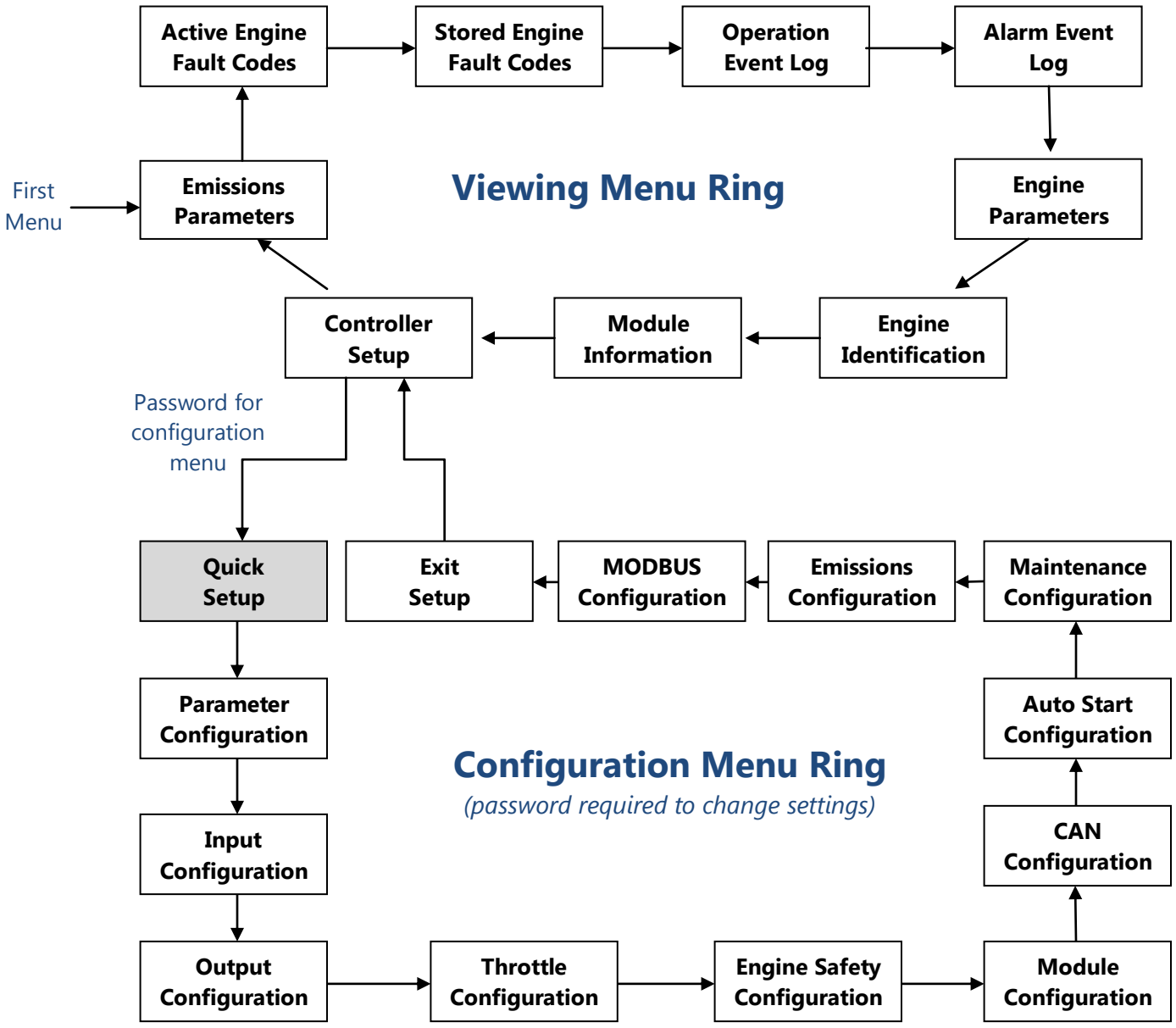
Recycle key to the OFF position after changing a setting.

Menu System Structure

The menu system consists of two menu rings:

Viewing Menu Ring – Menus for viewing alarms and engine information

Configuration Menu Ring – Menus for product settings and configuration



Viewing Menus

Emissions Parameters	Regen Options (Auto, Inhibit, Request)
	DPF Soot Load % View
	DPF Ash Load % View
	Time Since Last Regen View
	Regen Active/Not Active View
	Regen Inhibited/Not Inhibited View
	DPF Out Gas Temperature View
	DPF Differential Pressure View
Active Engine Fault Codes	View/Scroll Active Fault Codes
Stored Engine Fault Codes	View/Scroll Stored Fault Codes
Operation Event Log	View Last 32 Events (Start, Stop, Alarms)
Alarms Event Log	View Last 32 ECU and Controller Alarms)
Engine Parameters	View ECU Engine Information
	(% Load, Torque, Oil Temp, etc.)
Engine Identification	Engine Model # View
	Engine Serial # View
Module Information	Control Unit Part# View
	Control Unit Software Version View

Controller Setup	Quick Setup	(1)
(PASSWORD PROTECTED)	Parameter Configuration	(2)
	Input Configuration	(3)
	Output Configuration	(4)
	Throttle Configuration	(5)
	Engine Safety Configuration	(6)
	Module Configuration	(7)
	CAN Configuration	(8)
	Auto Start Configuration	(9)
	Maintenance Configuration	(10)
	Emissions Configuration	(11)
	MODbus Configuration	(12)

Individual Configuration menus listed on the following pages.

Configuration Menus

Quick Setup	Engine Type **(Mechanical)**
	Flywheel Teeth
	Preheat Time
	Warm Up Speed
	Prime Speed
	Operate Speed
	Cool Down Speed
	Suction/Discharge On/Off

Quick Setup	Engine Type **(Electronic)**
	Engine Manufacturer
	TSC Min Speed
	TSC Max Speed
	Warm Up Speed
	Prime Speed
	Operate Speed
	Cool Down Speed
	Suction/Discharge On/Off

Parameter Configuration	Engine Type **(Mechanical, Electronic)**
	Parameter Selection (Speed, Coolant Temp, Oil Pressure, Fuel Level,
	Voltage, Hourmeter, Inlet Pressure, Outlet Pressure)

Input Configuration	Digital Input 1 - Pre Set to High Float
	Digital Input 2 - Pre Set to Low Float
	Digital Input 3 - Low Water Alarm
	Digital Input 4 - Pre Set to Low Oil Alarm
	Digital Input 5 - Pre Set to Low Fuel Alarm
	Digital Input 6 - Pre Set to Emergency Stop
	Digital Input 7 - Pre Set to External Shutdown
	Digital Input 8 – Pre Set to MOD bus

Output Configuration	Relay Output 1 - Pre Set to Start Warning
	Relay Output 2 - Pre Set to Fuel/Run
	Relay Output 3 - Pre Set to Pre Heat
	Relay Output 4 - Pre Set to Crank Signal
	Relay Output 5 - Pre Set to Throttle Up
	Relay Output 6 - Pre Set to Throttle Down
	Relay Output 7 - Pre Set to Pre Alarm & Alarm
	Relay Output 8 Setup (Function, Polarity, Initial State)

Throttle Configuration	Throttle Type - Throttle Type Selection (Default = TSC Vernier)
	E-Throttle Mode Selection (Default = J1939 TSC)
	TSC Mode Selection (Default = Primary)
	TSC Min Speed Selection (Default = 800 rpm)
	TSC Max Speed Selection (Default = 2400 rpm)
	TSC Ramp Rate Selection (Default = 100rpm/sec)
	Throttle Curve Selection (Default = Linear)
	Multistate Speed 1 Selection
	Multistate Speed 2 Selection
	Multistate Speed 3 Selection
	Multistate Speed 4 Selection
	PWM Min Duty Cycle % Selection
	PWM Max Duty Cycle % Selection

Engine Safety Configuration	Sender Check Bypass Time Period Selection
	Fuel Level Check On/Off Selection
	Low Fuel Level Pre Alarm % Selection
	Low Fuel Level Alarm % Selection
	Fuel Level Alarm Delay Time Selection
	Oil Pressure Check On/Off Selection
	Low Oil Pressure Pre Alarm % Selection
	Low Oil Pressure Alarm % Selection
	Oil Pressure Alarm Time Delay Selection
	Engine Temperature Check On/Off
	Engine Temperature Pre Alarm Selection
	Engine Temperature Alarm Selection
	Engine Temperature Alarm Time Delay Selection
	Battery Volt Check On/Off
	Low Battery Volt Pre Alarm Selection
	High Battery Volt Pre Alarm Selection
	Over Speed Alarm On/Off
	Over Speed Alarm RPM Setting
	Over Speed Alarm Time Delay Selection

Module Configuration	English/Metric Selection (Default = English)
	Suction/Discharge On/Off (Default = Off)
	Clear Operation Log Yes/No
	Clear Alarm Log Yes/No

CAN Configuration	Source Address (Default = 44) Available 3, 17, 228, 4, 43, 44
	TSC1 Address (Default = 3) Available 3, 17, 228, 4, 43, 44
	Engine Address (0, 1, 2)
	Engine Mfr (Default = Deere) Available Cat, Cummins, Other
CAN bus transmit parameters	Speed Xmit (Default = Off) Transmit over CAN bus
	Temp Xmit (Default = Off) Transmit over CAN bus
	Oil Pressure Xmit (Default = Off) Transmit over CAN bus
	Fuel Level Xmit (Default = Off) Transmit over CAN bus
	Voltage Xmit (Default = Off) Transmit over CAN bus
	Hours Xmit (Default = Off) Transmit over CAN bus
	Suc/Dis Pressure Xmit (Default = Off) Transmit over CAN bus
	Faults Xmit (Default = Active Only) Transmit over CAN bus

Auto Start Configuration	Auto Start Delay (Default = 10 seconds)
	Pre Heat Time (Default = 0 seconds)
	Crank Time (Default = 10 seconds)
	Crank Rest Time (Default = 10 seconds)
	Warm Up Speed (Default = 800 rpm)
	Warm Up Time (Default = 10 seconds)
	Prime Speed (Default = 1000 rpm)
	Prime Time (Default = 10 seconds)
	Operate Speed (Default = 900)
	Cool Down Speed (Default = 800 rpm)
	Cool Down Time (Default = 10 seconds)
	Crank Cycles (Default = 5)
	Fault Bypass Period (Default = 10 seconds)
	Crank Hold Delay (Default = 0)
	Crank Release Speed (Default = 400 rpm)
Battery Recharge System Settings	Recharge Monitor (Default = Off)
	Recharge Voltage Selection (Default = 11.9 VDC)
	Recharge Delay Selection (Default = 60 seconds)
	Recharge Run Time Selection (Default = 15 minutes)
	Next Recharge Time Interval Selection (Default = 45 minutes)

Maintenance Configuration	Service Interval Message On/Off (Default = Off)
	Reset Interval Yes/No (Default = Off)
	Service Warning Hour Selection (Default = 0 hrs)
	Service Required Message Hour Selection (Default = 0 hrs)
	Next Service Warning Interval Selection (Default = 200 hrs)
	Next Required Message Hour Interval (Default = 250 hrs)
	1st Warning Service Hour Selection (Default = 75 hrs)
	1st Service Required Message Hours (Default = 100 hrs)

Emissions Configuration	TSC Regen Speed Selection (Default = 750 rpm)
	Allow Service Regen Yes/No (Deere Only) (Default = No)
	Regen Interlock On/Off (Default = Off)
	TSC Transmit On/Off (Default = On) (stop TSC to engine during regen)

MODbus Configuration	Baud Rate (Default = 9600)
	Parity (Default = Odd)
	Stop Bits (Default = 1)
	Slave Address (Default = 1)
	Enable Gauges (Default = No)
	Tachometer (Default = 0 - 3000 rpm)
	Engine Oil Temperature (Default = 100-250°F)
	Trans Oil Temperature (Default = 100-250°F)

COMMUNICATIONS

Panel information is available via CAN bus or MOD bus protocols.

MOD bus

Panel information is available via MOD bus protocol on pins 13 and 14 of the 31 pin accessory connector. Configuration settings for MOD bus communications are provided in the ***MOD bus Configuration menu***.

CAN bus

Panel information is available via CAN bus protocol on pins 26 and 27 of the 31 pin accessory harness connector. For mechanical engines, individual parameters such as engine speed, engine temperature and engine hours can be broadcast on to the CAN bus by the panel. Each parameter needs to be turned "On" individually in the ***CAN Configuration menu***.

Suction and discharge pressure can also be turned "On" to broadcast suction and discharge pressure onto the CAN bus.

BATTERY RECHARGE SYSTEM

The panel has the ability to monitor the engine battery system and take action if a low condition arises. The following settings are selectable and are accessed in the Auto Start Configuration menu.

Parameter	Default
Recharge Monitor	Off
Recharge @	11.9 VDC
Recharge Delay	60 Sec
Recharge Run for	15 Min
Next Recharge in	45 Min
Vbattery Trim	0.5 VDC

When the battery system monitor is enabled and the panel in Auto Start operation, battery voltage is monitored. If voltage drops below the "Recharge @" level for the "Recharge Delay" time, the engine is started and runs according to the automatic throttle settings. The engine runs for the "Recharge Run for" time period and then shuts down. Another low battery condition is triggered after the "Next Recharge in" period.

EMISSIONS MONITORING

EMISSIONS INFORMATION

The panel provides lamp indications, display messages and other emission related information. This information is broadcast from the engine ECU and is captured and displayed by the panel. The panel includes an ***Emissions Parameters viewing menu*** that allows the operator to view the following emissions related information.

Heading	Default	Range
DPF Soot Load	View Only	0 – 200%
DPF Ash Load	View Only	0 – 200%
Time Since Regeneration	View Only	# of Hours Since Last Regeneration
Regeneration Process	Current Status	Active or Not Active

REGENERATION PROCESS

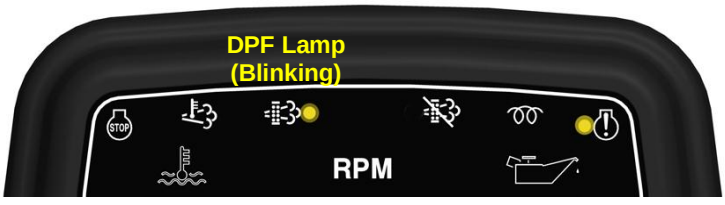
The regeneration process is controlled by the engine ECU. The engine ECU monitors emissions parameters such as soot level and ash level. For Deere engines, when the engine ECU determines that a regeneration is necessary, it initiates the regeneration process which requires the engine to operate at a designated speed for a designated period of time as determined by the engine ECU. The engine ECU communicates the need for a regeneration via the regeneration lamp on the panel.

When the engine ECU initiates a regeneration, the yellow DPF (Diesel Particulate Filter) lamp will illuminate with the display message shown above. The operator can press the ENTER button (for Yes) to allow the regeneration to initiate or the MENU button (for No) to delay the regeneration process to a later time. Answering "No" only delays the regeneration process. The regeneration lamp stays illuminated and regen request prompts continue as long as the engine ECU determines a regeneration is required

Over time, the engine ECU increases the level of severity through both lamp indications and display messages.

Levels of severity:

1) Lowest Level
2) Moderate Level
3) High Level
4) Warning Level
5) Service Regen Level



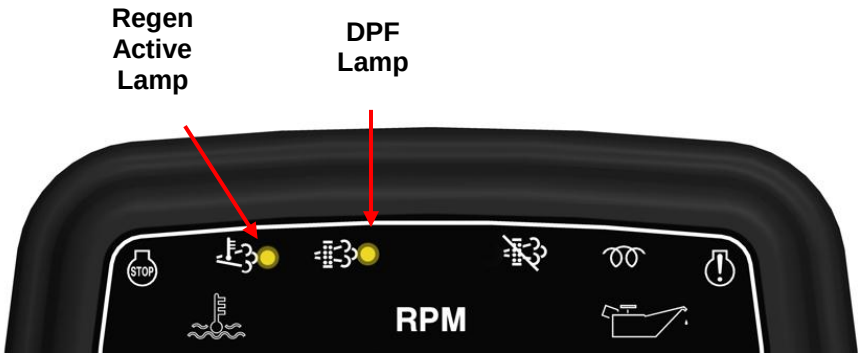
At the lowest level, the DFP lamp illuminates. As the levels increase, the DFP lamp begins to blink. As the levels continue to increase, the yellow alarm lamp illuminates.

At the most severe level, the DPF lamp blinks and the red engine alarm lamp illuminates.

STANDARD REGENERATION

If the operator selects ENTER for yes, the panel will show the "RPM May Increase" message and ask the operator to respond by pressing the MENU button for "no" or the ENTER button for "yes".

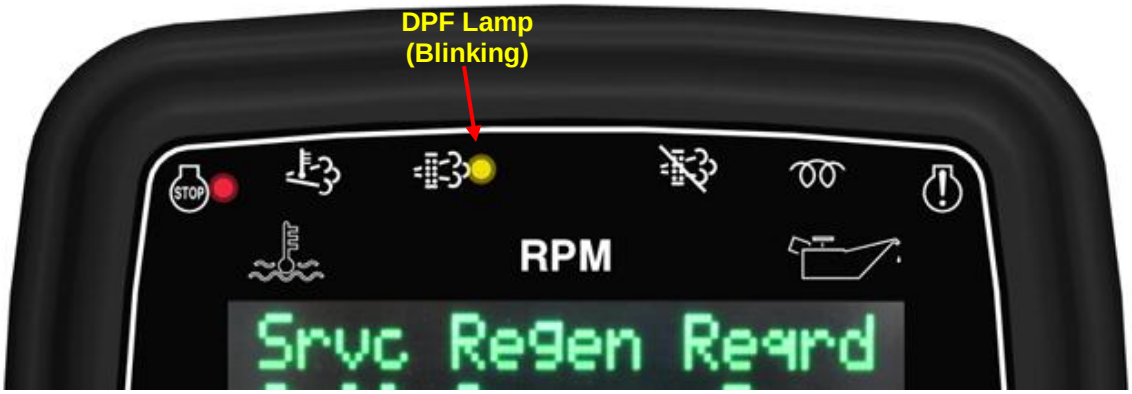
This interlock question is asked to make sure the operator is aware that the engine ECU may increase engine speed per the regeneration requirements.



The regeneration active lamp illuminates during the regeneration process. The DFP lamp stays illuminated until the engine ECU determines that a regeneration is no longer required.

SERVICE REGENERATION LEVEL

For Deere engines, the most severe level is the service regen level. At this level, the DFP lamp is blinking and the red alarm lamp illuminates. When the service level is reached, the engine ECU has determined that the situation is severe and a service regeneration is necessary. At the service regen level, the engine ECU may de-rate the engine or prevent it from starting and the message shown below appears on the display.



REGEN INHIBIT

The panel provides two methods for "inhibiting" a regeneration process. The first method is to answer "No" to the Regen Request message when it appears on the display. The second method is to select "Inhibit Regen" in the ***Emissions Configuration Menu*** (under Regen Options). The two available settings are "Auto" and "Inhibit Regen".

The "Auto" setting allows the engine ECU to initiate and control the regeneration process. The "Inhibit Regen" setting delays the regeneration process. The "Inhibit Regen" setting only delays the regeneration process until higher levels of severity are reached. At higher levels of severity, the engine ECU no longer accepts the "Inhibit Regen" message from the panel.

When the "Inhibit Regen" setting is selected, the inhibit lamp illuminates.

PIERCE PUMP
an FCX Performance Company

SECTION - 8

FACTORY TEST REPORT

Gorman-Rupp Company-Mansfield, Ohio

Test Record

Gorman-Rupp of Canada Limited

Test No.	LH0011855	Curve No.		Priming Test No.		Purpose:	Model No.	PAH16A60C-B-(C18)~
Page No.	1 Of 2	Date	1/18/2019	Remarks / Pictures		Pierce Pump Company, Inc., FCX Performar	SN.:Pump	1677516
Imp/Rotor	38614-802 11010			Diameter	IN	900 RPM Pump 1800 RPM Engine	Size: S x D	18" 16" IN
Width		E.T.O.		Face Cl.	STD STD IN	Certified test	Powered by	C18 Engine
		cast	print		Fr. Bk.		Driver SN.:	
Idler No.	NA			Vol / Hsg	38219-502 110			
Lift Station No.		Customer Order No.		4646961	G-R S.O. No.	C000308389		
Seal No.	25285-825	Liquid	WATER	Temp-Liquid (°F)	68.64			
Barometer	28.4 in-Hg			Temp-Room (°F)	73.06	Other Information	Certified test	

Stat. Lift 6.0 F SLC 2.94 F Spec. Gr. 1 [Flow Measured By 18" E&H (GPM.: Ethernet) Spec. Gr. 1]

Suct. Line - Vert. 10' of 18" pipe Elbow 90° GR LR Horiz. 4' of 18" pipe

PRESS. §	VAC. §	GAGE CORR. §	V.H. §	T.D.H. §	FLOW (GPM)	RPM	VOLTS	AMPS	kW	POWER FACTOR	DbA	COMMENTS	@ TORQUE	INPUT H.P.	NPSH-R	EFF.
190.8	0.90	1.10	0.00	191.0	27	1800										
186.9	1.00	1.10	0.06	187.1	2020	1800										
179.3	-7.10	1.10	0.24	187.7	4054	1800										
170.4	-9.50	1.10	0.56	181.6	6173	1800										
168.2	-10.20	1.10	0.62	180.1	6473	1800										
168.9	-10.30	1.10	0.66	181.0	6682	1800										
151.5	-12.90	1.10	1.21	166.7	9056	1800										

§ Pressure In Feet Unless Otherwise Stated # Flow In GPM Unless Otherwise Stated @ Torque In Foot Pounds Unless Otherwise Stated Test Run By **Jeff Baker**

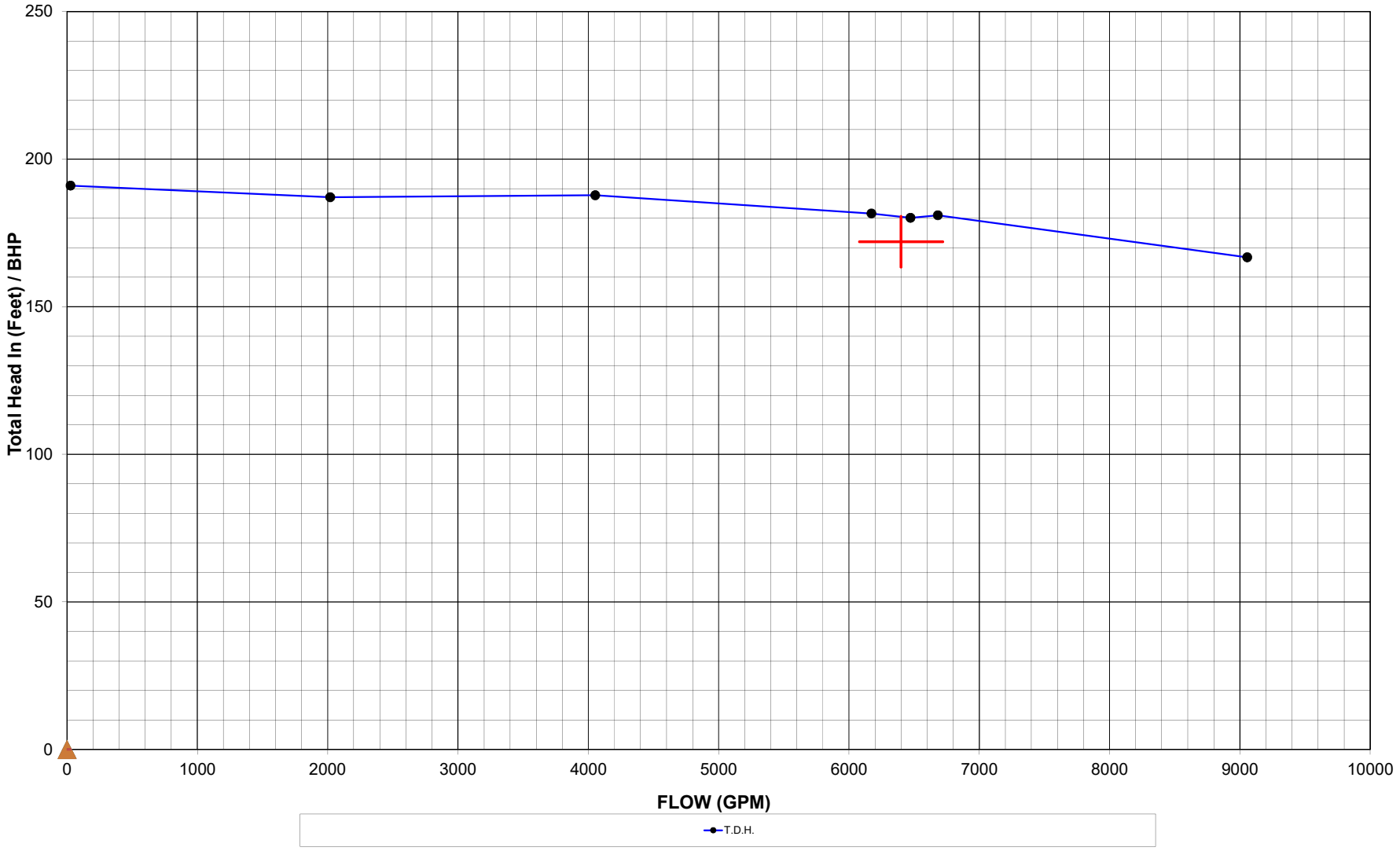
*Estimated Reading

CD 00281

Centrifugal Pump Performance Curve

The Gorman-Rupp Company - Mansfield, Ohio Gorman-Rupp Of Canada, Limited

Test No.	LH0011855	Curve No.		Purpose:	Pierce Pump Company, Inc., FCX Performance, Inc	Model No.	PAH16A60C-B-(C18)~	
Page	2 Of 2	Date	1/18/2019		900 RPM Pump 1800 RPM Engine	SN.:Pump	1677516	
Imp / Rotor No.	38614-802 11010	Diameter		Volute No.	38219-502 11010	Size	18" x	16"
Width		Face Cl.	Factory set Fr.	Factory set Bk.	Spec. Gr. 1	RPM	1800	
Lift Station No.		Customer Order No.	4646961		G-R S. O. No.	C000308389		



Test Run By: Jeff Baker

CD 00284

PIERCE PUMP
an FCX Performance Company

SECTION - 9

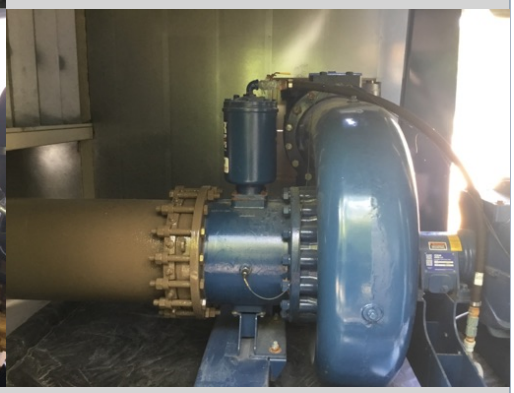
START UP REPORTS

PIERCE PUMP

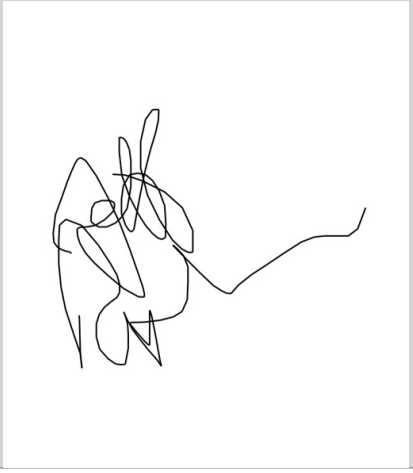
an FCX Performance Company

OUTSIDE PUMP REPAIR - Tuesday, September 24, 2019 12:02:02 PM (**JASON BENNETT**)	
User Name	JASON BENNETT
User #	4692516406
Form Started	9/24/2019 12:02:02 PM
Form Submitted	9/26/2019 7:25:11 AM
Date of Service	Tuesday, September 24, 2019
Order Number	2596138
Repair Site	Customer Site
Customer Name	Heritage Contractor
Location	Rockwall
Contact Info	
1 Name	James w/ H&H
Phone	806-336-0862
Reason for Service Call	Start up
Mfg	GR
Pump Data	

Description of Work Completed	Arrived on site. Checked in with customer. Looked over system, setup of skid, and controls. Once all prechecks were complete, customer had city divert all sewage to lift station. Pit approximately 2/3 full upon start up. Test ran unit for approximately thirty minutes and checked pressure and flow at different speeds. Per cat rep the engine ran perfect. All pumping operations good. Found customer supplied transducer bad. Electrician changed out transducer and works good. Only able to operate and test in hand today due to water supply. PPC will need to return at later date to complete a full auto start up test. Customer will contact ppc when ready. Left site.



	 
Labor enter below is for the work performed on the date of this form. Additional labor may be charged if additional service or work is performed. ****** PLEASE NOTE: LABOR IS CHARGED DOOR TO DOOR. ADDITIONAL TIME WILL BE CHARGED BASED ON TRAVEL TIME ***** Information reviewed by customer representative	YES
Labor Performed	
1 Tech Name	JB
Tech Number	48
Labor Type	Labor
Start Time	6:30:00 AM
End Time	2:30:00 PM
2 Tech Name	JB
Tech Number	48
Labor Type	Other
Other type of Labor description	OT
Start Time	2:30:00 PM
End Time	4:30:00 PM
Parts enter below is for any additional parts that are added to the order while at the job site. Additional parts may be charged if they are already on the order or fill additional service or work is performed. Information reviewed by customer representative	NO

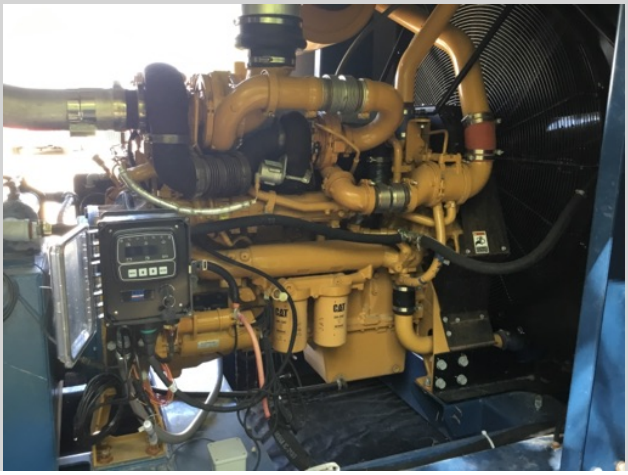
Parts added to order while on site	
Truck Charges for this form. Information reviewed by customer representative	YES
Truck Charges	
1 Truck Number	48
Zones	Zone 2
Is this the FINAL service form and is the Service Order complete?	NO
Pierce Pump Company Service Tech has reviewed service information above with the signature of the cusomer representative below.	YES
Customer representative signature. Please type name of customer represenative above the signature.	Jeff Reynolds 

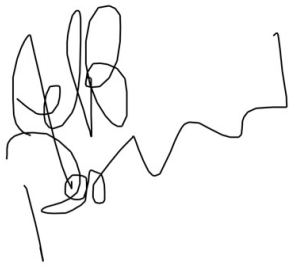
PIERCE PUMP

an FCX Performance Company

PUMP START UP - Tuesday, September 24, 2019 12:03:03 PM (**JASON BENNETT**)	
User Name	JASON BENNETT
User #	4692516406
Form Started	9/24/2019 12:03:03 PM
Form Submitted	9/26/2019 7:37:16 AM
DATE	Tuesday, September 24, 2019
ORDER NUMBER	2596138
REPAIR SITE	CUSTOMER SITE
CUSTOMER NAME	Heritage Contractor
LOCATION	Rockwall
CONTACT INFO	
Reason for Service Call	Start up
Pump MFG	GR
	
Pump Model	PAH16A60-B-C18~
Pump Serial Number	1677516N
Pump data	

Type of Pump (CC, Frm Mtd, split-case, in-line, etc)	DIESEL DRIVEN END SUCTION
IMP Dia	STD
Liquid being pumped	Sewage
Motor MFG	Caterpillar

Motor Model	BDN0218 
Motor Cat # or Spec #	Attached Data 
Motor Serial Number	472-81
Motor Data	
Voltage	Diesel
Enclosure	T-2
Amp Draw	
25%	
50%	
75%	
100%	
Static Pressure	
Suction	1.4’
Discharge	0
Dynamic Pressure	
Static	-10.4’ VACUUM @1750 RPM
Discharge	155’
Bearing Temp - Pump	
T1	
T2	
T3	
Bearing Temp - Motor	
T1	
Drive End	84

T2	
Drive End	109
T3	
Drive End	180
Coupler Temp	
Customer Representative Signature. Please type name of customer represenative above the signature	Jeff Reynolds 
Pierce Representative Signature. Please type name of Pierce represenative above the signature.	JB