Equipment Source Inc.

ES-PP60
6” Trailer-Mounted Pump

The high-volume, self-priming, mobile pumping solution that won’t quit.

- Pioneer Prime pump powered by Kubota diesel engine
- 2600 gpm flow rate with 3-inch solids handling
- Vacuum assisted, run-dry priming system
- Durable ESI trailer with built-in fuel tank

PUMPS

Kubota

PIONEER PUMP

PERFORMANCE THROUGH INNOVATION™

BUILT ARCTIC TOUGH

www.EquipmentSourceInc.com

Equipment Source Inc.

ES-PP60
6” Trailer-Mounted Pump

Pump
- Pioneer Prime series pump
- 6-inch suction and discharge flanges
- Maximum flow rate of 2600 gallons per minute
- 3-inch solids handling capabilities for application flexibility
- Up to 140-foot lift to move liquid to higher discharge points
- UltraPrime™ priming system with vacuum assist pump provides run-dry operation
- Automatic self-priming in cases of lost suction
- Heavy-duty construction for reduced maintenance costs
- High efficiency design for reduced fuel costs

Engine
- Kubota V3600T 4-cycle, turbocharged diesel engine
- Maximum shaft power of 70 hp
- DSE control panel for ease of operation and engine speed monitoring
- Optima Spiral Cell technology for superior starting performance

Trailer
- Powder coated trailer and components
- 115 gallon built-in fuel tank
- Rear drop legs for stability during operation
- Front stone guard to protect engine during transport

Specifications	
Connections	6” x 6” Class 150 ANSI flanges
Max flow rate	2600 gpm (9842 lpm)
Max solids handling	3” (76 mm)
Max lift	140’ (42 meters)
Max operating speed	2200 rpm
Fuel capacity	115 gal (435 L) ULSD
Fuel consumption	3.5 gph @ 2200 rpm (max) 2.3 gph @ 1800 rpm

Anchorage, AK
7780 Old Seward Hwy.
907-341-2250

Fairbanks, AK
1919 Van Horn Rd.
907-458-9049

Renton, WA
1010 SW 41st St.
425-251-6119

Williston, ND
5064 Bennet Loop
701-774-5312

PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

Service Parts Kits

Pump Models

PP66S10 SC66S10 VP66S10

The mechanical seal kit and bearing frame kit are offered separately. We recommend ordering both kits for a major service.

Both the Mechanical Seal and Bearing Frame kits include all of the O-rings needed for service.

Part Number	Description
372000105	Mechanical Seal Kit, includes O-rings
373000109	Bearing Frame Kit, includes O-rings

PN 372000105 Mechanical Seal Kit

Qty	Item #	Description
1	12721153	Shim 1.75 X .78 X .005
1	12721154	Shim 1.75 X .78 X .010
1	12721155	Shim 1.75 X .78 X .015
1	30148243	O-Ring, Seal Gland
4	30148273	O-Ring, Volute Suction Cover
1	30148336	O-Ring, Cleanout Cover
2	30148260	O-Ring, Bearing Plate
1	30148165	O-Ring, Bearing Cover
1	30148018	O-Ring, Volute
1	30400171	Seal
1	30500167	Lip Seal
1	37622075C225	Impeller Screw
1	11427176	Washer, Impeller
1	12211121	Key
1	34800104	P-80 Lubricant, 10ML
1	34800105	Loctite 263, 0.5ML

PN 373000109 Bearing Frame Kit

Qty	Item #	Description
1	12721104	Shim 6.68 X 5.69 X .005
1	12721105	Shim 6.68 X 5.69 X .010
1	12721106	Shim 6.68 X 5.69 X .015
1	31900121	Bearing
1	31900122	Bearing
2	34300113	Bearing Isolator
1	353005100196	Snap Ring
1	30148243	O-Ring, Seal Gland
2	30148273	O-Ring, Volute Suction Cover
1	30148336	O-Ring, Cleanout Cover
1	30148260	O-Ring, Bearing Plate
1	30148165	O-Ring, Bearing Cover
4	30148018	O-Ring, Volute
3	31858118	Tapered Rubber Plug

Service Parts Kits

Pump Models
PP66S10 SC66S10 VP66S10

Ordering Information

Parts Kits are in stock and available for shipment within 2 business days.
Please call or fax orders. Phone (503) 266-4115, Fax (503) 266-4116.
Email: Canbyparts@pioneerpump.com.

Part Number	Description
372000105	Mechanical Seal Repair Kit
373000109	Bearing Frame Repair Kit

Optional Parts

Additional parts for this model.

Model	Description	Part Number
66S10	Wear Ring	109026810
66S10	Impeller CA6NM SS	1123007610

Seal Installation Tool for 2.50” Shafts

66S10	Installation Tool	3671710236B

Notes:

1. Part numbers listed reflect updated part numbers as of Feb 1, 2015. Older documentation may have different part numbers. Please consult factory if differences appear.
2. Viton O-rings are included when available.

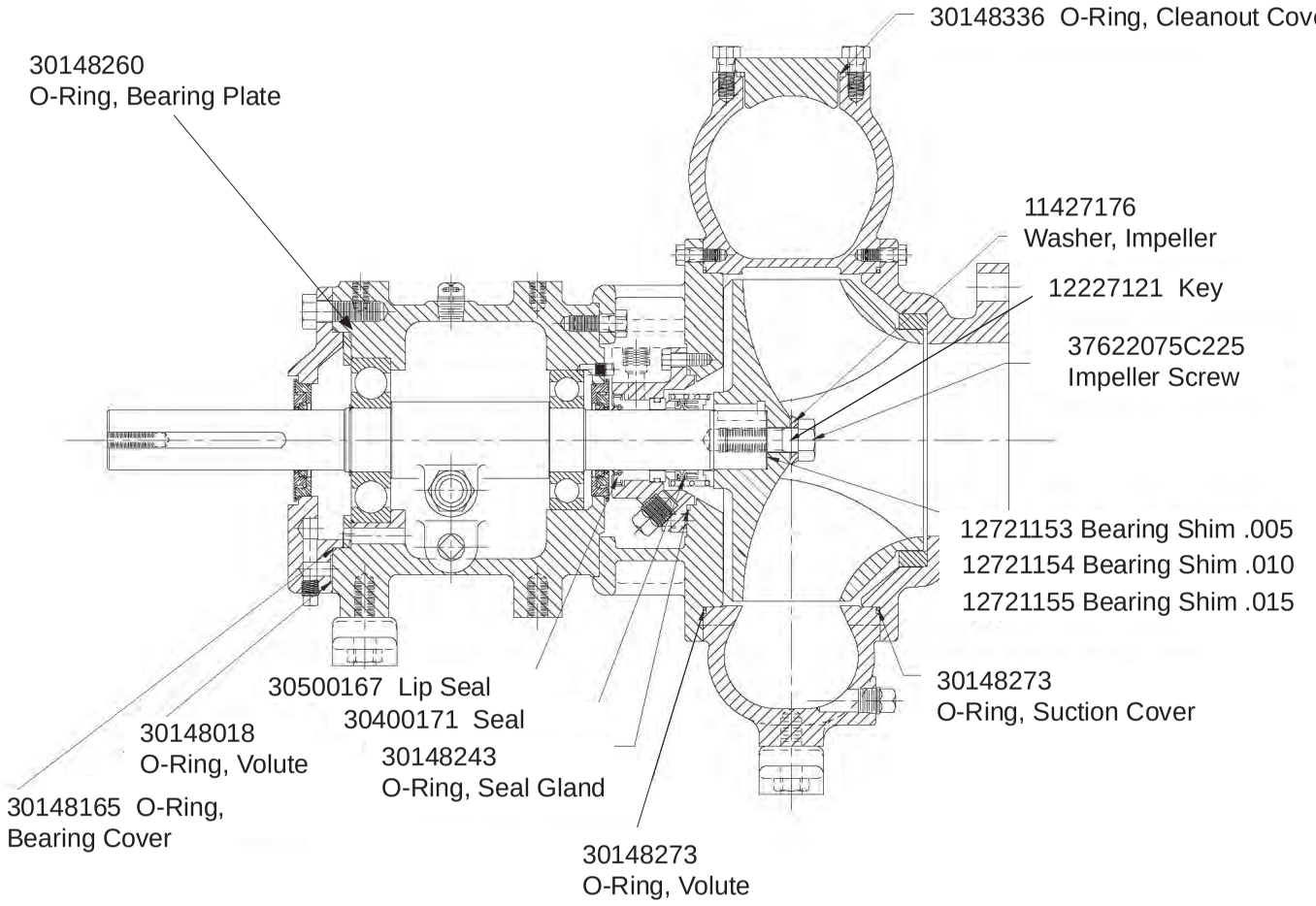
PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

310 South Sequoia Parkway, Canby, OR 97013 USA
Phone (503) 266-4115 ■ Fax (503) 266-4116
www.pioneerpump.com

Parts Drawing - 372000105 Mechanical Seal Parts Kit

Pump Models

PP66S10
SC66S10
VP66S10
Oil Lubricated



PN 372000105 Mechanical Seal Kit

Qty	Item #	Description
1	12721153	Shim 1.75 X .78 X .005
1	12721154	Shim 1.75 X .78 X .010
1	12721155	Shim 1.75 X .78 X .015
1	30148243	O-Ring, Seal Gland
4	30148273	O-Ring, Volute Suction Cover
1	30148336	O-Ring, Cleanout Cover
2	30148260	O-Ring, Bearing Plate
1	30148165	O-Ring, Bearing Cover
1	30148018	O-Ring, Volute
1	30400171	Seal
1	30500167	Lip Seal
1	37622075C225	Impeller Screw
1	11427176	Washer, Impeller
1	12227121	Key

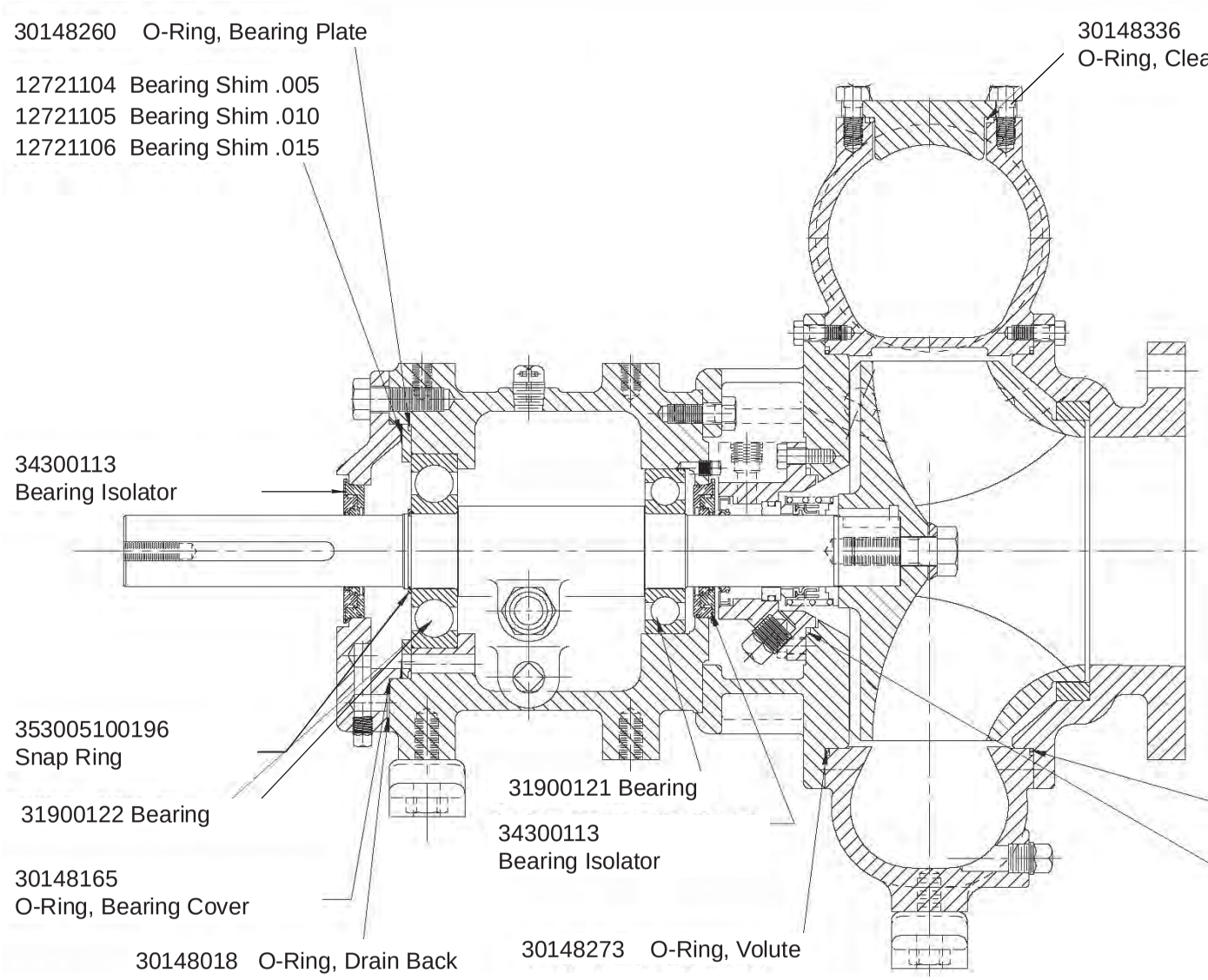
PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

310 South Sequoia Parkway, Canby, OR 97013 USA
Phone (503) 266-4115 ■ Fax (503) 266-4116
www.pioneerpump.com

Parts Drawing - 373000109 Bearing Frame Parts Kit

Pump Models

PP66S10
SC66S10
VP66S10
Oil Lubricated



PN 373000109 Bearing Frame Kit

Qty	Item #	Description
1	12721104	Shim 6.68 X 5.69 X .005
1	12721105	Shim 6.68 X 5.69 X .010
1	12721106	Shim 6.68 X 5.69 X .015
1	31900121	Bearing
1	31900122	Bearing
2	34300113	Bearing Isolator
1	353005100196	Snap Ring
1	30148243	O-Ring, Seal Gland
2	30148273	O-Ring, Volute Suction Cover
1	30148336	O-Ring, Cleanout Cover
1	30148260	O-Ring, Bearing Plate
1	30148165	O-Ring, Bearing Cover
4	30148018	O-Ring, Volute
3	31858118	Tapered Rubber Plug

PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

310 South Sequoia Parkway, Canby, OR 97013 USA
Phone (503) 266-4115 ■ Fax (503) 266-4116
www.pioneerpump.com

Operation

Recommended Fuel & Fueling Instructions

⚠CAUTION Do not overfill fuel tank, fuel tank should be filled to 90% of the full volume to allow for thermal expansion.

Use ULSD No. 1 or ULSD No. 2 for all machine models. For continuous duty operation, a daily refilling schedule should be established.

Access and Clearance

Ensure adequate clearance around the perimeter of the machine.

The operator should be able to walk around the machine with minimal obstruction

Leveling

Ensure the machine is placed on firm ground and the wheels are chocked, the pump should be close to level across the width of the machine.

Use the trailer jack and rear drop legs to stabilize the trailer

To adjust the drop legs:

- Remove the hitch pin
- Set leg height to a suitable position
- Re-insert the hitch pin to lock the drop leg in place

Once the trailer is stabilized, you can prepare the pump for startup

Pre-Startup Checklist

Use the following checklist to determine whether the machine can be safely started and operated:

- Machine is level on stable ground
- Wheels are chocked
- Exhaust is free of obstruction
- Adequate clearance around the perimeter of the machine
- Water is drained from fuel/water separator
- Engine oil and coolant levels are normal
- Fuel tank filled with recommended fuel type
- Ensure the ball valve on the vacuum prime assist is in the “open” position
- Ensure the throttle control is turned clockwise to idle

Startup

- Turn on the battery disconnect switch at the back of the control box
- Turn the key switch on the control panel to position I and wait for the glow plug light to turn off
- Turn the key switch to position II to start the engine
- Allow the engine to warm up for 5-10 minutes depending on outside temperature
- After the engine has warmed up, you may turn the throttle dial counterclockwise to increase RPM while monitoring the analog tachometer

Shutdown

- To shut down the pump, first return the throttle control to the idle position and allow the engine to run for 5 minutes before switching off the ignition & battery disconnect switch

Daily inspection

- Listen for abnormal sounds
- Check fluid levels
- Inspect fuel/water separator
- Check tire pressure
- Observe recommended maintenance schedule (see next page)

Maintenance schedule

Interval (Hours)	Maintenance Instruction	Notes
Daily	check primary fuel filter for water and drain as needed	
After first 50hrs	replace R60S (2 micron) primary fuel filter with R60T (10 Micron) Change oil and oil filter	SAE 10W-30 or 15W-40 (MIL-L-2104C or API classification CF or higher) **3.49 US gal (13.2L)**
Every 250hrs or 12 months	Check fan belt condition/tightness Check radiator hoses and clamps Check air intake hoses and clamps Clean air filter element	replace belt or hoses as necessary * clean air filter element with clean dry air on the inside of the element (pressure not to exceed 30psi)
Every 500hrs or 12 months	Change oil and replace oil filter Replace fuel filters & fan belt Inspect & clean water jackets Remove sediment from fuel tank	SAE 10W-30 or 15W-40 (MIL-L-2104C or API classification CF or higher) **3.49 US gal (13.2L)**
Every year	Replace air cleaner element Service trailer	
Every 1000hrs	Check valve clearance	Contact Kubota service rep
Every 1500hrs	Check fuel injection nozzle pressure	Contact Kubota service rep
Every 2 years	Change radiator coolant Replace hoses and band clamps (radiator, fuel & intake)	Flush the radiator 2-3 times with fresh clean water, fill 2.38US gal (9.0L) 50/50 Ethylene Glycol LLC

Engine Service

Refer to engine service manual for further instruction to complete routine service & troubleshooting

Pump Service

Refer to Pioneer Pump service manual for further instruction to complete routine maintenance

Trailer Service

General inspection guidelines

- Check tire pressure
- Test brake lights, turn signals and marker lights
- Test breakaway battery and charge if necessary
- Check condition of safety chains and jack stand
- Check tire condition and tightness of lug nuts
- Service wheel bearings and brakes every 12 to 24 months, this can be performed at any qualified trailer service center

Troubleshooting guide

Problem	Solution
Engine controller fails (no low oil pressure light when the key switch is turned to position I	* Check position of 12V disconnect * Check condition of battery * Check 40A fuse at starter terminal, replace if necessary * refer to 12V electrical schematic for a ground fault
Starter fails to engage	* Check fuel level *Check for water in fuel & drain completely if present *Check electric fuel pump. The pump should audibly engage when key switch is in Position I * Check engine preheat circuit. Circuit should draw 15-25A for up to 15 seconds when key switch is in position I * Check power supply to engine fuel solenoid
Engine stops after 20 seconds	* Check engine oil pressure switch * Check control panel for high temperature alarm. Check sensor for ground fault if active when the engine is cold
Engine fails from temp switch	* Check coolant level. CAUTION! Wait until the engine has cooled completely before opening the radiator cap * Check coolant condition * Check fan belt * Check sensor for ground fault

Maintenance Records

Machine Data

Machine Serial Number	
Engine Serial Number	
Pump Serial Number	

Maintenance Records

* Date * Engine Hours * Service Personnel * Service Location	Description of work completed

EQUIPMENT SOURCE INC.
LIMITED WARRANTY

WARRANTY INFORMATION

We warrant to you, the original purchaser, that all parts (except those 3rd party components listed below) of your new ESI product purchased from an Authorized ESI Distributer or from ESI directly will be free from defects in materials or workmanship for 1 (one) year/2,000 hours (whichever occurs first) from invoice date. Additional component warranties are listed below.

Summary of major component warranties (see component sections of this manual for further details and additional warranties):

1. Engine – 2 years/2,000 hours, whichever occurs first (please refer to the Kubota Engine Warranty sheet enclosed in this manual)
2. Pump – 1 year (please refer to the pump warranty sheet enclosed in this manual), wear parts are not covered under warranty.

In order to obtain warranty repairs, you must deliver the product, at your expense, together with proof of purchase to 1919 Van Horn Road, Fairbanks, AK 99701 or 7780 Old Seward Highway, Anchorage, AK 99518. Offsite warranty may be performed if customer pays all travel expenses.

WHAT THE WARRANTY DOES NOT COVER

This warranty **does not** cover:

1. Damage, malfunction or failures resulting from accidents, abuse, misuse, modifications, alteration, improper servicing or lack of performance of required maintenance service voids the warranty including but not limited to regularly scheduled oil changes and filter changes.
2. Normal maintenance services or replacement of maintenance items such as light bulbs, preheater plugs, filter elements, lubricants, oils, coolant, belts, tires, or other wear items.
3. 3rd party parts installed on ESI products. Unauthorized modifications to the unit will void the warranty and may impair function.
4. Use of the unit for application other than what the product was meant for voids the warranty.
5. Warranty coverage expires whenever the client, for whatever reason, is late in payment.
6. The warranty does not cover repairs or modifications for small oil weeps on Long Run Oil Tanks (if installed). A small amounting of weeping during break in is expected and does not warrant repairs.

LIMITATION ON OUR RESPONSIBILITY

Our responsibility for any and all losses and damages resulting from any cause whatsoever, including our negligence, alleged damage or defective goods, whether such defects are discoverable or latent, shall be limited to the repair or replacement of defective parts. IN NO EVENT WILL ESI BE LIABLE FOR LOSS OF USE, LOSS OF PROFITS, LOSS OF OR DAMAGE TO OTHER PROPERTY, INCONVENIENCE, COMMERCIAL LOSS, ENVIRONMENTAL CLEANUP OR OTHER SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER. ESI will in no event be liable for fuel, oil, coolant or other spills or cleanup regardless of cause or fault. Proper containment and monitoring is the responsibility of the end user.

OPERATION & SAFETY REQUIREMENTS

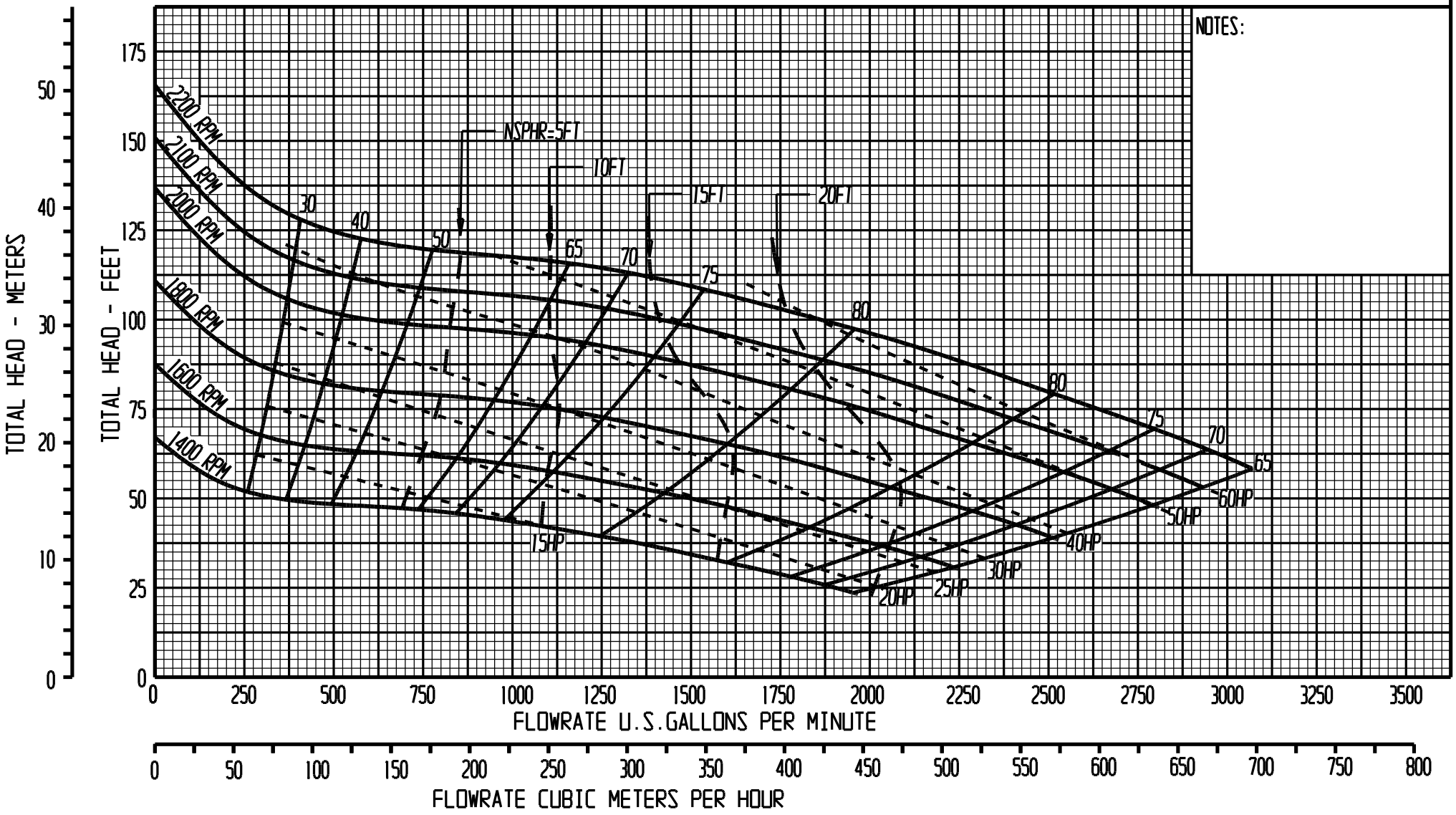
Failure to adhere to these requirements will void all warranties.

- Read and understand carefully all components of the Operator's Manual prior to starting or operating the unit.
- All equipment must be monitored daily (or more frequently if indicated in the Operation Manual). Monitoring can be achieved via electronic monitoring systems for remote

installations (unless otherwise noted in the Operation Manual).

- Learn how to operate and work safely. Know your equipment and its limitations. Always keep the engine in good condition.
- Disconnect the trailer from the tow vehicle and place wheel chocks behind the wheels prior to running or operating the unit.
- Do not carry out maintenance on a running or hot unit. Keep hands away from moving parts.
- Do not climb on top of the unit to perform work of any kind.
- When lifting the unit, ensure that the lifting device is rated for the unit weight. Only lift the unit with provided lifting rings or fork pockets.
- In case of emergency, shut off the engine and notify the person in responsible charge.
- Follow all applicable laws and regulations regarding operation and maintenance of the unit.
- Ensure that the trailer is registered with an applicable transport authority before towing.
- Refer to the various component sections of the Operator's Manual for proper maintenance and service intervals.

MODEL: SC66S10	SIZE: 6" x 6"	IMPELLER DIA. 10"	SPEED: VARIOUS RPM	SOLIDS SIZE: 3.0"



DATE: 03/17/2010	MODEL: SC66S10

PIONEER PUMP, INC.	PIONEER PRIME SERIES	DWG NO. A7488HQ-REV.001

DSEGenset

DSE402 MKII
WATERPROOF MANUAL/AUTO START CONTROL MODULE

FEATURES

The DSE402 MKII is a waterproof Manual/Automatic Start Control Module designed for genset and other applications. The module is designed to start and stop the engine via a manual waterproof key switch on the front panel. It will provide a number of engine protections, automatically shutting down the engine on detection of a fault condition. Provision is also made for an overspeed shutdown from either the MPU or AC Hz (to be specified on ordering).

First-up shutdown alarm is indicated by a steady red LED.

ENVIRONMENTAL TESTING STANDARDS

ELECTRO MAGNETIC COMPATIBILITY
BS EN 61000-6-2
EMC Generic Immunity Standard for the Industrial Environment
BS EN 61000-6-4
EMC Generic Emission Standard for the Industrial Environment

ELECTRICAL SAFETY
BS EN 60950
Safety of Information Technology Equipment, including Electrical Business Equipment

TEMPERATURE
BS EN 60068-2-1
Ab/Ae Cold Test -30°C
BS EN 60068-2-2
Bb/Be Dry Heat +70°C

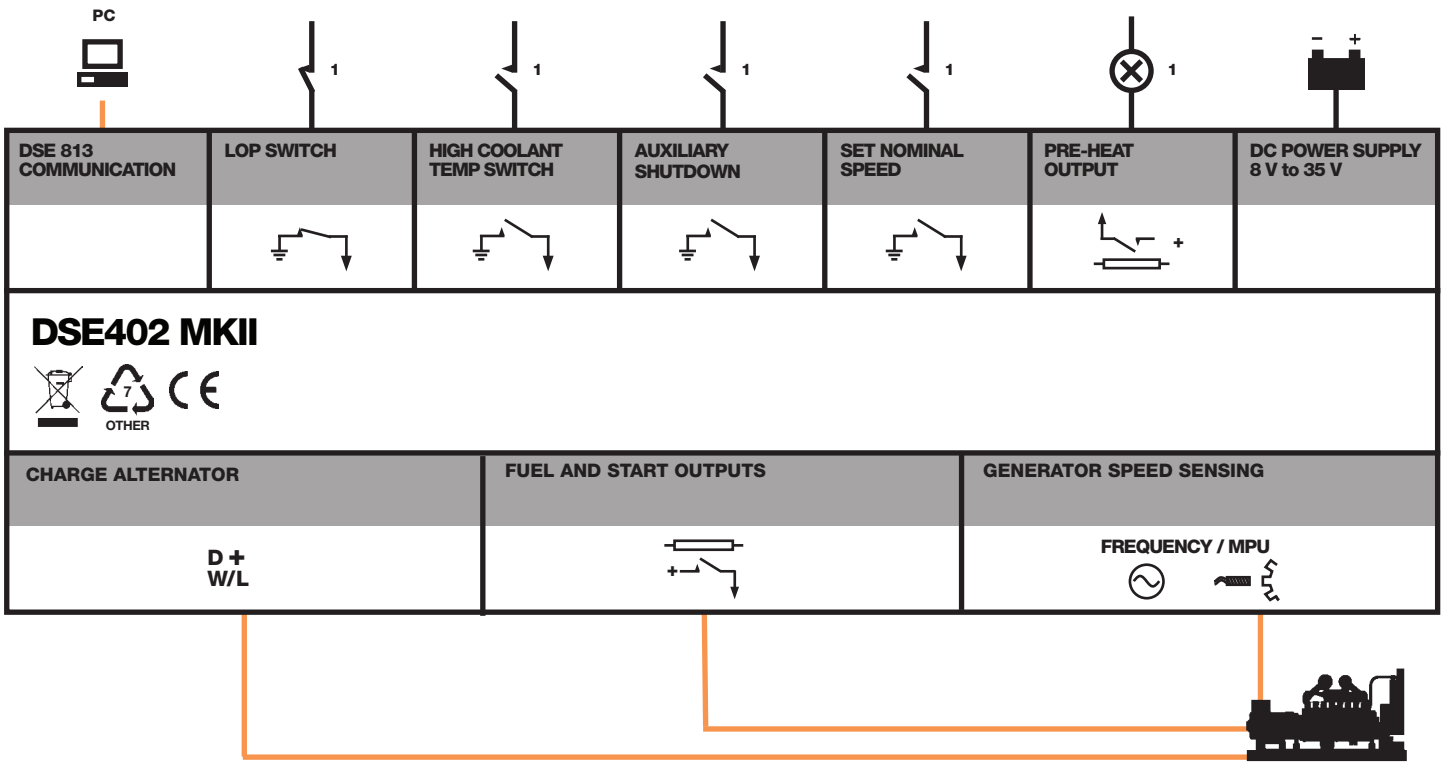
VIBRATION
BS EN 60068-2-6
Ten sweeps in each of three major axes
5Hz to 8Hz @ +/-7.5mm, 8Hz to 500Hz @ 2gn

HUMIDITY
BS EN 60068-2-30
Db Damp Heat Cyclic 20/55°C @ 95% RH
48 Hours
BS EN 60068-2-78
Cab Damp Heat Static 40°C @ 93% RH
48 Hours

SHOCK
BS EN 60068-2-27
Three shocks in each of three major axes
15gn in 11mS

DEGREES OF PROTECTION PROVIDED BY ENCLOSURES
BS EN 60529
IP66

COMPREHENSIVE FEATURE LIST TO SUIT A WIDE VARIETY OF GEN-SET APPLICATIONS



ISSUE 1

DSEGenset

DSE402 MKII
WATERPROOF MANUAL/AUTO START CONTROL MODULE

FEATURES

KEY FEATURES

- Key start
- Low oil pressure protection
- High engine temperature protection
- Auxiliary shutdown
- PC configurable via DSE813 interface and DSE Configuration Suite PC Software
- Automatic engine pre-heat
- Overspeed protection

KEY BENEFITS

- IP66 rating makes this module ideal for outdoor use
- Potted electronics prevents vibration and water damage
- Licence-free PC Software
- User friendly set up and fascia layout
- Uses DSE Configuration Suite PC Software for simple configuration

SPECIFICATION

DC SUPPLY

CONTINUOUS VOLTAGE RATING
8 V to 35 V continuous

CRANKING DROPOUTS
Able to survive 0 V for 50 mS, providing supply was at least 10 V before dropout and supply recovers to 5 V. This is achieved without the need for internal batteries.

MAXIMUM OPERATING CURRENT
120 mA at 12 V, 170 mA at 24 V

TYPICAL OPERATING CURRENT
60 mA at 12 V, 75 mA at 24 V
In stop position consumption is zero.

CHARGE/FAIL EXCITATION RANGE
0 V to 35 V

OUTPUTS

FUEL
15 A DC at supply voltage

START
15 A DC at supply voltage

PRE-HEAT
2 A DC at supply voltage

DIMENSIONS

OVERALL
157 mm x 111 mm x 60 mm
6.2” x 4.4” x 2.4”

PANEL CUT-OUT
132 mm x 84 mm

STORAGE TEMPERATURE RANGE
-40°C TO +85°C

OPERATING TEMPERATURE RANGE
-30°C TO +70°C

RELATED MATERIALS

TITLE	PART NO’S
DSE402 MKII Installation Instructions	053-087
DSE402 MKII Operator Manual	057-137
DSE402 MKII Configuration Suite Lite Software Manual	057-138
DSE813 USB Communications Adaptor Data Sheet	055-100

DEEP SEA ELECTRONICS PLC UK
Highfield House, Hunmanby Industrial Estate, Hunmanby YO14 0PH
TELEPHONE +44 (0) 1723 890099 **FACSIMILE** +44 (0) 1723 893303
EMAIL sales@deepseaplc.com **WEBSITE** www.deepseaplc.com

DEEP SEA ELECTRONICS INC USA
3230 Williams Avenue, Rockford, IL 61101-2668 USA
TELEPHONE +1 (815) 316 8706 **FACSIMILE** +1 (815) 316 8708
EMAIL sales@deepseausa.com **WEBSITE** www.deepseausa.com

Registered in England & Wales No.01319649
VAT No.316923457

055-097/4/11(2) US

DEEP SEA ELECTRONICS PLC
DSE402 MKII WATERPROOF KEYSTART CONTROLLER

Document number 057-137

Author : Paul Gibbons

Deep Sea Electronics Plc
Highfield House
Hunmanby
North Yorkshire
YO14 0PH
ENGLAND

Sales Tel: +44 (0) 1723 890099
Sales Fax: +44 (0) 1723 893303

E-mail: sales@deepseaplc.com
Website: www.deepseaplc.com

DSE Model DSE402 MKII WATERPROOF KEYSTART CONTROLLER Operators Manual

Amendments since last publication

Issue no.	Comments
1	First Release
2	Amended dimensions of Panel cut out & drawing dimensions

Clarification of notation used within this publication.

NOTE:	Highlights an essential element of a procedure to ensure correctness.
CAUTION!	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
WARNING!	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

TABLE OF CONTENTS

Section **Page**

1 BIBLIOGRAPHY

This document refers to and is referred to by the following DSE publications which can be obtained from the DSE website www.deepseaplc.com

1.1 INSTALLATION INSTRUCTIONS

Installation instructions are supplied with the product in the box and are intended as a 'quick start' guide only.

DSE PART	DESCRIPTION
053-087	DSE402 MKII Installation Instruction

1.2 MANUALS

DSE PART	DESCRIPTION
057-138	DSE402 MKII Configuration Suite Lite Software Manual

2 INTRODUCTION

This document details the installation and operation requirements of the DSE 402 MKII controller is part of the DSEGenset ® range of products.
The manual forms part of the product and should be kept for the entire life of the product. If the product is passed or supplied to another party, ensure that this document is passed to them for reference purposes.
This is not a *controlled document.* You will not be automatically informed of updates. Any future updates of this document will be included on the DSE website at www.deepseaplc.com

The model 402 is a waterproof key start controller. The controller is used to start and stop a engine, indicating fault conditions, automatically shutting down the engine for configured conditions and indicating the engine fault by a steady (WARNING) Shutdown (FLASHING) red LED.

Operation of the module is via a 3 position 'waterproof' key-switch with STOP (O), RUN (I) and START (II) positions. Turning the switch to the 'I' position will initiate a pre-heat relay . Pre-heat operation is indicated by a LED. Once the timer has expired the pre-heat relay will de-energise and the LED will extinguish. The preheat timer output can be configured.

The FUEL relay will then energise and on crank disconnect the Safety On delay timer will commence.

Pre-heat mode can be overridden at any time by turning the switch from the 'I' position to the 'II' position while the preheat LED is illuminated.

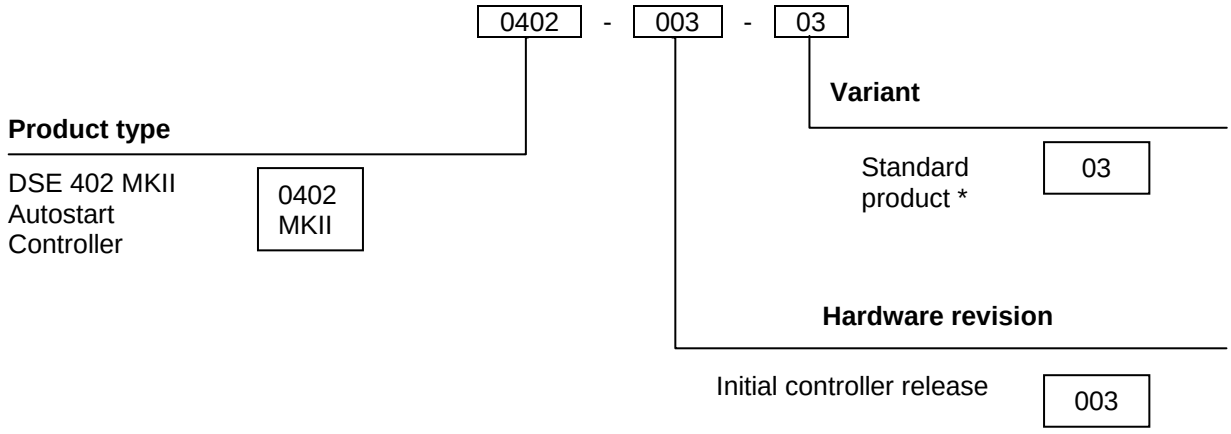
The Model 402 as described above can be configured for (AUTO), when the key position is left in RUN (I) a remote switch can be operated away from the controller to start and stop the engine.

Using a PC and the Configuration Suite Lite software along with the P813 interface allows configuration of selected operational sequences.

The Model 402 is resin encapsulated in a robust plastic case, designed for front panel mounting and supplied with a silicone seal to give IP 66 protection for the front of controller. Connections are via locking plug to Key switch and ¼ inch spade connectors.

3 SPECIFICATIONS

3.1 PART NUMBERING



* Standard product is Magnetic Pickup that can also be configured to sense frequency Hz or RPM using P813 interface and DSE Configuration Suite Lite software.

At the time of this document production, there are no variants of DSE402 MK II product.

3.2 TERMINAL SPECIFICATION

Connection type	Two part connector. • Male part fitted to controller • Female part is via ¼" Crimp Connectors (not supplied)
Minimum cable size	0.5mm² (AWG 24) (check crimp specification)
Maximum cable size	2.5mm² (AWG 10) (check crimp specification)

3.3 POWER SUPPLY REQUIREMENTS

Minimum supply voltage	8V continuous
Cranking dropouts	Able to survive 0V for 50mS providing the supply was at least 10V before the dropout and recovers to 5V afterwards. This is more than sufficient to allow the controller to operate during engine cranking where the battery supply often falls as low as 4V (on a 12V system!) This is achieved without the need for internal batteries or other external requirements.
Maximum supply voltage	35V continuous (60V protection for surges)
Reverse polarity protection	-35V continuous
Maximum operating current	170mA at 24V 120mA at 12V
Maximum standby current	In stop position consumption is zero

3.4 INPUTS

Number	(4) Auxiliary, Oil Pressure, Coolant Temp, Set Nominal Speed
Arrangement	Contact between terminal and ground
Low level threshold	2.1V minimum
High level threshold	6.6V maximum
Maximum input voltage	+50V DC with respect to plant supply negative
Minimum input voltage	-24V DC with respect to plant supply negative
Contact wetting current	2.5mA typical
Open circuit voltage	12V typical

3.4.1 FREQUENCY SENSING INPUT HZ , RPM

Measurement type	Frequency
Input Impedance	900K Ω ph-N
Phase to Neutral	15V to 333V AC (max)
Minimum frequency	3.5Hz
Maximum frequency	75.0Hz
Frequency resolution	0.1Hz
Frequency accuracy	±0.2Hz

3.4.2 MAGNETIC PICKUP

Type	Differential input
Minimum voltage	0.6V RMS
Max common mode voltage	±2V
Maximum frequency	10,000Hz
Resolution	6.25 RPM
Accuracy	±25 RPM

NOTE : DSE can supply a suitable magnetic pickup device, available in two body thread lengths :
DSE Part number 020-012 - Magnetic Pickup probe 5/8 UNF 2½" thread length
DSE Part number 020-013 - Magnetic Pickup probe 5/8 UNF 4" thread length

Magnetic Pickup devices can often be 'shared' between two or more devices. For example, one device can often supply the signal to both the DSE402 MKII speed switch and the engine governor. The possibility of this depends upon the amount of current that the magnetic pickup can supply.

3.5 CHARGE FAIL INPUT/OUTPUT

Minimum voltage	0V
Maximum voltage	35V (plant supply)
Resolution	0.2V
Accuracy	±1% of max measured voltage (±0.35V)
Excitation	Active circuit constant power output
Output Power	2.5W Nominal @12V and 24V
Current at 12V	210mA
Current at 24V	104mA

The charge fail input is actually a combined input and output.
Whenever the generator is required to run, the terminal provides excitation current to the charge alternator field winding.
When the charge alternator is correctly charging the battery, the voltage of the terminal is close to the plant battery supply voltage. In a failed charge situation, the voltage of this terminal is pulled down to a low voltage. It is this drop in voltage that triggers the *charge failure* alarm. The level at which this operates and whether this triggers a warning or shutdown alarm is configurable using the DSE Config Suite Lite Software.

3.6 OUTPUTS

3.6.1 FUEL (A), CRANK (B),

Type	Normally used for Preheat, Fuel and Start outputs.
Rating	15A resistive @ 35V

3.6.2 PRE-HEAT

Type	configurable output (Common Alarm, Energise to stop, Pre-heat)
Rating	2A resistive @ 35V

4 PC CONFIGURATION

P813 Interface	USB2.0 Device for connection to PC running DSE configuration suite Lite only Max distance 6m (yards)

4.1.1 PC COMMUNICATION

Using the DSE (P813 interface lead package available from Deep Sea PLC) with all the below items, the DSE 402 MKII controller can be connected to a computer to enable simple configuration of parameters. Connection details can be seen in the DSE 402 MKII Configuration Suite Lite software manual (Part no 057-138).

To connect a DSE402 MKII controller to a PC by USB, the following items are required:

- DSE402 MKII Controller

- P813 PC Interface (USB) DSE Part number 016-125

- DSE 402 MKII DSE configuration Suite Lite software
- Available from the DSE Website www.deepseaplc.com
- The software CD will be supplied with the P813 PC Interface (USB)

NOTE:- The DC supply must be connected to the controller for configuration by PC.

NOTE:- Refer to DSE402 MKII PC Software Manual (DSE part) for further details on connecting the P813 to the controller and PC.

4.2 DIMENSIONS AND MOUNTING

4.2.1.1 DIMENSIONS

158 mm x 112 mm x 87 mm*
(6.2” x 4.4” x 3.4”*)
* excluding key switch

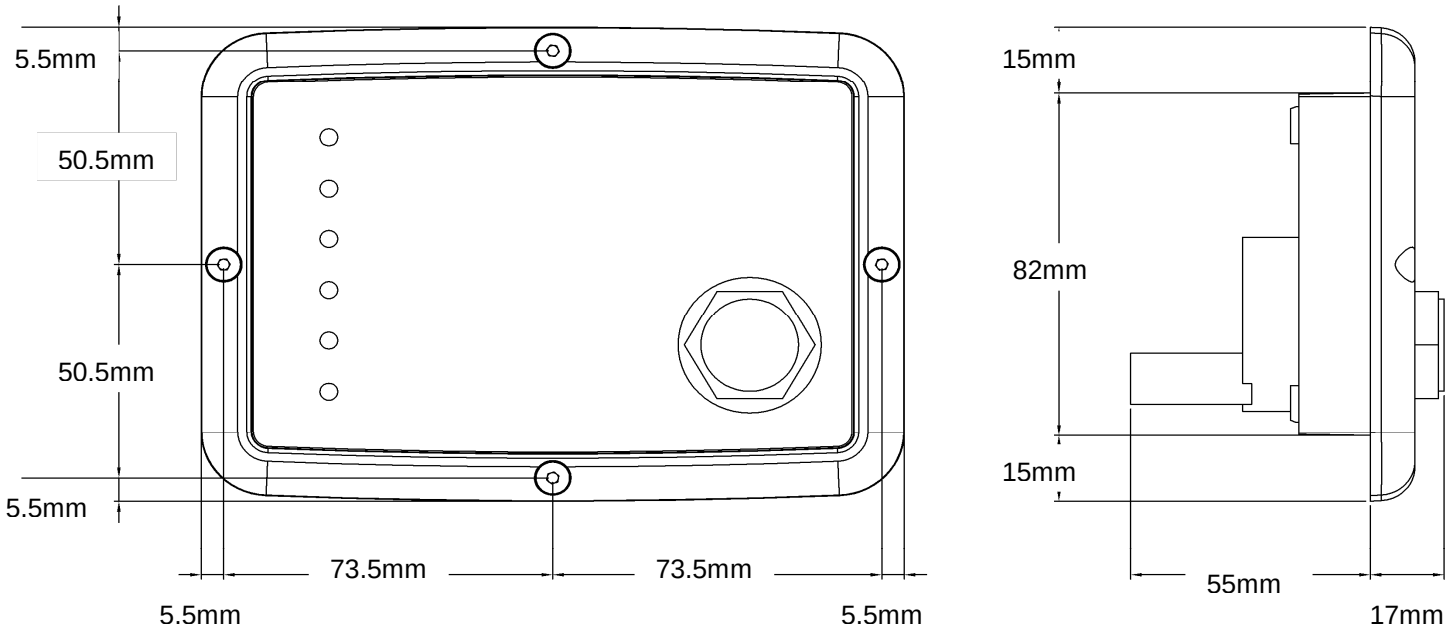
PANEL CUTOUT
132 mm x 84 mm
(5.2” x 3.3”)

Mounting
Waterproof sealing gasket for details see elsewhere in this manual.

The key-switch barrel has a drain hole which exits on the underside of the switch behind the mounting flange. Ensure suitable arrangements are made if mounting the controller within an enclosure.

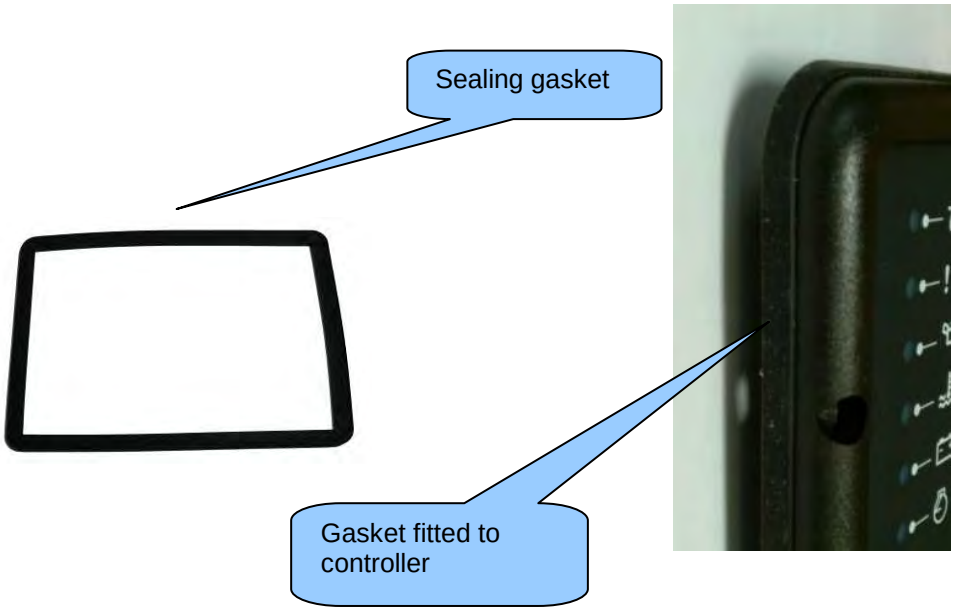
Screw Size: M4
Torque Rating: 0.60 Nm

WEIGHT
0.3 Kg (0.661 lb)



4.2.2 SILICON SEALING GASKET

The supplied silicon gasket provides improved sealing between the DSE402 MKII controller and the panel fascia.
The gasket is fitted to the controller before installation into the panel fascia.
Take care to ensure the gasket is correctly fitted to the controller to maintain the integrity of the seal.



4.3 APPLICABLE STANDARDS

BS 4884-1	This document conforms to BS4884-1 1992 Specification for presentation of essential information.
BS 4884-2	This document conforms to BS4884-2 1993 Guide to content
BS 4884-3	This document conforms to BS4884-3 1993 Guide to presentation
BS EN 60068-2-1 (Minimum temperature)	-30°C (-22°F)
BS EN 60068-2-2 (Maximum temperature)	+70°C (158°F)
BS EN 60950	Safety of information technology equipment, including electrical business equipment
BS EN 61000-6-2	EMC Generic Immunity Standard (Industrial)
BS EN 61000-6-4	EMC Generic Emission Standard (Industrial)
BS EN 60529 (Degrees of protection provided by enclosures) (see overleaf)	IP66 (front of controller when installed into the control panel with the supplied sealing gasket) IP42 (front of controller when installed into the control panel WITHOUT being sealed to the panel)
UL508 **NEMA rating** (Approximate) (see overleaf)	12 (Front of controller when installed into the control panel with the supplied sealing gasket). 2 (Front of controller when installed into the control panel WITHOUT being sealed to the panel)
IEEE C37.2 (Standard Electrical Power System Device Function Numbers and Contact Designations)	Under the scope of IEEE 37.2, *function numbers can also be used to represent functions in microprocessor devices and software programs*. As the controller is configurable by the generator OEM, the functions covered by the controller will vary. Under the controller's factory configuration, the device numbers included within the controller are : 2 – Time delay starting or closing relay 6 – Starting circuit breaker 30 – annunciator relay 54 – turning gear engaging device 62 – time delay stopping or opening relay 63 – pressure switch 74– alarm relay 81 – frequency relay 86 – lockout relay

4.3.1 ENCLOSURE CLASSIFICATIONS

IP CLASSIFICATIONS

DSE402 MKII **BS EN 60529** Degrees of protection provided by enclosures

IP66 (Front of controller when controller is installed into the control panel with the optional sealing gasket).
IP42 (front of controller when controller is installed into the control panel WITHOUT being sealed to the panel)
IP54 Rear of controller(suitable grease should be applied to terminals if exposed to a harsh environment

First Digit Protection against contact and ingress of solid objects		Second Digit Protection against ingress of water	
0	No protection	0	No protection
1	Protected against ingress solid objects with a diameter of more than 50 mm. No protection against deliberate access, e.g. with a hand, but large surfaces of the body are prevented from approach.	1	Protection against dripping water falling vertically. No harmful effect must be produced (vertically falling drops).
2	Protected against penetration by solid objects with a diameter of more than 12 mm. Fingers or similar objects prevented from approach.	2	Protection against dripping water falling vertically. There must be no harmful effect when the equipment (enclosure) is tilted at an angle up to 15° from it s normal position (drops falling at an angle).
3	Protected against ingress of solid objects with a diameter of more than 2.5 mm. Tools, wires etc. with a thickness of more than 2.5 mm are prevented from approach.	3	Protection against water falling at any angle up to 60° from the vertical. There must be no harmful effect (spray water).
4	Protected against ingress of solid objects with a diameter of more than 1 mm. Tools, wires etc. with a thickness of more than 1 mm are prevented from approach.	4	Protection against water splashed against the equipment (enclosure) from any direction. There must be no harmful effect (splashing water).
5	Protected against harmful dust deposits. Ingress of dust is not totally prevented but the dust must not enter in sufficient quantity to interface with satisfactory operation of the equipment. Complete protection against contact.	5	Protection against water projected from a nozzle against the equipment (enclosure) from any direction. There must be no harmful effect (water jet).
6	Protection against ingress of dust (dust tight). Complete protection against contact.	6	Protection against heavy seas or powerful water jets. Water must not enter the equipment (enclosure) in harmful quantities (splashing over).

NEMA CLASSIFICATIONS

402 MKII NEMA Rating (Approximate)

4 (Front of controller when controller is installed into the control panel with the optional sealing gasket).
3 (front of controller when controller is installed into the control panel WITHOUT being sealed to the panel)
2 Rear of controller (suitable grease should be applied to terminals if exposed to a harsh environment)

NOTE: - There is no direct equivalence between IP / NEMA ratings. IP figures shown are approximate only.

1 **IP30**	Provides a degree of protection against contact with the enclosure equipment and against a limited amount of falling dirt.
2 **IP31**	Provides a degree of protection against limited amounts of falling water and dirt.
3 **IP64**	Provides a degree of protection against windblown dust, rain and sleet; undamaged by the formation of ice on the enclosure.
3R **IP32**	Provides a degree of protection against rain and sleet:; undamaged by the formation of ice on the enclosure.
4 (X) **IP66**	Provides a degree of protection against splashing water, windblown dust and rain, hose directed water; undamaged by the formation of ice on the enclosure. (Resist corrosion).
12/12K **IP65**	Provides a degree of protection against dust, falling dirt and dripping non corrosive liquids.
13 **IP65**	Provides a degree of protection against dust and spraying of water, oil and non corrosive coolants.

5 INSTALLATION

The DSE402 MKII controller is designed to be mounted on the panel fascia. For dimension and mounting details, see the section entitled *Specification, Dimension and mounting* elsewhere in this document.

5.1 TERMINAL DESCRIPTION

5.1.1 DC SUPPLY, FUEL AND START OUTPUTS

Icon	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	1	DC Plant Supply Input (Positive) Minimum 8V to 35V	2.5mm² AWG 13	Recommended Maximum Fuse 30A anti-surge)
	2	Output relay (B) (Crank)	2.5 mm² AWG 13	Plant Supply Positive from terminal 1. 15 Amp rated.
	3	Output relay (C) (PRE-HEAT)	2.5mm² AWG 13	Plant Supply Positive from terminal 1. 2 Amp rated.
	4	Output relay (A) (FUEL)	2.5mm² AWG 13	Plant Supply Positive from terminal 1. 15 Amp rated.
	5	DC Plant Supply Input (Negative)	2.5mm² AWG 13	
	6	Auxiliary shutdown	1.0mm² AWG 18	Configurable input
	7	Oil Pressure	0.5mm² AWG 20	Connect to Oil pressure switch
	8	Coolant Temperature	0.5mm² AWG 20	Connect to Coolant Temperature switch
D + W/L	9	Charge fail / excite	1.0mm² AWG 18	
 Hz	10	Signal +	0.5mm² AWG 20	Magnetic pickup Positive / Frequency Hz or RPM sensing
	11	Signal -	0.5mm² AWG 20	Magnetic pickup Negative / Frequency Hz or RPM sensing
	12	SET NOMINAL SPEED	1.0mm² AWG 18	Configurable Input

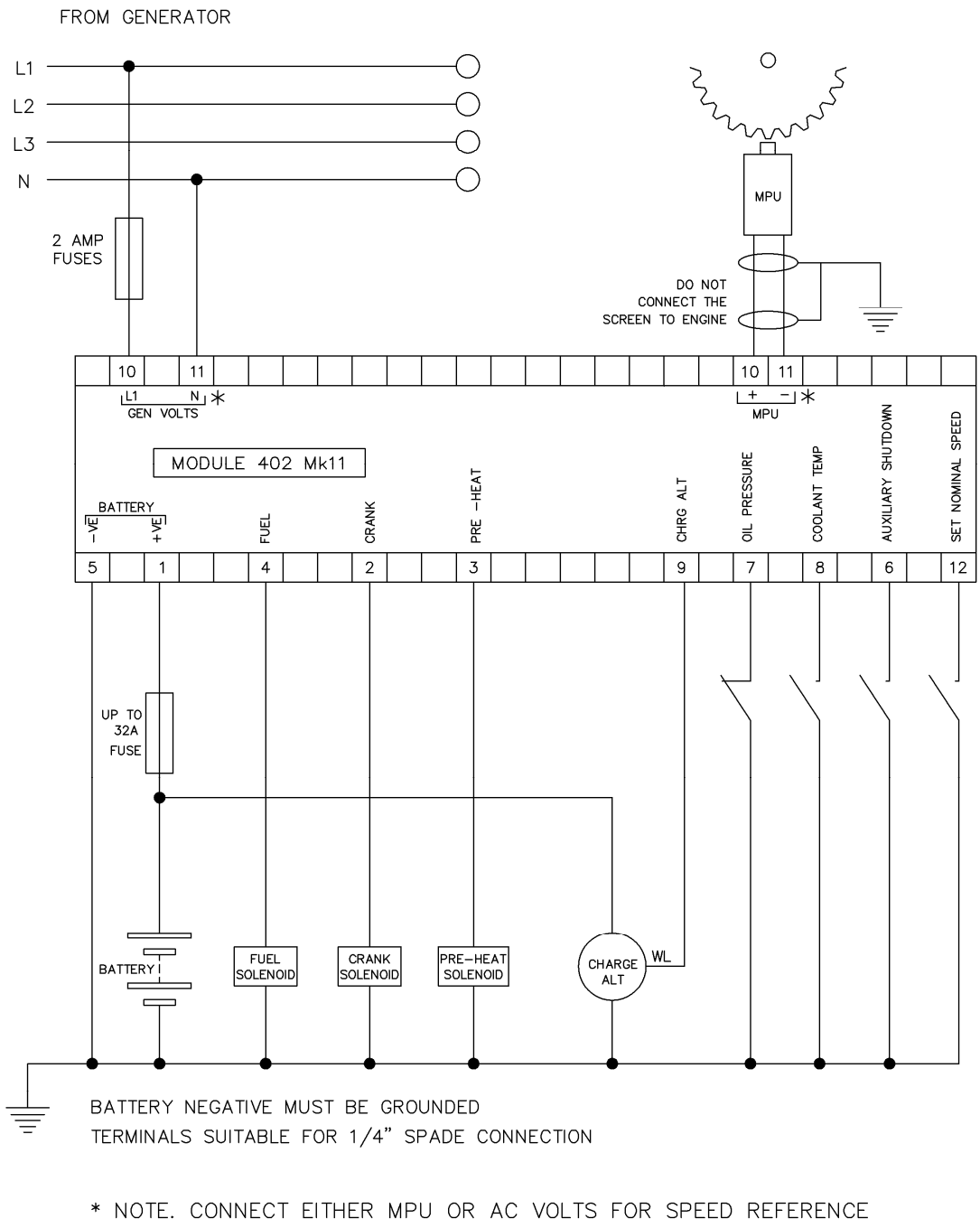
NOTE: - If you use PTFE insulating tape on the Oil pressure or Temperature switch thread when using earth return switches, ensure you do not insulate the entire thread, as this will prevent the switch body from being earthed via the engine block.

NOTE:- Screened cable must be used for connecting the Magnetic Pickup, ensuring that the screen is earthed at one end ONLY other wise the cable will act as an aerial.

5.2 TYPICAL WIRING DIAGRAMS

As every system has different requirements, these diagrams show only a TYPICAL system and do not intend to show a complete system.

Further wiring suggestions are available in the following DSE publications, available at www.deepseaplc.com to website members.



5.2.1 EARTH SYSTEMS

5.2.1.1 NEGATIVE EARTH

The typical wiring diagrams located within this document show connections for a negative earth system (the battery negative connects to Earth)

5.2.1.2 POSITIVE EARTH

When using a DSE controller with a Positive Earth System (the battery positive connects to Earth), the following points must be followed:

- Follow the typical wiring diagram as normal for all sections EXCEPT the earth points
- All points shown as Earth on the typical wiring diagram should connect to BATTERY NEGATIVE (not earth).

5.2.1.3 FLOATING EARTH

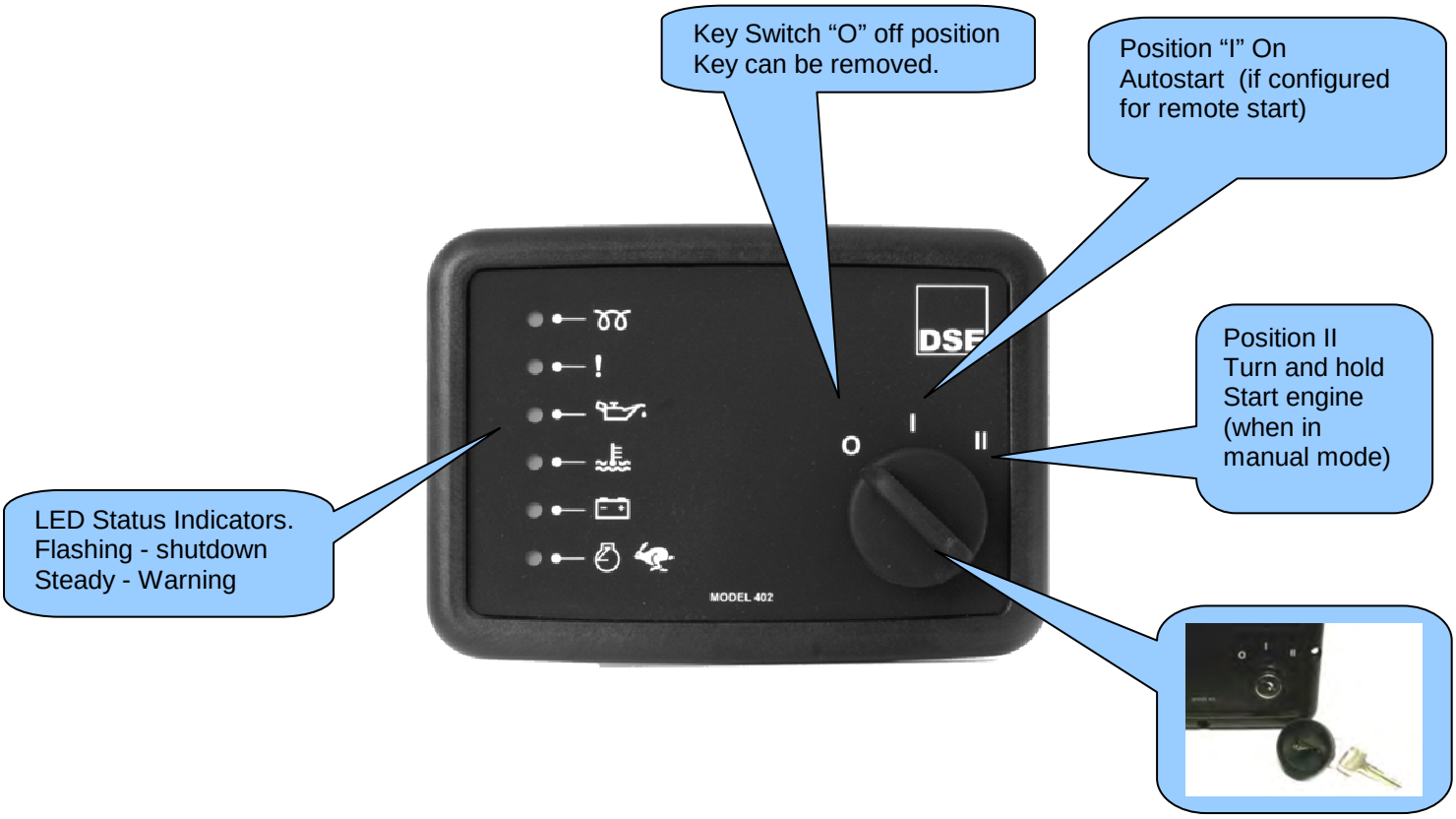
Where neither the battery positive nor battery negative terminals are connected to earth the following points must to be followed

- Follow the typical wiring diagram as normal for all sections EXCEPT the earth points
- All points shown as Earth on the typical wiring diagram should connect to BATTERY NEGATIVE (not earth).

5.3 DESCRIPTION OF CONTROLS

The following section details the function and meaning of the various controls on the controller.

5.4 DSE 402 MKII AUTOSTART CONTROL CONTROLLER



ICON	DESCRIPTION	
	Pre Heat	The Pre heat output The auxiliary charge alternator voltage is low as measured from the W/L terminal.
	Auxiliary Alarm	An external alarm condition has occurred. Example Emergency Stop
	LOW OIL PRESSURE	The controller detects that the engine oil pressure has fallen below the low oil pressure pre-alarm setting level after the *Safety On* timer has expired.
	ENGINE HIGH TEMPERATURE	The controller detects that the engine coolant temperature has exceeded the high engine temperature pre-alarm setting level after the *Safety On* timer has expired.
	BATTERY UNDER VOLTAGE / BATTERY OVER VOLTAGE	The DC supply has fallen below or risen above the low/high volts setting level.
	OVERSPEED	The engine speed has risen above the over speed pre alarm setting

5.5 QUICKSTART GUIDE

This section provides a quick start guide to the controller's operation

5.1 CONTROLS

Stop / Reset Turning the keyswitch to this position places the controller into its **Stop/Reset** mode. This will clear any alarm conditions unless the alarm condition is still present.	
Run. *Moving the Keyswitch into this position.* *Controller in manual or auto mode (auto mode if remote start configured).* *Preheat timer commences and gives pre-heat output.*	
Turn and hold In this position will send the Fuel and crank signals to start the engine, The preheat will continue if the timer has not expired this is indicated by the preheat led.	

6 SETTINGS AND ADJUSTMENTS

The setting of nominal speed and adjustment of trip points can be set using the following method.

6.1.1.1 SETTING OF NOMINAL SPEED

- With the DSE402 MKII connected, run the engine at nominal speed. Connect the 'Set Nominal Speed' input to battery negative to set the nominal speed.

6.1.1.2 ADJUSTMENT OF TRIP POINTS

- Turn the pre-set potentiometers to set the trip point. The factory setting for the Trip is 90% to 140% . The range is adjusted from 0% to 400% of nominal engine speed via the DSE Configuration Suite Lite PC Software.
- Turn the pre-set potentionmeters clockwise to increase the trip point, turn it anti-clockwise to decrease the trip point.
- The *'Engine Overspeed LED'* will illuminate when the trip has been achieved.

6.2 SHUTDOWNS / WARNINGS

Shutdowns are latching alarms and stop the Generator. Clear the alarm and remove the fault then switch the Keyswitch to "O" to reset the controller.
A flashing LED indicates a shutdown condition
A steady LED indicates a warning.

NOTE:- The alarm condition must be rectified before a reset will take place. If the alarm condition remains, it will not be possible to reset the unit (The exception to this is the Low Oil Pressure alarm and similar 'active from safety on' alarms, as the oil pressure will be low with the engine at rest).

Display	Reason
LOW OIL PRESSURE	The engine oil pressure has fallen below the low oil pressure trip setting level after the *Safety On* timer has expired.
ENGINE HIGH TEMPERATURE	The engine coolant temperature has exceeded the high engine temperature trip setting level after the *Safety On* timer has expired.
OVERSPEED	The engine speed has exceeded the pre-set trip
UNDERSPEED	The engine speed has fallen below the pre-set trip after the ***Safety On*** timer has expired.

7 COMMISSIONING

7.1.1 PRE-COMMISSIONING

Before the system is started, it is recommended that the following checks are made:-

10.1. The unit is adequately cooled and all the wiring to the controller is of a standard and rating compatible with the system. Check all mechanical parts are fitted correctly and that all electrical connections (including earths) are sound.

10.2. The unit **DC** supply is fused and connected to the battery and that it is of the correct polarity.

10.3. Make all checks on the engine and alternator as detailed by their respective manufacturer documentation.
10.4. Check all other parts in the system according to the manufacturer documentation.
10.5. Thoroughly review the configuration of the DSE controller and check that all parameters meet the requirements of your system.

10.6. +To check the start cycle operation, take appropriate measures to prevent the engine from starting (disable the operation of the fuel solenoid). After a visual inspection to ensure it is safe to proceed, connect the battery supply. Put the Keyswitch into the "**I"** position and then "**II",** the unit start sequence will commence.

10.7. The starter will engage and operate for the pre-set crank period. After the starter motor has attempted to start the engine the explanation mark will illuminate.

10.8. Restore the engine to operational status (reconnect the fuel solenoid). Turn the Ketswitch to the off position and then to the **"I " then "II"**. This time the engine will start and the starter motor will disengage automatically. If not then check the engine is fully operational (fuel available, etc.) and the fuel solenoid is operating. The engine will now run up to operating speed. If not, and an alarm is present, check the alarm condition for validity, and check input wiring. The engine will continue to run for an indefinite period.

10.9. Fully commission the engine/alternator and any other parts in the system as detailed in the respective manufacturer documentation. This could includes load bank testing, load acceptance, breaker control and more.

10.10. If despite repeated checking of the connections between the **DSE402 MKII** controller and the customer's system, satisfactory operation cannot be achieved, then the customer is requested to contact the factory for further advice on:-

INTERNATIONAL TEL: +44 (0) 1723 890099
INTERNATIONAL FAX: +44 (0) 1723 893303
E-mail: Support@Deepseaplc.com
Website : www.deepseaplc.com

FAULT FINDING

SYMPTOM	POSSIBLE REMEDY
Unit is inoperative Read/Write configuration does not operate	Check the battery and wiring to the unit. Check the DC supply. Check the DC fuse.
Unit shuts down	Check DC supply voltage is not above 35 Volts or below 9 Volts Check the operating temperature is not above 70℃. Check the DC fuse.
Intermittent Magnetic Pick-up sensor fault	Ensure that Magnetic pick-up screen only connects to earth at one end, if connected at both ends, this enables the screen to act as an aerial and will pick up random voltages. Check pickup is correct distance from the flywheel teeth.
Low oil Pressure fault operates after engine has fired	Check engine oil pressure. Check oil pressure switch and wiring. Check configured polarity (if applicable) is correct (i.e. Normally Open or Normally Closed)
High engine temperature fault operates after engine has fired.	Check engine temperature. Check switch and wiring. Check configured polarity (if applicable) is correct (i.e. Normally Open or Normally Closed) .
common fault operates	Check relevant switch and wiring of fault indicated by LED. Check configuration of input.
Fail to Start is activated after pre-set number of attempts to start	Check wiring of fuel solenoid. Check fuel. Check battery supply. Check battery supply is present on the Fuel output of the controller. Check the speed-sensing signal is present on the controller's inputs. Refer to engine manual.
Continuous starting of generator when in **AUTO**	Check that there is no signal present on the "Remote Start" input. Check configured polarity is correct.
Generator fails to start on receipt of Remote Start signal.	Check Start Delay timer has timed out. Check signal is on "Remote Start" input. Confirm correct configuration of input Check that the oil pressure switch is indicating low oil pressure to the controller. Depending upon configuration, then set will not start if oil pressure is not low.
Pre-heat inoperative	Check wiring to engine heater plugs. Check battery supply. Check battery supply is present on the Pre-heat output of controller. Check pre-heat configuration is correct.
Starter motor inoperative	Check wiring to starter solenoid. Check battery supply. Check battery supply is present on the Starter output of controller. Ensure that the Emergency Stop input is at Positive. Ensure oil pressure switch or sensor is indicating the "low oil pressure" state to the controller.
Controller appears to 'revert' to an earlier configuration	When editing a configuration using the PC software it is vital that the configuration is first 'read' from the controller before editing it. This edited configuration must then be "written" back to the controller for the changes to take effect.

NOTE:- The above fault finding is provided as a guide check-list only. As the controller is configurable for a range of different features, always refer to the source of your controller configuration if in doubt.

8 MAINTENANCE, SPARES, REPAIR AND SERVICING

The DSE402 MKII controller is *Fit and Forget*. As such, there are no user serviceable parts within the controller. In the case of malfunction, you should contact your original equipment manufacturer (OEM).

8.1 PURCHASING ADDITIONAL SEALING GASKET FROM DSE

Item	Description	Part No.
	DSE402 MKII silicon sealing gasket	020-016

9 WARRANTY

DSE provides limited warranty to the equipment purchaser at the point of sale. For full details of any applicable warranty, you are referred to your original equipment supplier (OEM).

10 DISPOSAL

10.1 WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)

Directive 2002/96/EC
If you use electrical and electronic equipment you must store, collect, treat, recycle and dispose of WEEE separately from your other waste.

10.2 ROHS (RESTRICTION OF HAZARDOUS SUBSTANCES)

Directive 2002/95/EC: 2006
To remove specified hazardous substances (Lead, Mercury, Hexavalent Chromium, Cadmium, PBB & PBDE´s)

Exemption Note: Category 9. (Monitoring & Control Instruments) as defined in Annex 1B of the WEEE directive will be exempt from the RoHS legislation. This was confirmed in the August 2005 UK´s Department of Trade and Industry RoHS REGULATIONS Guide (Para 11).

Despite this exemption, DSE has been carefully removing all non RoHS compliant components from our supply chain and products.
When this is completed, a Lead Free & RoHS compatible manufacturing process will be phased into DSE production.

This process is almost complete and is being phased through different product groups.

This page is intentionally blank.

This page is intentionally blank.

California Proposition 65

⚠ WARNING ⚠

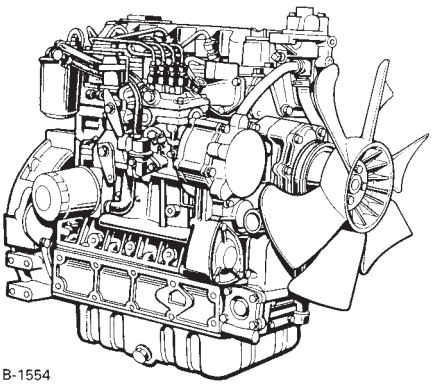
Engine exhaust, some of its constituents, certain vehicle components and fluids, contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

ENGLISH

OPERATOR'S MANUAL

KUBOTA
DIESEL ENGINE

MODELS **V3600-E3 · V3600-T-E3 · V3800-DI-T-E3 · V3300-E3BG · V3600-T-E3BG · V3800-DI-T-E3BG**



B-1554

1J411-8911-4

READ AND SAVE THIS MANUAL

Kubota

ENGLISH

FOREWORD

You are now the proud owner of a KUBOTA Engine. This engine is a product of KUBOTA quality engineering and manufacturing. It is made of fine materials and under a rigid quality control system. It will give you long, satisfactory service. To obtain the best use of your engine, please read this manual carefully. It will help you become familiar with the operation of the engine and contains many helpful hints about engine maintenance. It is KUBOTA's policy to utilize as quickly as possible every advance in our research. The immediate use of new techniques in the manufacture of products may cause some small parts of this manual to be outdated. KUBOTA distributors and dealers will have the most up-to-date information. Please do not hesitate to consult with them.

SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read these instructions carefully. It is essential that you read the instructions and safety regulations before you attempt to assemble or use this unit.

DANGER : Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING : Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

CAUTION : Indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury.

IMPORTANT : Indicates that equipment or property damage could result if instructions are not followed.

NOTE : Gives helpful information.

CONTENTS

ENGLISH

ENGLISH

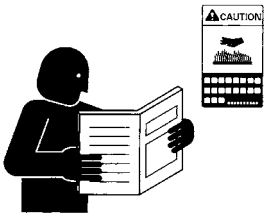
SAFE OPERATION

Careful operation is your best assurance against an accident. Read and understand this section carefully before operating the engine. All operators, no matter how much experience they may have, should read this and other related manuals before operating the engine or any equipment attached to it. It is the owner's obligation to provide all operators with this information and instruct them on safe operation.

Be sure to observe the following for safe operation.

1. OBSERVE SAFETY INSTRUCTIONS

- Read and understand carefully this "OPERATOR'S MANUAL" and "LABELS ON THE ENGINE" before attempting to start and operate the engine.
- Learn how to operate and work safely. Know your equipment and its limitations. Always keep the engine in good condition.
- Before allowing other people to use your engine, explain how to operate and have them read this manual before operation.
- DO NOT modify the engine. UNAUTHORIZED MODIFICATIONS to the engine may impair the function and/or safety and affect engine life. If the engine does not perform properly, consult your local Kubota Engine Distributor first.



1AAACAAAP008B

2. WEAR SAFE CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

- DO NOT wear loose, torn or bulky clothing around the machine that may catch on working controls and projections or into fans, pulleys and other moving parts causing personal injury.
- Use additional safety items-PPE, e.g. hard hat, safety protection, safety goggles, gloves, etc., as appropriate or required.
- DO NOT operate the machine or any equipment attached to it while under the influence of alcohol, medication, or other drugs, or while fatigued.
- DO NOT wear radio or music headphones while operating the engine.

1AEAAAAAP0130

3. CHECK BEFORE STARTING & OPERATING THE ENGINE

- Be sure to inspect the engine before operation. Do not operate the engine if there is something wrong with it. Repair it immediately.
- Ensure all guards and shields are in place before operating the engine. Replace any that are damaged or missing.
- Check to see that you and others are a safe distance from the engine before starting.
- Always keep the engine at least 3 feet (1 meter) away from buildings and other facilities.
- DO NOT allow children or livestock to approach the machine while the engine is running.
- DO NOT start the engine by shorting across starter terminals. The machine may start in gear and move. Do not bypass or defeat any safety devices.

1BAABADAP0010

4. KEEP THE ENGINE AND SURROUNDINGS CLEAN

- Be sure to stop the engine before cleaning.
- Keep the engine clean and free of accumulated dirt, grease and trash to avoid a fire. Store flammable fluids in proper containers and cabinets away from sparks and heat.
- Check for and repair leaks immediately.
- DO NOT stop the engine without idling; Allow the engine to cool down, first. Keep the engine idling for about 5 minutes before stopping unless there is a safety problem that requires immediate shut down.

1AEAAAAAP0120

5. SAFE HANDLING OF FUEL AND LUBRICANTS -KEEP AWAY FROM FIRE

- Always stop the engine before refueling and/or lubricating.
- DO NOT smoke or allow flames or sparks in your work area. Fuel is extremely flammable and explosive under certain conditions.
- Refuel at a well ventilated and open place. When fuel and/or lubricants are spilled, refuel after letting the engine cool down.
- DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause a fire or severe engine damage.
- Do not use unapproved containers e.g. buckets, bottles, jars. Use approved fuel storage containers and dispensers.

1AAACAAAP001A

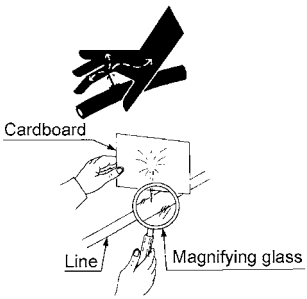
6. EXHAUST GASES & FIRE PREVENTION

- Engine exhaust fumes can be very harmful if allowed to accumulate. Be sure to run the engine in a well ventilated location and where there are no people or livestock near the engine.
- The exhaust gas from the muffler is very hot. To prevent a fire, do not expose dry grass, mowed grass, oil or any other combustible materials to exhaust gas. Keep the engine and muffler clean at all times.
- To avoid a fire, be alert for leaks of flammable substances from hoses and lines. Be sure to check for leaks from hoses or pipes, such as fuel and hydraulic fluid by following the maintenance check list.
- To avoid a fire, do not short across power cables and wires. Check to see that all power cables and wirings are in good condition. Keep all electrical connections clean. Bare wire or frayed insulation can cause a dangerous electrical shock and personal injury.

1AAACAAAP011A

7. ESCAPING FLUID

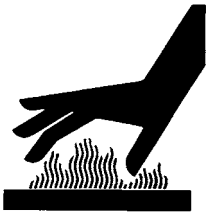
- Relieve all pressure in the air, the oil and the cooling systems before disconnecting any lines, fittings or related items.
- Be cautious of possible pressure relief when disconnecting any device from a pressurized system that utilizes pressure. DO NOT check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- Escaping fluid under pressure has sufficient force to penetrate skin causing serious personal injury.
- Fluid escaping from pinholes may be invisible. Use a piece of cardboard or wood to search for suspected leaks: do not use hands and body. Use safety goggles or other eye protection when checking for leaks.
- If injured by escaping fluid, see a medical doctor immediately. This fluid can produce gangrene or severe allergic reaction.



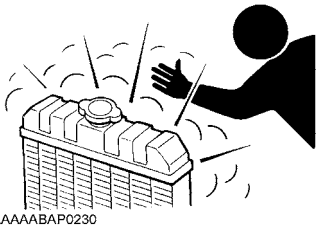
1ABAAAAAP120F

8. CAUTIONS AGAINST BURNS & BATTERY EXPLOSION

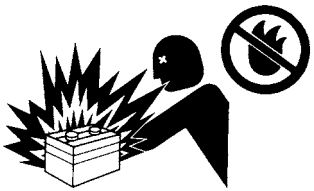
- To avoid burns, be cautious of hot components, e.g. muffler, muffler cover, radiator, hoses, engine body, coolants, engine oil, etc. during operation and after the engine has been shut off.
- DO NOT remove the radiator cap while the engine is running or immediately after stopping. Otherwise hot water will spout out from the radiator. Wait until the radiator is completely cool to the touch before removing the cap. Wear safety goggles.
- Be sure to close the coolant drain valve, secure the pressure cap, and fasten the pipe band before operating. If these parts are taken off, or loosened, it will result in serious personal injury.
- The battery presents an explosive hazard. When the battery is being charged, hydrogen and oxygen gases are extremely explosive.
- DO NOT use or charge the battery if its fluid level is below the LOWER mark.
  Otherwise, the component parts may deteriorate earlier than expected, which may shorten the service life or cause an explosion. Immediately, add distilled water until the fluid level is between the UPPER and LOWER marks.
- Keep sparks and open flames away from the battery, especially during charging. DO NOT strike a match near the battery.
- DO NOT check the battery charge by placing a metal object across the terminals. Use a voltmeter or hydrometer.
- DO NOT charge a frozen battery. There is a risk of explosion. When frozen, warm the battery up to at least 16°C (61°F).



1AEABAAAP0080



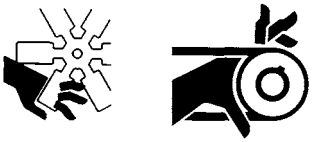
1AAAAABAP0230



1ARAEAAAP0520

9. KEEP HANDS AND BODY AWAY FROM ROTATING PARTS

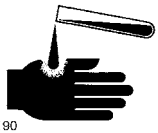
- Be sure to stop the engine before checking or adjusting the belt tension and cooling fan.
- Keep your hands and body away from rotating parts, such as the cooling fan, V-belt, fan drive pulley or flywheel. Contact with rotating parts can cause severe personal injury.
- DO NOT run the engine without safety guards. Install safety guards securely before operation.



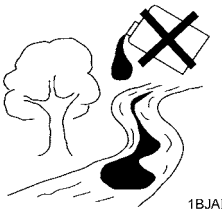
1ABAAAAAP1470

10. ANTI-FREEZE & DISPOSAL OF FLUIDS

- Anti-freeze contains poison. Wear rubber gloves to avoid personal injury. In case of contact with skin, wash it off immediately.
- DO NOT mix different types of Anti-freeze. The mixture can produce a chemical reaction causing harmful substances. Use approved or genuine KUBOTA Anti-freeze.
- Be mindful of the environment and the ecology. Before draining any fluids, determine the correct way to dispose of them. Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters and batteries.
- When draining fluids from the engine, place a suitable container underneath the engine body.
- DO NOT pour waste onto the ground, down a drain, or into any water source. Dispose of waste fluids according to environmental regulations.



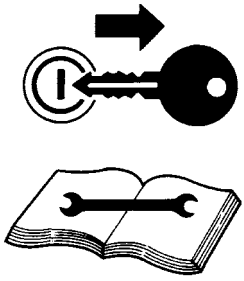
1BJABAAAP0190



1BJABAAAP0180

11. CONDUCTING SAFETY CHECKS & MAINTENANCE

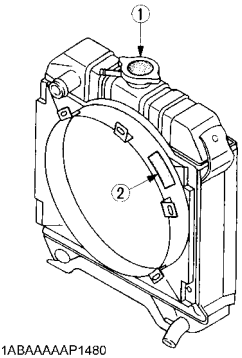
- When inspecting the engine or servicing, place the engine on a large flat surface. DO NOT work on anything that is supported ONLY by lift jacks or a hoist. Always use blocks or the correct stands to support the engine before servicing.
- Disconnect the battery from the engine before conducting service. Put a "DO NOT OPERATE!" tag on the key switch to avoid accidental starting.
- To avoid sparks from an accidental short circuit always disconnect the battery's ground cable (-) first and reconnect it last.
- Be sure to stop the engine and remove the key when conducting daily and periodic maintenance, service and cleaning.
- Check or conduct maintenance after the engine, coolant, muffler, or muffler cover have cooled off completely.
- Always use the appropriate tools and fixtures. Verify that they are in good condition before performing any service work. Make sure you understand how to use them before service.
- Use ONLY correct engine barring techniques for manually rotating the engine. DO NOT attempt to rotate the engine by pulling or prying on the cooling fan and V-belt. This practice can cause serious personal injury or premature damage to the cooling fan and belt.



1BJABAAAP0200

- Replace fuel pipes and lubricant pipes with their hose clamps every 2 years or earlier whether they are damaged or not. They are made of rubber and age gradually.
- When servicing is performed together by two or more persons, take care to perform all work safely.
- Keep a first aid kit and fire extinguisher handy at all times.

12. WARNING AND CAUTION LABELS



1ABAAAAAP1480

① Part No.19077-8724-1 or 16667-8724-1
(55mm in diameter) (37mm in diameter)

1ABACAAAP036K

② Part No.TA040-4957-1
Stay clear of engine
fan and fan belt


1AGAMAAAP2620

13. CARE OF WARNING AND CAUTION LABELS

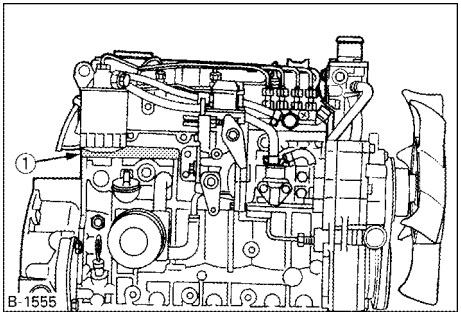
1. Keep warning and caution labels clean and free from obstructing material.
2. Clean warning and caution labels with soap and water, dry with a soft cloth.
3. Replace damaged or missing warning and caution labels with new labels from your local KUBOTA dealer.
4. If a component with warning and caution label(s) affixed is replaced with a new part, make sure the new label(s) is (are) attached in the same location(s) as the replaced component.
5. Mount new warning and caution labels by applying to a clean dry surface and pressing any bubbles to the outside edge.

ENGLISH

SERVICING OF THE ENGINE

Your dealer is interested in your new engine and has the desire to help you get the most value from it. After reading this manual thoroughly, you will find that you can do some of the regular maintenance yourself.
However, when in need of parts or major service, be sure to see your KUBOTA dealer.
For service, contact the KUBOTA Dealership from which you purchased your engine or your local KUBOTA dealer.
When in need of parts, be prepared to give your dealer the engine serial number.
Locate the serial number now and record them in the space provided.

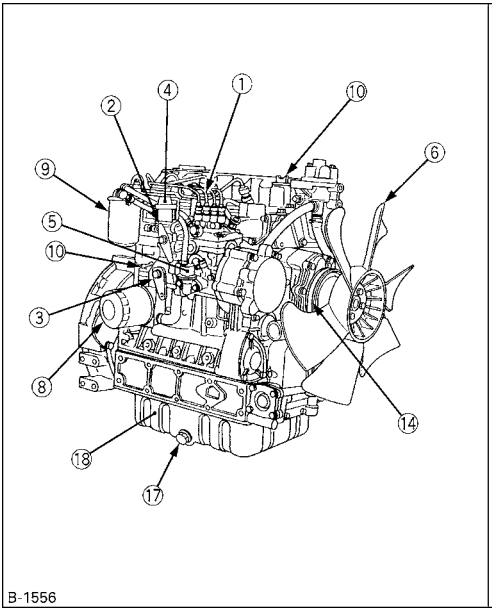
	Type	Serial No.
Engine		
Date of Purchase		
Name of Dealer		
(To be filled in by purchaser)		



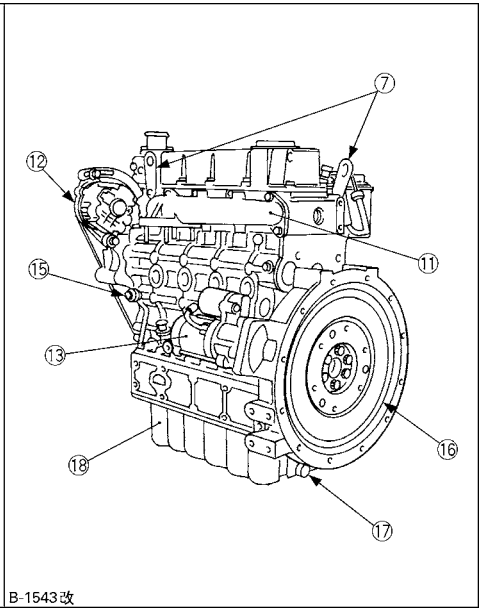
(1) Engine serial number

ENGLISH

NAMES OF PARTS



B-1556



B-1543改

(1) Intake manifold
(2) Speed control lever
(3) Engine stop lever
(4) Shut off solenoid
(5) Fuel feed pump
(6) Cooling fan
(7) Engine hook
(8) Oil filter cartridge
(9) Fuel filter
(10) Oil filler plug
(11) Exhaust manifold
(12) Alternator
(13) Starter
(14) Fan belt
(15) Oil pressure switch
(16) Flywheel
(17) Oil drain plug
(18) Oil pan

PRE-OPERATION CHECK

BREAK-IN

During the engine break-in period, observe the following by all means:

1. Change engine oil and oil filter cartridge after the first 50 hours of operation. (See "**ENGINE OIL**" in "**PERIODIC SERVICE**" section.)
2. When ambient temperature is low, operate the machine after the engine has been completely warmed up.

DAILY CHECK

To prevent trouble from occurring, it is important to know the conditions of the engine well. Check it before starting.

CAUTION

To avoid personal injury:

- **Be sure to install shields and safeguards attached to the engine when operating.**
- **Stop the engine at a flat and wide space when checking.**
- **Keep dust or fuel away from the battery, wiring, muffler and engine to prevent a fire. Check and clear them before operating everyday. Pay attention to the heat of the exhaust pipe or exhaust gas so that it can not ignite trash.**

Item		Ref. page
1. Parts which had trouble in previous operation		-
2. By walking around the machine	(1) Oil or water leaks	15 to 20
	(2) Engine oil level and contamination	15
	(3) Amount of fuel	12
	(4) Amount of coolant	18
	(5) Dust in air cleaner dust cup	21
	(6) Damaged parts and loosened bolts and nuts	-
3. By inserting the key into the starter switch	(1) Proper functions of meters and pilot lamps; no stains on these parts	-
	(2) Proper function of glow lamp timer	-
4. By starting the engine	(1) Color of exhaust fumes	7
	(2) Unusual engine noise	7
	(3) Engine start-up condition	5
	(4) Slow-down and acceleration behavior	7

ENGLISH

OPERATING THE ENGINE

STARTING THE ENGINE(NORMAL)

CAUTION

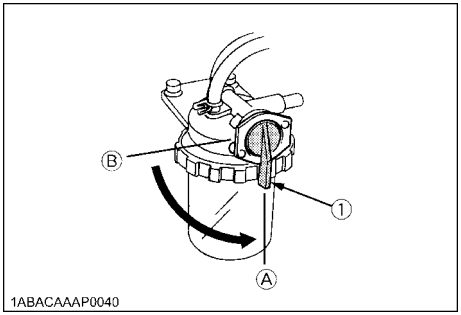
To avoid personal injury:

- **Do not allow children to approach the machine while the engine is running.**
- **Be sure to install the machine on which the engine is installed, on a flat place.**
- **Do not run the engine on gradients.**
- **Do not run the engine in an enclosed area. Exhaust gas can cause air pollution and exhaust gas poisoning.**
- **Keep your hands away from rotating parts (such as fan, pulley, belt, flywheel etc.) during operation.**
- **Do not operate the machine while under the influence of alcohol or drugs.**
- **Do not wear loose, torn or bulky clothing around the machine. It may catch on moving parts or controls, leading to the risk of accident. Use additional safety items, e.g. hard hat, safety boots or shoes, eye and hearing protection, gloves, etc., as appropriate or required.**
- **Do not wear radio or music headphones while operating engine.**
- **Check to see if it is safe around the engine before starting.**
- **Reinstall safeguards and shields securely and clear all maintenance tools when starting the engine after maintenance.**

IMPORTANT :

- Do not use ether or any starting fluid for starting the engine, or a severe damage will occur.
- When starting the engine after a long storage (of more than 3 months), first set the stop lever to the "STOP" position and then activate the starter for about 10 seconds to allow oil to reach every engine part.

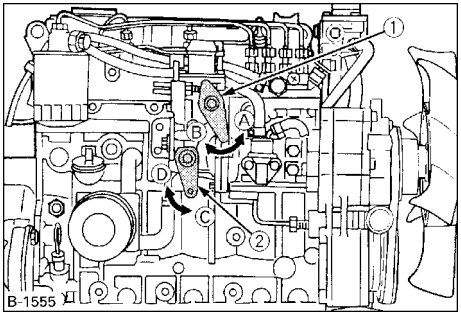
1. Set the fuel lever to the "ON" position.



(1) Fuel lever
(A) "ON"
(B) "OFF"

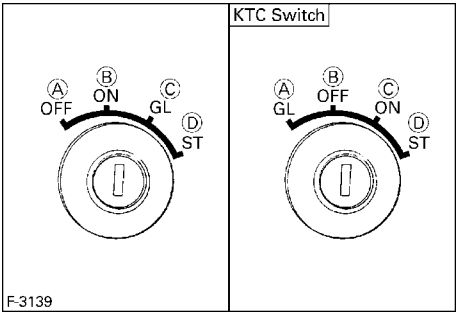
2. Place the engine stop lever to the "START" position.

3. Place the speed control lever at more than half "OPERATION".



(1) Speed control lever
(2) Engine stop lever
(A) "IDLING"
(B) "OPERATION"
(C) "START"
(D) "STOP"

4. Insert the key into the key switch and turn it "ON".



(A) "SWITCHED OFF"
(B) "OPERATION"
(C) "PREHEATING"
(D) "STARTING"

(A) "PREHEATING"
(B) "SWITCHED OFF"
(C) "OPERATION"
(D) "STARTING"

5. Turn the starter switch to the "PREHEATING" position to allow the glow lamp to redden.

NOTE :
(with lamp timer in use)
- The glow lamp goes out in about 5 seconds when the lamp timer is up. Refer to this for pre-heating. Even with the glow lamp off, the glow plug can be pre-heated by turning the starter switch to the "PRE-HEATING" position.

6. Turn the key to the "STARTING" position and the engine should start. Release the key immediately when the engine starts.

7. Check to see that the oil pressure lamp and charge lamp are off. If the lamps are still on, immediately stop the engine, and determine the cause.
(See "**CHECKS DURING OPERATION**" in "**OPERATING THE ENGINE**" section.)

NOTE :
- If the oil pressure lamp should be still on, immediately stop the engine and check;
  - if there is enough engine oil.
  - if the engine oil has dirt in it.
  - if the wiring is faulty.

8. Warm up the engine at medium speed without load.

IMPORTANT :
- If the glow lamp should redden too quickly or too slowly, immediately ask your KUBOTA dealer to check and repair it.
- If the engine does not catch or start at 10 seconds after the starter switch is set at "STARTING" position, wait for another 30 seconds and then begin the engine starting sequence again. Do not allow the starter motor to run continuously for more than 20 seconds.

COLD WEATHER STARTING

If the ambient temperature is below -5°C(23°F)* and the engine is very cold, start it in the following manner:
Take steps (1) through (4) above.

5. Turn the key to the "PREHEATING" position and keep it there for a certain period mentioned below.

IMPORTANT :
- Shown below are the standard preheating times for various temperatures. This operation, however, is not required, when the engine is warmed up.

Ambient temperature	Preheating time	
	V3600-E3 V3600-T-E3 V3300-E3BG V3600-T-E3BG	V3800-DI-T-E3 V3800-DI-T-E3BG
Above 10°C (50°F)	NO NEED	
10°C (50°F) to -5°C (23°F)	Approx.5 seconds	Approx.15 seconds
Below -5°C (23°F)	Approx.10 seconds	Approx.30 seconds
Limit of continuous use	20 seconds	30 seconds

6. Turn the key to the "STARTING" position and the engine should start.
(If the engine fails to start after 10 seconds, turn off the key for 5 to 30 seconds. Then repeat steps (5) and (6).)

IMPORTANT :
- Do not allow the starter motor to run continuously for more than 20 seconds.
- Be sure to warm up the engine, not only in winter, but also in warmer seasons. An insufficiently warmed-up engine can shorten its service life.
- When there is fear of temperature dropping below -15°C (5°F) detach the battery from the machine, and keep it indoors in a safe area, to be reinstalled just before the next operation.

ENGLISH

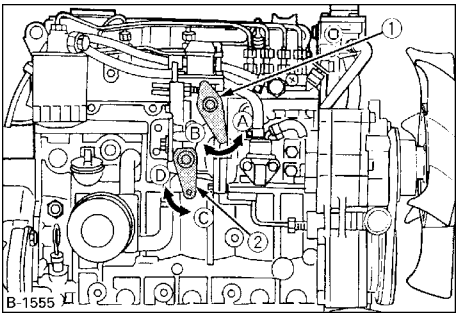
STOPPING THE ENGINE

1. **Return the speed control lever to low idle, and run the engine under idling conditions.**

IMPORTANT :
- If equipped with a turbo-charger, allow the engine to idle for 5 minutes before shutting it off after a full load operation.
  Failure to do so may lead to turbo-charger trouble.

2. **The engine should stop with the starter switch placed at the OFF position. (In case of non-stopping, set the engine stop lever to the "STOP" position manually.)**

3. **After stopping the engine, remove the key.(Be sure to return the engine stop lever to the START position to be ready for the next starting in case of manually stopping.)**



(1) Speed control lever
(2) Engine stop lever
(A) "IDLING"
(B) "OPERATION"
(C) "START"
(D) "STOP"

CHECKS DURING OPERATION

While running, make the following checks to see that all parts are working correctly.

■Radiator Cooling water(Coolant)

⚠ WARNING

To avoid personal injury:

- **Do not remove radiator cap until coolant temperature is well below its boiling point. Then loosen cap slightly to the stop position, to relieve any pressure, before removing cap completely.**

If the coolant temperature warning lamp lights up or if steam or coolant does not stop squirting from the radiator overflow pipe, turn off the load and **keep the engine idling (COOLING-DOWN) for at least 5 minutes** to let it cool down gradually. Then stop the engine and take the following inspection and servicing.

1. Check to see if the coolant runs short or if there is any coolant leak;
2. Check to see if there is any obstacle around the cooling air inlet or outlet;
3. Check to see if there is any dirt or dust between radiator fins and tube;
4. Check to see if the fan belt is too loose; and
5. Check to see if radiator water pipe is clogged.

■Oil pressure lamp

The lamp lights up to warn the operator that the engine oil pressure has dropped below the prescribed level. If this should happen during operation or should not go off even after the engine is accelerated more than 1000rpm, immediately stop the engine and check the following:

1. Engine oil level (See "**ENGINE OIL**" in "**PERIODIC SERVICE**" section.)

■Charge lamp

The lamp lights up to warn the operator that the battery charge is low. If this should happen during operation, immediately stop the engine and check the following:

1. Cable broken
2. Poor connection at alternator terminal
3. Fan belt too loose or damaged

■**Fuel**

CAUTION

To avoid personal injury:

- **Fluid escaping from pinholes may be invisible. Do not use hands to search for suspected leaks; Use a piece of cardboard or wood, instead. If injured by escaping fluid, see a medical doctor at once. This fluid can produce gangrene or a severe allergic reaction.**
- **Check any leaks from fuel pipes or fuel injection pipes. Use eye protection when checking for leaks.**

Be careful not to empty the fuel tank. Otherwise air may enter the fuel system, requiring fuel system bleeding. (See "**FUEL**" in "**PERIODIC SERVICE**" section.)

■**Color of exhaust**

While the engine is run within the rated output range:

- The color of exhaust remains colorless.
- If the output slightly exceeds the rated level, exhaust may become a little colored with the output level kept constant.
- If the engine is run continuously with dark exhaust emission, it may lead to trouble with the engine.

■**Immediately stop the engine if;**

- The engine suddenly slows down or accelerates.
- Unusual noises are suddenly heard.
- Exhaust fumes suddenly become very dark.
- The oil pressure lamp or the water temperature alarm lamp lights up.

REVERSED ENGINE REVOLUTION AND REMEDIES

CAUTION

To avoid personal injury:

- **Reversed engine operation can make the machine reverse and run it backwards. It may lead to serious trouble.**
- **Reversed engine operation may make exhaust gas gush out into the intake side and ignite the air cleaner; It could catch fire.**

Reversed engine revolution must be stopped immediately since engine oil circulation is cut quickly, leading to serious trouble.

■**How to tell when the engine starts running backwards**

1. Lubricating oil pressure drops sharply. Oil pressure warning light, if used, will light.
2. Since the intake and exhaust sides are reversed, the sound of the engine changes, and exhaust gas will come out of the air cleaner.
3. A louder knocking sound will be heard when the engine starts running backwards.

■**Remedies**

1. Immediately turn the starter switch to the "OFF" position and set the engine stop lever to the "STOP" position to stop the engine.
2. After stopping the engine, check the air cleaner, intake rubber tube and other parts and replace parts as needed.

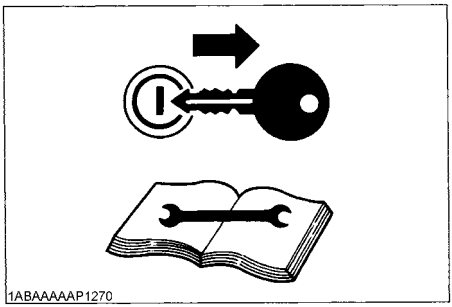
ENGLISH

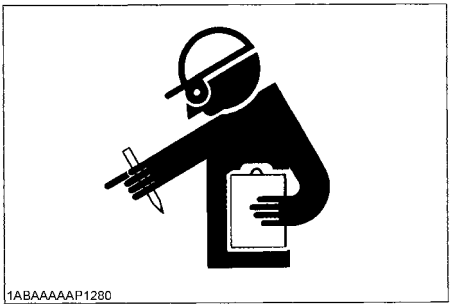
MAINTENANCE

CAUTION

To avoid personal injury:

- **Be sure to conduct daily checks, periodic maintenance, refueling or cleaning on a level surface with the engine shut off and remove the key.**
- **Before allowing other people to use your engine, explain how to operate, and have them read this manual before operation.**
- **When cleaning any parts, do not use gasoline but use regular cleanser.**
- **Always use proper tools, that are in good condition. Make sure you understand how to use them, before performing any service work.**
- **When installing, be sure to tighten all bolts lest they should be loose. Tighten the bolts by the specified torque.**
- **Do not put any tools on the battery, or battery terminals may short out. Severe burns or fire could result. Detach the battery from the engine before maintenance.**
- **Do not touch muffler or exhaust pipes while they are hot; Severe burns could result.**


1ABAAAAAP1270


1ABAAAAAP1280

SERVICE INTERVALS

Observe the following for service and maintenance.

Interval	Item	Ref. page		
Every 50 hours	Check of fuel pipes and clamp bands	14		@
	Draining water separator	-		
See NOTE	Change of engine oil	15 to 17	◎	
Every 250 hours	Cleaning of air cleaner element	21	*1	@
	Cleaning of fuel filter	14		
	Check of fan belt tightness	22		
	Check of radiator hoses and clamp bands	19		
	Check of intake air line	-		@
Every 500 hours	Replacement of oil filter cartridge	17	◎	
	Replacement of fuel filter cartridge	15		@
	Removal of sediment in fuel tank	-		
	Cleaning of water jacket (radiator interior)	18 to 20		
	Replacement of fan belt	22		
	Cleaning of water separator	-		
Every year	Replacement of air cleaner element	21	*2	@
Every 1000 hours	Check of valve clearance	-	*3	
Every 1500 hours	Check of fuel injection nozzle injection pressure	-	*3	@
Every 3000 hours	Check of turbo charger	-	*3	@
	Check of injection pump	-	*3	@
	Check of fuel injection timer	-	*3	@
Every two years	Change of radiator coolant (L.L.C.)	19 to 20		
	Replacement of radiator hoses and clamp bands	19		
	Replacement of fuel pipes and clamp bands	14	*3	@
	Replacement of intake air line	-	*4	@
	Replacement of fan belt (or every 500 hours)	22		

IMPORTANT :

- The jobs indicated by ◎ must be done after the first 50 hours of operation.

*1 Air cleaner should be cleaned more often in dusty conditions than in normal conditions.
*2 After 6 times of cleaning.
*3 Consult your local KUBOTA Dealer for this service.
*4 Replace only if necessary.

- When the battery is used for less than 100 hours in a year, check its electrolyte yearly. (for refillable battery's only)
- The items listed above (@ marked) are registered as emission related critical parts by KUBOTA in the U.S. EPA nonroad emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction.
  Please see the Warranty Statement in detail.

NOTE :

- **Changing interval of engine oil**

Models	Interval
V3600-E3, V3600-T-E3, V3300-E3BG, V3600-T-E3BG	250 Hrs or 1 year whichever comes first
V3800-DI-T-E3, V3800-DI-T-E3BG	500 Hrs or 1 year whichever comes first
Initial	50 Hrs

- API service classification: above CF-4 grade
- Ambient temperature: below 35°C (95°F)

NOTE :

Lubricating oil

With strict emission control regulations now in effect, the CF-4 and CG-4 engine oils have been developed for use with low sulfur fuels, for On-Highway vehicle engines. When a Non-Road engine runs on high sulfur fuel, it is advisable to use a "CF or better" classification engine oil with a high Total Base Number (a minimum TBN of 10 is recommended).

- **Lubricating oil recommended when a low-sulfur or high-sulfur fuel is employed.**

○ : Recommendable × : Not recommendable

Lubricating oil classification	Fuel		Remarks
	Low-sulfur	High-sulfur	
CF	○	○	*TBN≧10
CF-4	○	×	
CG-4	○	×	
CH-4	○	×	
CI-4	○	×	

*TBN: Total Base Number
**Fuel

- Diesel Fuel Specification Type and Sulfur Content % (ppm) used, must be compliant with all applicable emission regulations for the area in which the engine is operated.
- Use of diesel fuel with sulfur content less than 0.05 % (500 ppm) is strongly recommended.
- If high-sulfur fuel (sulfur content 0.50 % (5000 ppm) to 1.0 % (10000 ppm)) is used as a diesel fuel, change the engine oil and oil filter at shorter intervals. (approximately half).
- DO NOT USE Fuels that have sulfur content greater than 1.0 % (10000 ppm).
- Since KUBOTA diesel engines of less than 56 kW (75 hp) utilize EPA Tier 4 and Interim Tier 4 standards, the use of ultra low sulfur fuel is mandatory for these engines, when operated in US EPA regulated areas. Therefore, please use No.2-D S15 diesel fuel as an alternative to No.2-D, and use No.1-D S15 diesel fuel as an alternative to No.1-D for ambient temperatures below -10°C (14°F).
  No.1-D or No.2-D, S15 : Ultra Low Sulfur Diesel (ULSD) 15 ppm or 0.0015 wt.%

- CJ-4 classification oil is intended for use in engines equipped with DPF (Diesel Particulate Filter) and is Not Recommended for use in Kubota E3 specification engines.
- Oil used in the engine should have API classification and Proper SAE Engine Oil according to the ambient temperatures as shown below:

Above 25°C (77°F)	SAE30, SAE10W-30 or 15W-40
-10°C to 25°C (14°F to 77°F)	SAE10W-30 or 15W-40
Below -10°C (14°F)	SAE10W-30

- Recommended API classification
  Refer to the following table for the suitable American Petroleum Institute (API) classification of engine oil according to the engine type (with internal EGR, external EGR or non-EGR) and the Fuel Type Used : (Ultra Low Sulfur or High Sulfur Fuels).

Fuel type	Engine oil classification (API classification)	
	Engines with non-EGR Engines with internal EGR	Engines with external EGR
High Sulfur Fuel [0.05 % (500 ppm) ≦ Sulfur Content < 0.50 % (5000 ppm)]	**CF** (If the "CF-4, CG-4, CH-4 or CI-4" engine oil is used with a high-sulfur fuel, change the engine oil at shorter intervals. (approximately half))	---
Ultra Low Sulfur Fuel [Sulfur Content < 0.0015 % (15 ppm)]	**CF, CF-4, CG-4, CH-4 or CI-4**	**CF or CI-4** (Class CF-4, CG-4 and CH-4 engine, oils cannot be used on EGR type engines.)

EGR: Exhaust Gas Re-circulation

ENGLISH

PERIODIC SERVICE

FUEL

Fuel is flammable and can be dangerous. You should handle fuel with care.

CAUTION

To avoid personal injury:

- **Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.**
- **Be careful not to spill fuel during refueling. If fuel should spill, wipe it off at once, or it may cause a fire.**
- **Do not fail to stop the engine before refueling. Keep the engine away from the fire.**
- **Be sure to stop the engine while refueling or bleeding and when cleaning or changing fuel filter or fuel pipes. Do not smoke when working around the battery or when refueling.**
- **Check the above fuel systems at a well ventilated and wide place.**
- **When fuel and lubricant are spilled, refuel after letting the engine cool off.**
- **Always keep spilled fuel and lubricant away from engine.**

■Fuel level check and refueling

1. Check to see that the fuel level is above the lower limit of the fuel level gauge.
2. If the fuel is too low, add fuel to the upper limit. Do not overfill.

Flash Point, °C (°F)	Water and Sediment, volume %	Carbon Residue on, 10 percent Residuum, %	Ash, weight %
Min	Max	Max	Max
52 (125)	0.05	0.35	0.01

Distillation Temperatures, °C(°F) 90% Point		Viscosity Kinematic cSt or mm^2/s at 40°C		Viscosity Saybolt, SUS at 37.8°C(100°F)	
Min	Max	Min	Max	Min	Max
282 (540)	338 (640)	1.9	4.1	32.6	40.1

Sulfur, weight %	Copper Strip Corrosion	Cetane Number
Max	Max	Min
0.50	No. 3	40

- Cetane Rating : The minimum recommended Fuel Cetane Rating is 45. A cetane rating greater than 50 is preferred, especially for ambient temperatures below -20 °C (-4 °F) or elevations above 1500 m (5000 ft).
- Diesel Fuel Specification Type and Sulfur Content % (ppm) used, must be compliant with all applicable emission regulations for the area in which the engine is operated.
- Use of diesel fuel with sulfur content less than 0.05 % (500 ppm) is strongly recommended.
- If high-sulfur fuel (sulfur content 0.50 % (5000 ppm) to 1.0 % (10000 ppm)) is used as a diesel fuel, change the engine oil and oil filter at shorter intervals. (approximately half).
- DO NOT USE Fuels that have sulfur content greater than 1.0 % (10000 ppm).
- Diesel fuels specified to EN 590 or ASTM D975 are recommended.
- No.2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service. (SAE J313 JUN87)
- Since KUBOTA diesel engines of less than 56 kW (75 hp) utilize EPA Tier 4 and Interim Tier 4 standards, the use of ultra low sulfur fuel is mandatory for these engines, when operated in US EPA regulated areas. Therefore, please use No.2-D S15 diesel fuel as an alternative to No.2-D, and use No.1-D S15 diesel fuel as an alternative to No.1-D for ambient temperatures below -10 °C (14 °F).
  1) SAE : Society of Automotive Engineers
  2) EN : European Norm
  3) ASTM : American Society of Testing and Materials
  4) US EPA : United States Environmental Protection Agency
  5) No.1-D or No.2-D, S15 : Ultra Low Sulfur Diesel (ULSD) 15 ppm or 0.0015 wt.%

IMPORTANT :
- Be sure to use a strainer when filling the fuel tank, or dirt or sand in the fuel may cause trouble in the fuel injection pump.
- For fuel, always use diesel fuel. You are required not to use alternative fuel, because its quality is unknown or it may be inferior in quality. Kerosene, which is very low in cetane rating, adversely affects the engine. Diesel fuel differs in grades depending on the temperature.
- Be careful not to let the fuel tank become empty, or air can enter the fuel system, necessitating bleeding before next engine start.

■Air bleeding the fuel system

CAUTION

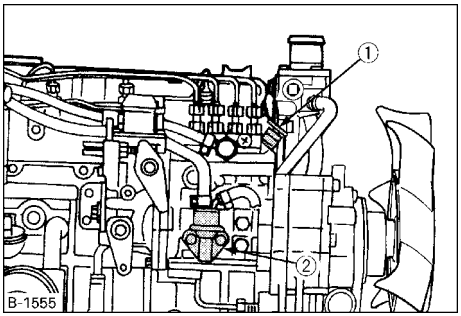
To avoid personal injury;
- **Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.**

Air bleeding of the fuel system is required if;
- after the fuel filter and pipes have been detached and refitted;
- after the fuel tank has become empty; or
- before the engine is to be used after a long storage.

[PROCEDURE Ⓐ] (gravity feed fuel tanks only)
1. Fill the fuel tank to the fullest extent. Open the fuel filter lever.
2. Open the joint bolt on top of the fuel injection pump.
3. Turn the engine, continue it for about 10 seconds, then stop it, or move the fuel feed pump lever by hand (optional).
4. Close the Joint bolt on top of the fuel injection pump.

IMPORTANT :
- Always keep the air vent cock on the fuel injection pump closed except when air is vented, or it may cause the engine to stop.

[GRAVITY FEED SYSTEM]



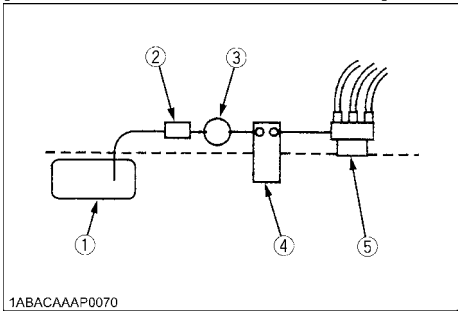
(1) Joint bolt
(2) Fuel feed pump

NOTE :
- For the engine equipped with automatic venting (optional) no manual bleeding of fuel lines is required.

[PROCEDURE Ⓑ] (fuel tanks lower than injection pump)
1. For fuel tanks that are lower than the injection pump. The fuel system must be pressurized by the fuel system electric fuel pump.
2. If an electric fuel pump is not used, you must manually actuate the pump by lever to bleed.
3. The primary fuel filter ③ must be on the pressure side of the pump if the fuel tank is lower than the injection pump.
4. To bleed follow (2) through (4) above. (PROCEDURE Ⓐ)

IMPORTANT :
- Tighten air vent plug of the fuel injection pump except when bleeding, or it may stop the engine suddenly.

[TANK BELOW INJECTION PUMP SYSTEM]



(1) Fuel tank below injection pump
(2) Pre-filter
(3) Electric or Mechanical pump
(4) Main Filter
(5) Injection pump

■Checking the fuel pipes

CAUTION

To avoid personal injury;

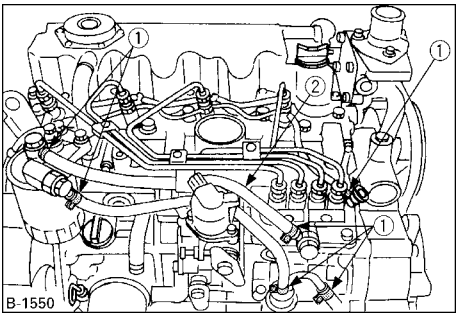
- **Check or replace the fuel pipes after stopping the engine. Broken fuel pipes can cause fires.**

Check the fuel pipes every 50 hours of operation. When if;

1. If the clamp band is loose, apply oil to the screw of the band, and tighten the band securely.
2. If the fuel pipes, made of rubber, became worn out, replace them and clamp bands every 2 years.
3. If the fuel pipes and clamp bands are found worn or damaged before 2 years' time, replace or repair them at once.
4. After replacement of the pipes and bands, air-bleed the fuel system.

IMPORTANT :

- When the fuel pipes are not installed, plug them at both ends with clean cloth or paper to prevent dirt from entering. Dirt in the pipes can cause fuel injection pump malfunction.

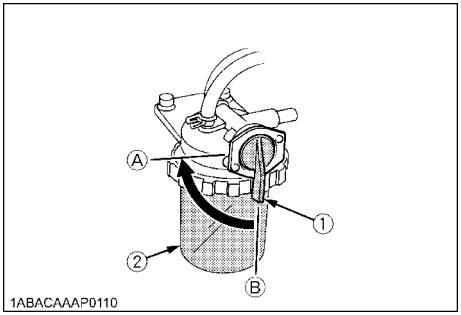


(1) Clamp band
(2) Fuel pipe

■Cleaning the fuel filter pot

Every 100 hours of operation, clean the fuel filter in a clean place to prevent dust intrusion.

1. Close the fuel filter lever.

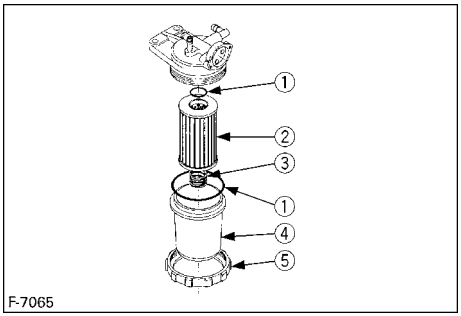


(1) Fuel filter lever
(2) Fuel filter pot
(A) "OFF"
(B) "ON"

2. Remove the top cap, and rinse the inside with diesel fuel.
3. Take out the element, and rinse it with diesel fuel.
4. After cleaning, reinstall the fuel filter, keeping out of dust and dirt.
5. Air-bleed the injection pump.

IMPORTANT :

- Entrance of dust and dirt can cause a malfunction of the fuel injection pump and the injection nozzle. Wash the fuel filter cup periodically.



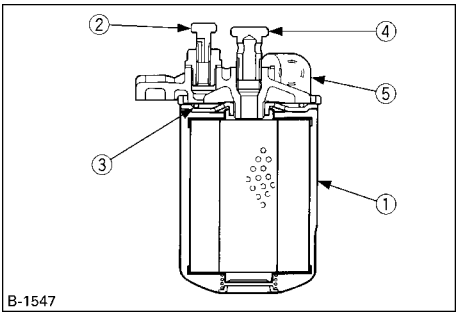
(1) O ring
(2) Filter element
(3) Spring
(4) Filter bowl
(5) Screw ring

■Fuel filter cartridge replacement

1. Replace the fuel filter cartridge with a new one every 500 operating hours.
2. Apply fuel oil thinly over the gasket and tighten the cartridge into position by hand-tightening only.
3. Finally, vent the air.

IMPORTANT :

- Replace the fuel filter cartridge periodically to prevent wear of the fuel injection pump plunger or the injection nozzle, due to dirt in the fuel.



(1) Fuel filter cartridge
(2) Air vent plug
(3) O ring
(4) Pipe joint
(5) Cover

NOTE :

- The fuel filter cartridge and water separator should be replaced more earlier according to the fuel classification in use.

ENGINE OIL

⚠ CAUTION

To avoid personal injury:

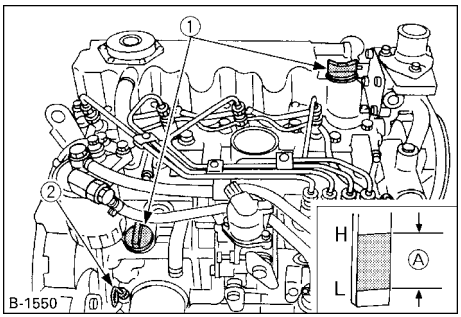
- **Be sure to stop the engine before checking and changing the engine oil and the oil filter cartridge.**
- **Do not touch muffler or exhaust pipes while they are hot; Severe burns could result. Always stop the engine and allow it to cool before conducting inspections, maintenance, or for a cleaning procedure.**
- **Contact with engine oil can damage your skin. Put on gloves when using engine oil. If you come in contact with engine oil, wash it off immediately.**

IMPORTANT :

- Do not operate a diesel engine when engine oil is overfilled. This oil can drain through the air intake system, which cause engine disacceleration and oil leaks from breather pipings. It could result in a over-running or oil hammering of engine in case of the engine with suction blow-by gases breathered in.

■Checking oil level and adding engine oil

1. Check the engine oil level before starting or more than 5 minutes after stopping the engine.
2. Remove the oil level gauge, wipe it clean and reinstall it.
3. Take the oil level gauge out again, and check the oil level.



(1) Oil filler plug
(2) Oil level gauge
[Lower end of oil level gauge]
(A) Engine oil level within this range is proper.

4. If the oil level is too low, remove the oil filler plug, and add new oil to the prescribed level.
5. After adding oil, wait more than 5 minutes and check the oil level again. It takes some time for the oil to drain down to the oil pan.

Models	Engine oil quantity
V3600-E3, V3600-T-E3, V3800-DI-T-E3, V3300-E3BG, V3600-T-E3BG, V3800-DI-T-E3BG	13.2 L (3.49 U.S. gal.)

* API service classification: above CF grade

IMPORTANT :

- Engine oil should be MIL-L-2104C or have properties of API classification CF or higher.
  Change the type of engine oil according to the ambient temperature.

above 25°C (77°F)	SAE30 or SAE10W-30 SAE15W-40
-10°C to 25°C (14°F to 77°F)	SAE10W-30 or SAE15W-40
below -10°C (14°F)	SAE10W-30

- When using oil of different brands from the previous one, be sure to drain all the previous oil before adding the new engine oil.

NOTE :

- Be sure to inspect the engine, locating it on a level place. If placed on gradients accurately, oil quantity may not be measured.

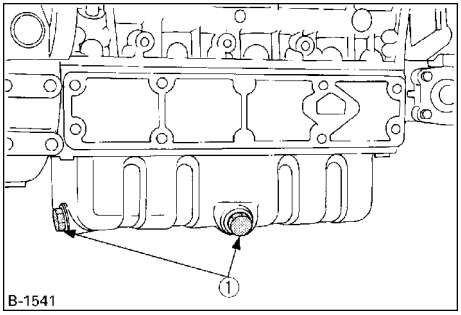
■Changing engine oil

CAUTION

To avoid personal injury:

- **Be sure to stop the engine before draining engine oil.**
- **When draining engine oil, place some container underneath the engine and dispose it according to local regulations.**
- **Do not drain oil after running the engine. Allow engine to cool down sufficiently.**

1. Change oil after the initial 50 hours of operation and every 500 (for DI spec), 250 (for IDI spec) hours thereafter.
   When the annual operating hours are below 500 (DI spec) or 250 (IDI spec), replace the oil every year.
2. Remove the drain plug at the bottom of the engine, and drain all the old oil. Drain oil will drain easier when the oil is warm.
3. When letting out the oil, remove the filler plug too. With the filler plug still in place, it would be difficult to discharge the oil completely.
4. Add new engine oil up to the upper limit of the oil level gauge. Be careful not to add oil above the upper limit of the oil level gauge.



(1) Oil drain plug

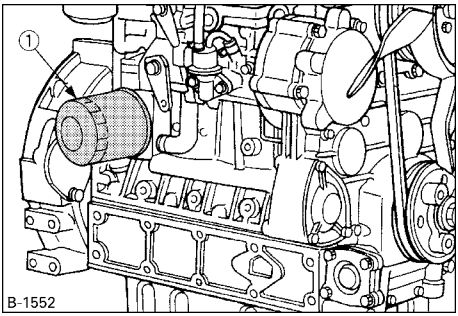
■**Replacing the oil filter cartridge**

CAUTION

To avoid personal injury:

- **Be sure to stop the engine before changing the oil filter cartridge.**
- **Allow engine to cool down sufficiently, oil can be hot and cause burns.**

1. Replace the oil filter cartridge. Oil filter cartridge should be replaced after the initial 50 hours of operation and every 500 hours thereafter.
2. Remove the old oil filter cartridge with a filter wrench.
3. Apply a film of oil to the gasket for the new cartridge.
4. Screw in the cartridge by hand. When the gasket contacts the seal surface, tighten the cartridge enough by hand. Because, if you tighten the cartridge with a wrench, it will be tightened too much.



(1) Oil filter cartridge

5. After the new cartridge has been replaced, the engine oil level normally decreases a little. Thus, run the engine for a while and check for oil leaks through the seal before checking the engine oil level. Add oil if necessary.

NOTE :

- Wipe off any oil sticking to the machine completely.

RADIATOR

Coolant will last for one day's work if filled all the way up before operation start. Make it a rule to check the coolant level before every operation.

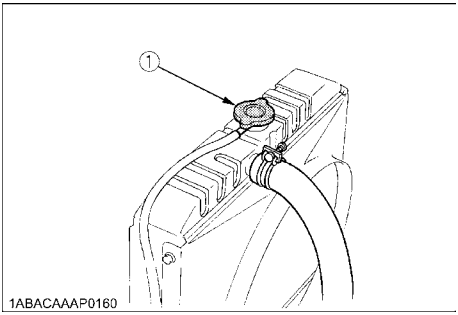
WARNING

To avoid personal injury:

- **Do not stop the engine suddenly, stop it after about 5 minutes of unloaded idling.**
- **Work only after letting the engine and radiator cool off completely (more than 30 minutes after it has been stopped).**
- **Do not remove the radiator cap while coolant is hot. When cool to the touch, rotate cap to the first stop to allow excess pressure to escape. Then remove cap completely.**
  If overheats should occur, steam may gush out from the radiator or recovery tank; Severe burns could result.

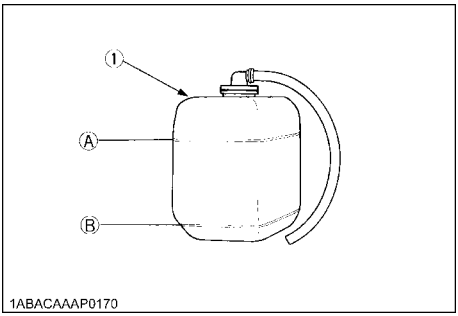
■Checking coolant level, adding coolant

1. Remove the radiator cap, after the engine has completely cooled, and check to see that coolant reaches the supply port.



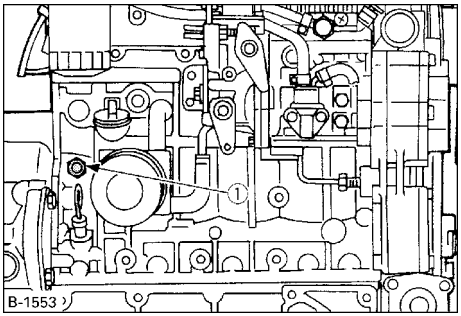
(1) Radiator pressure cap

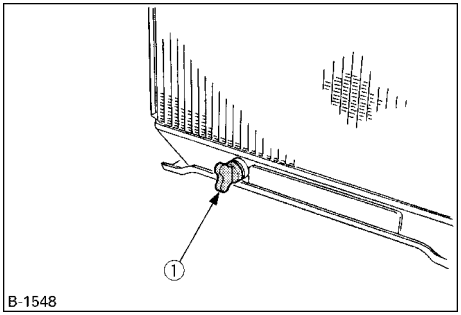
2. If the radiator is provided with a recovery tank, check the coolant level of the recovery tank. When it is between the "FULL" and "LOW " marks, the coolant will last for one day's work.



(1) Recovery tank (A) "FULL"
(B) "LOW "

3. When the coolant level drops due to evaporation, add water only up to the full level.
4. Check to see that two drain cocks; one is at the crankcase side and the other is at the lower part of the radiator as figures below.





(1) Coolant drain cock

IMPORTANT :

- If the radiator cap has to be removed, follow the caution and securely retighten the cap.
- If coolant should be leak, consult your local KUBOTA dealer.
- Make sure that muddy or sea water does not enter the radiator.
- Use clean, fresh water and 50% anti-freeze to fill the recovery tank.
- Do not refill recovery tank with coolant over the "FULL" level mark.
- Be sure to close the radiator cap securely. If the cap is loose or improperly closed, coolant may leak out and decrease quickly.

■Changing coolant

1. To drain coolant, always open both drain cocks and simultaneously open the radiator cap as well. With the radiator cap kept closed, a complete drain of water is impossible.
2. Remove the overflow pipe of the radiator pressure cap to drain the recovery tank.
3. Prescribed coolant volume (U.S.gallons)

Models	Quantity
V3600-E3, V3600-T-E3, V3800-DI-T-E3, V3300-E3BG, V3600-T-E3BG, V3800-DI-T-E3BG	9.0 L (2.38 U.S. gal.)

NOTE :

- Coolant quantities shown are for standard radiators.

4. An improperly tightened radiator cap or a gap between the cap and the seat quickens loss of coolant.
5. Check and clean the plug threads and surface and the pucking thims of the water drain plug to prevent dirt and debris from the entering the engine.
6. Coolant (Radiator cleaner and anti-freeze)

Season	Coolant
All seasons	Pure water and anti-freeze (See "**Anti-freeze**" in "**RADIATOR**" section.)

■Remedies for quick decrease of coolant

1. Check any dust and dirt between the radiator fins and tube. If any, remove them from the fins and the tube.
2. Check the tightness of the fan belt. If loose, tighten it securely.
3. Check the internal blockage in the radiator hose. If scale forms in the hose, clean with the scale inhibitor or its equivalent.

■Checking radiator hoses and clamp

CAUTION

To avoid personal injury:

- **Be sure to check radiator hoses and clamp bands periodically. If radiator hose is damaged or coolant leaks, overheats or severe burns could occur.**

Check to see if radiator hoses are properly fixed every 250 hours of operation or 6 months, whichever comes first.

1. If clamp bands are loose or water leaks, tighten clamp bands securely.
2. Replace hoses and tighten clamp bands securely, if radiator hoses are swollen, hardened or cracked.

Replace hoses and clamp bands every 2 years or earlier, if checked and found that hoses are swollen, hardened or cracked.

■Precaution at overheating

The event that the coolant temperature is nearly or more than the boiling point is called **"OVERHEATING"**.
While running, make the following checks to see that all parts are working correctly. **If anything is unusual, inspect it, referring to the relevant description in "MAINTENANCE" and "PERIODIC SERVICE" section**.

◆ Coolant

If the coolant temperature warning lamp lights up or if steam or coolant does not stop squirting from the radiator overflow pipe, turn off the load and **keep the engine idling (COOLING-DOWN) for at least 5 minutes** to let it cool down gradually. Then stop the engine and take the following inspection and servicing.

1. Check to see if the coolant runs short or if there is any coolant leak;
2. Check to see if there is any obstacle around the cooling air inlet or outlet;
3. Check to see if there is any dirt or dust between radiator fins and tube;
4. Check to see if the fan belt is too loose; and
5. Check to see if radiator water pipe is clogged.

■Cleaning radiator core(outside)

If dust is between the fin and tube, wash it away with running water.

IMPORTANT :

- Do not clean radiator with firm tools such as spatulas or screwdrivers. They may damage specified fin or tube. It can cause coolant leaks or decrease cooling performance.

■Anti-freeze

⚠ CAUTION

To avoid personal injury:

- When using anti-freeze, put on some protection such as rubber gloves (Anti-freeze contains poison.).
- If should drink anti-freeze, throw up at once and take medical attention.
- When anti-freeze comes in contact with the skin or clothing, wash it off immediately.
- Do not mix different types of anti-freeze. The mixture can produce chemical reaction causing harmful substances.
- Anti-freeze is extremely flammable and explosive under certain conditions. Keep fire and children away from anti-freeze.
- When draining fluids from the engine, place some container underneath the engine body.
- Do not pour waste onto the grounds, down a drain, or into any water source.
- Also, observe the relevant environmental protection regulations when disposing of anti-freeze.

Always use a 50/50 mix of long-life coolant and clean soft water in KUBOTA engines.
Contact KUBOTA concerning coolant for extreme conditions.

1. Long-life coolant (hereafter LLC) comes in several types. Use ethylene glycol (EG) type for this engine.
2. Before employing LLC-mixed cooling water, flush the radiator with fresh water. Repeat this procedure 2 or 3 times to clean up the radiator and engine block from inside.
3. Mixing the LLC
   Premix 50% LLC with 50% clean soft water. When mixing, stir it up well, and then fill into the radiator.
4. The procedure for the mixing of water and anti-freeze differs according to the make of the anti-freeze. Refer to SAE J1034 standard, more specifically also to SAE J814c.

Vol % Anti-freeze	Freezing Point		Boiling Point *	
	°C	°F	°C	°F
50	-37	-34	108	226

*At 1.013×10^5 Pa (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

5. Adding the LLC
   (1) Add only water if the coolant level reduces in the cooling system by evaporation.
   (2) If there is a coolant leak, add the LLC of the same manufacturer and type in the same coolant percentage.
   *Never add any long-life coolant of different manufacturer. (Different brands may have different additive components, and the engine may fail to perform as specified.)
6. When the LLC is mixed, do not employ any radiator cleaning agent. The LLC contains anti-corrosive agent. If mixed with the cleaning agent, sludge may build up, adversely affecting the engine parts.
7. Kubota's genuine long-life coolant has a service life of 2 years. Be sure to change the coolant every 2 years.

NOTE :

- The above data represent industry standards that necessitate a minimum glycol content in the concentrated anti-freeze.

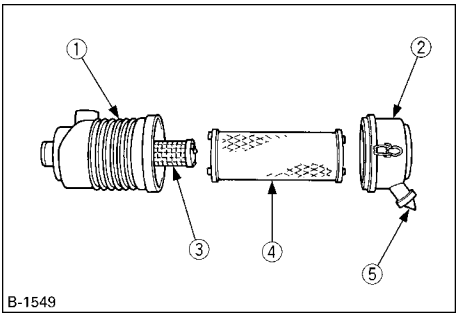
■Radiator cement

As the radiator is solidly constructed, there is little possibility of water leakage. Should this happen, however, radiator cement can easily fix it. If leakage is serious, contact your local KUBOTA dealer.

AIR CLEANER

Since the air cleaner employed on this engine is a dry type, never apply oil to it.

1. Open the evacuator valve once a week under ordinary conditions - or daily when used in a dusty place. This will get rid of large particles of dust and dirt.
2. Wipe the inside air cleaner clean with cloth if it is dirty or wet.
3. Avoid touching the primary element except when cleaning.
4. When dry dust adheres to the element, blow compressed air from the inside turning the element. Pressure of compressed air must be under 205 kPa (2.1 kgf/cm², 30 psi).
5. Replace the primary element every year or every 6 cleanings. If the primary element is stained heavily, replace it soon. At this time, replace the secondary element too.
6. The secondary element should be removed only if it is to be replaced.
7. To protect the engine, do not remove the secondary element in servicing the primary element.



(1) Air cleaner body
(2) Cover
(3) Secondary element
(4) Primary element
(5) Evacuator valve

IMPORTANT :

- Make sure the hooking clip for the element is tight enough. If it is loose, dust and dirt may be sucked in, wearing down the cylinder liner and piston ring earlier and thereby resulting in poor power output.
- Do not overservice the air cleaner element. Overservicing may cause dirt to enter the engine causing premature wear. Use the dust indicator as a guide on when to service.

■Cleaning Primary Air Filter Element

To clean the element, use clean dry compressed air on the inside of the element.
Air pressure at the nozzle must not exceed 205 kPa (2.1 kgf/cm²; 30 psi).
Maintain reasonable distance between the nozzle and the filter.

■Evacuator valve

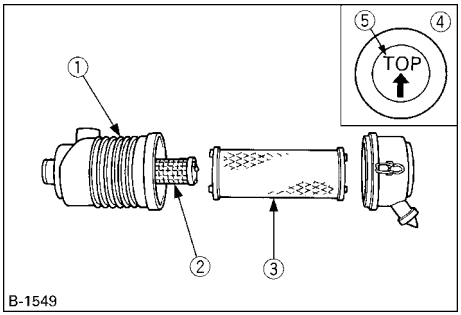
Open the evacuator valve once a week under ordinary conditions - or daily when used in a dusty place - to get rid of large particles of dust and dirt.

■For the air cleaner with a dust cup (optional)

Remove and clean out the dust cup before it becomes half full with dust; usually once a week, or even every day if the working surroundings are dusty.
Install the air cleaner dust cup with "TOP" indicated on the rear of the cup in the up position. (However, it may be installed in either direction when the cover is placed at the lower part.)

IMPORTANT :

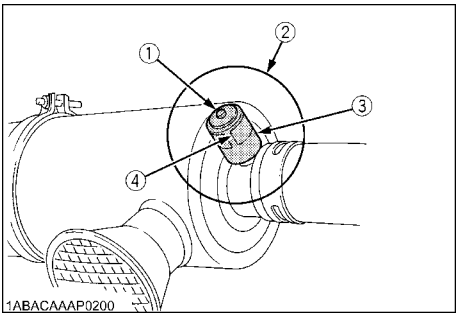
- If the dust cup is mounted incorrectly, dust or dirt does not collect in the cup, and direct attachments of the dust to the element will cause its lifetime to shorten to a great extent.



(1) Air cleaner body
(2) Secondary element
(3) Primary element
(4) Dust cup
(5) "Top" mark

■Dust indicator (optional)

If the red signal on the dust indicator attached to the air cleaner is visible, the air cleaner has reached the service level.
Clean the element immediately, and reset the signal with the "RESET" button.



(1) "RESET" button
(2) Dust indicator
(3) Service level
(4) Signal

ELECTRIC WIRING

CAUTION

To avoid personal injury:

◆Shorting of electric cable or wiring may cause a fire.

- **Check to see if electric cables and wiring are swollen, hardened or cracked.**
- **Keep dust and water away from all power connections.**
  Loose wiring terminal parts, make bad connections. Be sure to repair them before starting the engine.

Damaged wiring reduces the capacity of electrical parts. Change or repair damaged wiring immediately.

FAN BELT

■Adjusting Fan Belt Tension

CAUTION

To avoid personal injury:

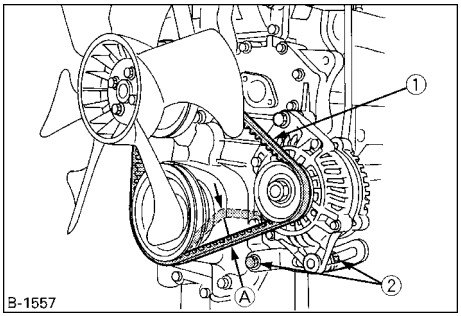
- **Be sure to stop the engine and remove the key before checking the belt tension.**
- **Be sure to reinstall the detached safety shield after maintenance or checking.**

Proper fan belt tension	A deflection of between 10 to 12 mm (0.39 to 0.47 in.) when the belt is pressed in the middle of the span.

1. Stop the engine and remove the key.
2. Apply moderate thumb pressure to belt between the pulleys.
3. If tension is incorrect, loosen the alternator mounting bolts and, using a lever placed between the alternator and the engine block, pull the alternator out until the deflection of the belt falls within acceptable limits.
4. Replace fan belt if it is damaged.

IMPORTANT :

- If belt is loosen or damaged and the fan is damaged, it could result in overheats or insufficient charging. Correct or replace belt.



(1) Fan belt
(2) Bolt and nut
(A) 10 to 12 mm (0.39 to 0.47 in.) (under load of 6~7 kgf (13.2~15.4 lbs))

CARRIAGE AND STORAGE

CARRIAGE

CAUTION

To avoid personal injury:

- **Fix the engine securely not to fall during operation.**
- **Do not stand near or under the engine while carrying it.**
- **The engine is heavy. In handling it, be very alert not to get your hands and body caught in.**

1. Use carrier such as crane when carrying the engine, or hurt your waist and yourself. Support the engine securely with rope not to fall while carrying it.
2. When lifting the engine, put the hook securely to metal fittings attached to the engine. Use strong hook and fittings enough to hang the engine.

STORAGE

CAUTION

To avoid personal injury:

- **Do not clean the machine with engine running.**
- **To avoid the danger of exhaust fume poisoning, do not operate the engine in a closed building without proper ventilation.**
- **When storing the engine just after running, let the engine cool off.**

Before storing the engine for more than a few months, remove any dirt on the machine, and:

1. Drain the coolant in the radiator. Open the cock at the bottom of the radiator, and remove the pressure cap to drain water completely. Leave the cock open. Hang a note written "No water" on the pressure cap. Since water may freeze when the temperature drops below 0°C (32°F), it is very important that no water is left in the machine.
2. Remove dirty engine oil, fill with new oil and run the engine for about 5 minutes to let the oil penetrate to all the parts.
3. Check all the bolts and nuts, and tighten if necessary.
4. Remove the battery from the engine, adjust the electrolyte level, and recharge it. Store the battery in a dry and dark place.
5. When the engine is not used for a long period of time, run it for about 5 minutes under no load every 2 to 3 months to keep it free from rust. If the engine is stored without any running, moisture in the air may condense into dew over the sliding parts of the engine, resulting in rust there.
6. If you forget to run the engine for longer than 5 to 6 months, apply enough engine oil to the valve guide and valve stem seal and make sure the valve works smoothly before starting the engine.
7. Store the engine in a flat place and remove the key from engine.
8. Do not store the engine in a place where has flammable materials such as dry grass or straw.
9. When covering the engine for storage, let engine and muffler cool off completely.
10. Operate the engine after checking and repairing damaged wirings or pipes, and clearing flammable materials carried by mouse.

ENGLISH

TROUBLESHOOTING

If the engine does not function properly, use the following chart to identify and correct the cause.

■When it is difficult to start the engine

Cause	Countermeasures
Fuel is thick and doesn't flow.	* Check the fuel tank and fuel filter. * Remove water, dirt and other impurities. * As all fuel will be filtered by the filter, if there should be water or other foreign matters on the filter, clean the filter with kerosene.
Air or water mixed in fuel system	* If air is in the fuel filter or injection lines, the fuel pump will not work properly. * To attain proper fuel injection pressure, check carefully for loosened fuel line coupling, loose cap nut, etc. * Loosen joint bolt stop fuel filter and air vent screws of fuel injection pump to eliminate all the air in the fuel system.
Engine oil becomes thick in cold weather and engine cranks slow.	* Change grade of oil according to the weather (temperature.)
Battery is discharged and the engine will not crank.	* Charge battery. * In winter, always remove battery from machine, charge fully and keep indoors. Install in machine at time of use.

■When output is insufficient

Cause	Countermeasures
Fuel is insufficient.	* Check fuel system.
Overheating of moving parts	* Check lubricating oil system. * Check to see if lubricating oil filter is working properly. * Filter element deposited with impurities would cause poor lubrication. Change element.
Air cleaner is dirty	* Clean the element every 100 hours of operation.
Injection pump wear	* Do not use poor quality fuel as it will cause wear of the pump. Only use No. 2-D diesel fuel. (See "**FUEL**" in "**PERIODIC SERVICE**" section.)

■When engine suddenly stops

Cause	Countermeasures
Lack of fuel	* Check the fuel tank and refill the fuel, if necessary. * Also check the fuel system for air or leaks.
Bad nozzle	* If necessary, replace with a new nozzle.
Moving parts are overheated due to shortage of lubrication oil or improper lubrication.	* Check amount of engine oil with oil level gauge. * Check lubricating oil system. * At every 2 times of oil change, oil filter cartridge should be replaced.

■When color of exhaust is especially bad

Cause	Countermeasures
Fuel is of extremely poor quality.	* Select good quality fuel. Use No. 2-D diesel fuel only.
Nozzle is bad.	* If necessary, replace with new nozzle.

■When engine must be stopped immediately

Cause	Countermeasures
Color of exhaust suddenly turns dark.	* Check the fuel injection system, especially the fuel injection nozzle.
Bearing parts are overheated.	* Check the lubricating system.
Oil lamp lights up during operation.	* Check the lubricating system. * Check the function of the relieve valve in the lubricating system. * Check pressure switch. * Check filter base gasket.

NOTE :

- If the cause of trouble can not be found, contact your KUBOTA dealer.

■When engine overheats

Cause	Countermeasures
Engine oil insufficient	* Check oil level. Replenish oil as required.
Fan belt broken or elongated	* Change belt or adjust belt tension.
Coolant insufficient	* Replenish coolant.
Excessive concentration of antifreeze	* Add water only or change to coolant with the specified mixing ratio.
Radiator net or radiator fin clogged with dust	* Clean net or fin carefully.
Inside of radiator or coolant flow route corroded	* Clean or replace radiator and parts.
Fan or radiator or radiator cap defective	* Replace defective parts.
Thermostat defective	* Check thermostat and replace if necessary.
Temperature gauge or sensor defective	* Check temperature with thermometer and replace if necessary.
Overload running	* Reduce load.
Head gasket defective or water leakage	* Replace parts.
Unsuitable fuel used	* Use the specified fuel.

SPECIFICATIONS

Model	V3600-E3	V3600-T-E3
Type	Vertical, water-cooled, 4-cycle diesel	
Number of cylinders	4	
Bore and stroke mm (in.)	98 × 120 (3.86 × 4.72)	
Total displacement L(cu.in.)	3.620 (220.9)	
Combustion type	Spherical type (E-TVCS)	
SAE NET Intermittent kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	45.8 / 2600 (61.4 / 2600)	58.8 / 2600 (78.8 / 2600)
SAE NET Continuous kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	39.8 / 2600 (29.7 / 2600)	51.1 / 2600 (68.5 / 2600)
SAE Standby kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	—	—
Maximum bare speed min^{-1}(rpm)	2800	
Maximum bare idling speed min^{-1}(rpm)	775 to 825	
Order of firing	1-3-4-2	
Direction of rotation	Counter-clockwise (viewed from flywheel side)	
Injection pump	Bosch type mini pump	
Injection pressure MPa (kgf / cm^2, psi)	13.93 (142, 2020)	
Injection timing (Before T.D.C.)	0.14 rad (8°)	0.07 rad (4°)
Compression ratio	22.6	21.8
Fuel	Diesel fuel oil No.2-D	
Lubricant (API classification)	above CF grade	
Dimension mm (in.) (length × width × height)	745 × 536 × 741.5 (29.33 × 21.10 × 29.19)	745 × 538.5 × 794 (29.33 × 21.20 × 31.26)
Dry weight kg (lbs.)	264 (582)	275 (606.3)
Starting system	Cell starter (with glow plug)	
Starting motor	12V, 3.0kW	
Charging generator	12V, 1080W(KEA), 720W(EU)	
Recommended battery capacity	12V, 136AH (400 CCA or higher) 0°F (-17.8°C) SAE rating	

NOTE :

- Specifications are subject to change without notice.

Model	V3800-DI-T-E3
Type	Vertical, water-cooled, 4-cycle diesel
Number of cylinders	4
Bore and stroke mm (in.)	100 × 120 (3.94 × 4.72)
Total displacement L(cu.in.)	3.769 (230)
Combustion type	Direct injection type (E-CDIS)
SAE NET Intermittent kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	71.4 / 2600 (95.7 / 2600)
SAE NET Continuous kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	62.0 / 2600 (83.1 / 2600)
SAE Standby kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	—
Maximum bare speed min^{-1}(rpm)	2800
Maximum bare idling speed min^{-1}(rpm)	775 to 825
Order of firing	1-3-4-2
Direction of rotation	Counter-clockwise (viewed from flywheel side)
Injection pump	Bosch type mini pump
Injection pressure MPa (kgf / cm^2, psi)	First opening pressure 18.63 (190, 2275) Second opening pressure 23.54 (240, 3128)
Injection timing (Before T.D.C.)	0.10 rad (6°)
Compression ratio	19.0
Fuel	Diesel fuel oil No.2-D
Lubricant (API classification)	above CF grade
Dimension mm (in.) (length × width × height)	745 × 549 × 794 (29.33 × 21.61 × 31.26)
Dry weight kg (lbs.)	288 (634.9)
Starting system	Cell starter (with air heater)
Starting motor	12V, 3.0kW
Charging generator	12V, 1080W(KEA), 720W(EU)
Recommended battery capacity	12V, 136AH (400 CCA or higher) 0°F (-17.8°C) SAE rating

NOTE :

- Specifications are subject to change without notice.

Model	V3300-E3BG
Type	Vertical, water-cooled, 4-cycle diesel
Number of cylinders	4
Bore and stroke mm (in.)	98 × 110 (3.86 × 4.33)
Total displacement L(cu.in.)	3.318 (202.49)
Combustion type	Spherical type (E-TVCS)
SAE NET Continuous kW / min^{-1}(rpm)	30.6 / 1800 (41.0 / 1800)
H.P. (SAEJ1349) (HP / min^{-1} (rpm))	25.0 / 1500 (33.5 / 1500)
SAE Standby kW / min^{-1}(rpm)	33.6 / 1800 (45.0 / 1800)
H.P. (SAEJ1349) (HP / min^{-1} (rpm))	27.5 / 1500 (36.9 / 1500)
Maximum bare speed min^{-1}(rpm)	1890
Order of firing	1-3-4-2
Direction of rotation	Counter-clockwise (viewed from flywheel side)
Injection pump	Bosch type mini pump
Injection pressure MPa (kgf / cm^2, psi)	13.93 (142, 2020)
Injection timing (Before T.D.C.)	0.17 rad (10°)
Compression ratio	22.6
Fuel	Diesel fuel oil No.2-D
Lubricant (API classification)	above CF grade
Dimension mm (in.) (length × width × height)	769 × 536 × 770 (30.28 × 20.10 × 30.31)
Dry weight kg (lbs.)	276 (608)
Starting system	Cell starter (with air heater)
Starting motor	12V, 2.5kW
Charging generator	12V 540W
Recommended battery capacity	12V, 88AH

NOTE :

- Specifications are subject to change without notice.

NOTE (FOR E3BG or T-E3BG type):

- Flywheel type is SAE clutch No.11-1/2, SAE clutch No.10 or its equivalent.
- Flywheel housing type is SAE No.3 or its equivalent.
- Governor drop is within 5%.
- Continuous will operate at the stated rating continuously and have a 10% overload capability for one hour in 12 hours.
- Standby will operate at the stated full rating for one hour in 12 hours. No overload capacity is specified for this rating.

Model	V3600-T-E3BG
Type	Vertical, water-cooled, 4-cycle diesel
Number of cylinders	4
Bore and stroke mm (in.)	98 × 120 (3.86 × 4.72)
Total displacement L(cu.in.)	3.620 (220.9)
Combustion type	Spherical type (E-TVCS)
SAE NET Continuous kW / min^{-1}(rpm)	39.2/1800 (52.5/1800)
H.P. (SAEJ1349) (HP / min^{-1} (rpm))	32.1/1500 (43.0/1500)
SAE Standby kW / min^{-1}(rpm)	43.1/1800 (57.8/1800)
H.P. (SAEJ1349) (HP / min^{-1} (rpm))	35.3/1500 (47.3/1500)
Maximum bare speed min^{-1}(rpm)	1890
Order of firing	1-3-4-2
Direction of rotation	Counter-clockwise (viewed from flywheel side)
Injection pump	Bosch type mini pump
Injection pressure MPa (kgf / cm^2, psi)	13.93 (142, 2020)
Injection timing (Before T.D.C.)	0.09 rad (5°)
Compression ratio	21.8
Fuel	Diesel fuel oil No.2-D
Lubricant (API classification)	above CF grade
Dimension mm (in.) (length × width × height)	769 × 539 × 803 (30.28 × 21.22 × 31.61)
Dry weight kg (lbs.)	283 (624)
Starting system	Cell starter (with air heater)
Starting motor	12V, 3.0kW
Charging generator	12V 540W
Recommended battery capacity	12V, 88AH

NOTE :

- Specifications are subject to change without notice.

NOTE (FOR E3BG or T-E3BG type):

- Flywheel type is SAE clutch No.11-1/2, SAE clutch No.10 or its equivalent.
- Flywheel housing type is SAE No.3 or its equivalent.
- Governor drop is within 5%.
- Continuous will operate at the stated rating continuously and have a 10% overload capability for one hour in 12 hours.
- Standby will operate at the stated full rating for one hour in 12 hours. No overload capacity is specified for this rating.

Model	V3800-DI-T-E3BG
Type	Vertical, water-cooled, 4-cycle diesel
Number of cylinders	4
Bore and stroke mm (in.)	100 × 120 (3.94 × 4.72)
Total displacement L(cu.in.)	3.769 (230)
Combustion type	Direct injection type (E-CDIS)
SAE NET Intermittent kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	—
SAE NET Continuous kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	48.0 / 1800 (64.4 / 1800)
SAE Standby kW / min^{-1}(rpm) H.P. (SAEJ1349) (HP / min^{-1} (rpm))	52.8 / 1800 (70.8 / 1800)
Maximum bare speed min^{-1}(rpm)	1800
Maximum bare idling speed min^{-1}(rpm)	—
Order of firing	1-3-4-2
Direction of rotation	Counter-clockwise (viewed from flywheel side)
Injection pump	Bosch type mini pump
Injection pressure MPa (kgf / cm^2, psi)	First opening pressure 18.63 (190, 2275) Second opening pressure 23.54 (240, 3128)
Injection timing (Before T.D.C.)	0.11 rad (6.5°)
Compression ratio	19.0
Fuel	Diesel fuel oil No.2-D
Lubricant (API classification)	above CF grade
Dimension mm (in.) (length × width × height)	768.6 × 535.5 × 797 (30.26 × 21.08 × 31.38)
Dry weight kg (lbs.)	290 (639.3)
Starting system	Cell starter (with air heater)
Starting motor	12V, 3.0kW
Charging generator	12V, 540W
Recommended battery capacity	12V, 88AH

NOTE :

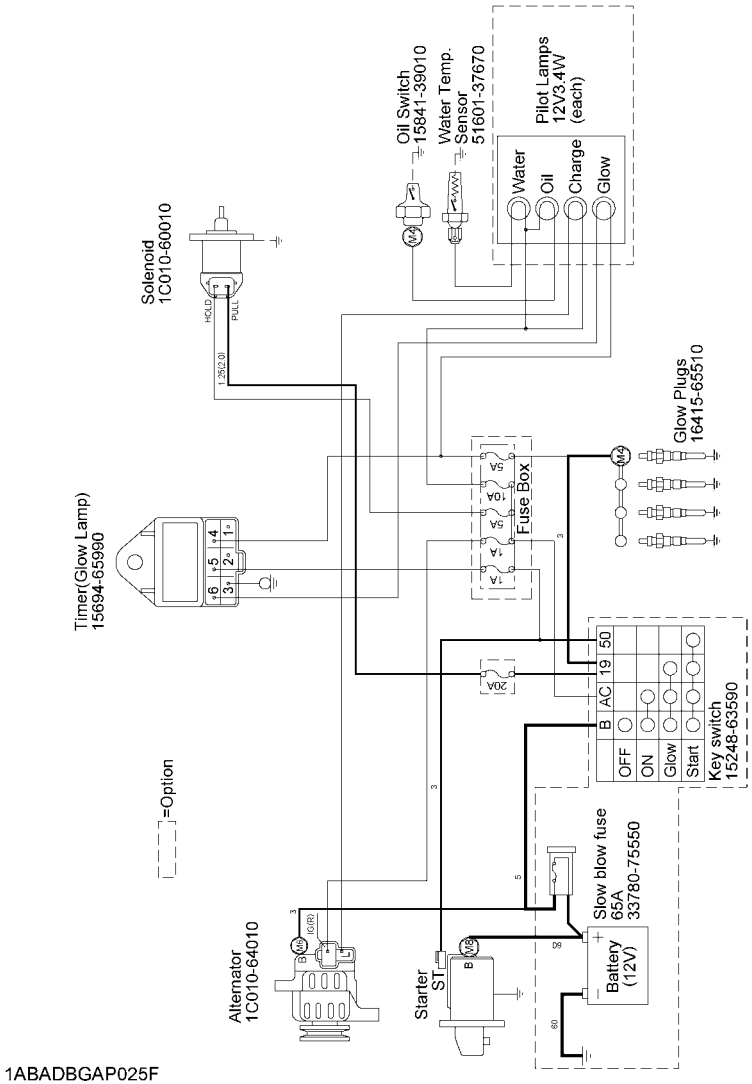
- Specifications are subject to change without notice.

NOTE (FOR E3BG or T-E3BG type):

- Flywheel type is SAE clutch No.11-1/2, SAE clutch No.10 or its equivalent.
- Flywheel housing type is SAE No.3 or its equivalent.
- Governor drop is within 5%.
- Continuous will operate at the stated rating continuously and have a 10% overload capability for one hour in 12 hours.
- Standby will operate at the stated full rating for one hour in 12 hours. No overload capacity is specified for this rating.

WIRING DIAGRAMS

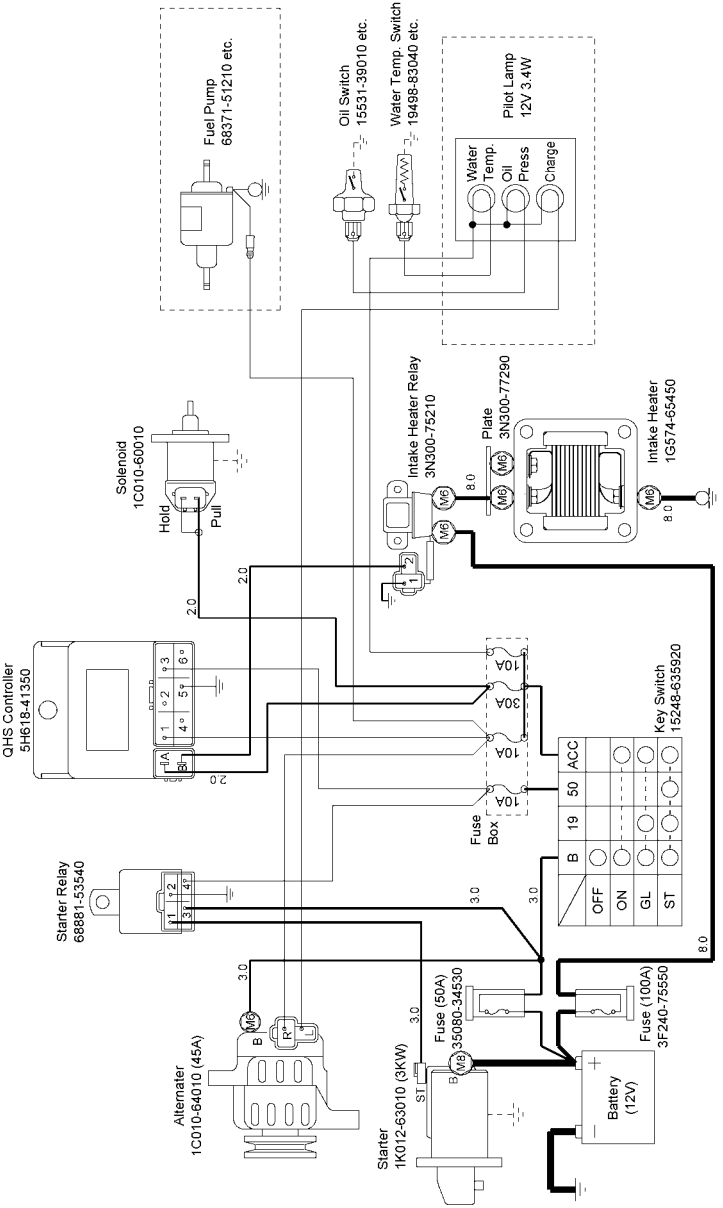
■**V3600-E3, V3600-T-E3, V3300-E3BG, V3600-T-E3BG**



1ABADBGAP025F

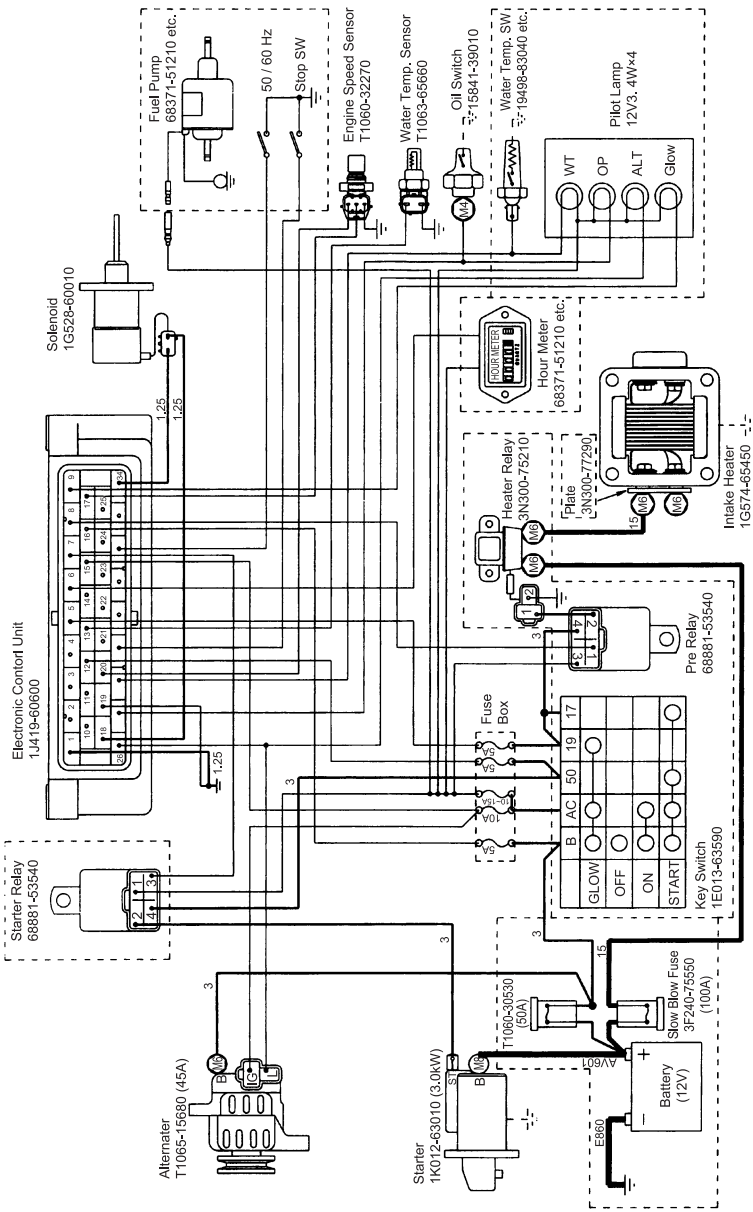
ENGLISH

■V3800-DI-T-E3



1ABADBGAP026A

■V3800-DI-T-E3BG



※The parts boxed in [ ] are reference. NOT equipped for standard eigine spec.
※Non marked wire SQ is 0.85~1.25mm² (AWG#18~16).
※Use heatproof cables, if room temperature around wire harness become over 167°F (75°C).

KUBOTA ENGINE AMERICA CORPORATION
LIMITED WARRANTY ON INDUSTRIAL ENGINES
AND REPLACEMENT PARTS EFFECTIVE JANUARY 1, 2009

OUR WARRANTY TO YOU
We warrant to you, the original purchaser, that all parts (except those referred to below) of your new Kubota industrial engine and replacement parts purchased from an Authorized Kubota Industrial Engine Distributor or OEM Distributor in the United States will be free from defects in materials or workmanship during the following periods.

1. Industrial Engines for 2 years or 2,000 hours, whichever occurs first.

2. Industrial Engines Major Component Warranty (MCW), 3 years or 3000 hours, whichever occurs first, parts only.

   MCW covers cylinder block, cylinder head, crankshaft, camshaft, gears, pistons, rods, flywheel, flywheel housing, oil pump, pulleys, governor, intake manifold, oil pan, ignition distributor.

   MCW does not cover rings, bearings, water pump, any electrical component, valve train components, accessory parts, seals, gaskets, carburetors, exhaust manifold, hoses, all fuel system components, muffler, any filters, radiator, fan, belts, thermostat, spark plugs, fuel transfer pumps.

3. Replacement parts for 1 year.

WHAT WE WILL DO
We will, at our option, repair or replace any part covered by this warranty which becomes defective, malfunctions or otherwise fails to conform with this warranty under normal use and service during the term of the warranty at no charge for parts or labor. (Parts only for MCW)

WHAT YOU MUST DO TO OBTAIN WARRANTY SERVICE
In order to obtain warranty repairs, you must deliver the product, together with proof of purchase, to an Authorized Kubota Industrial Engine Distributor or Dealer at your expense. The names and addresses of such Authorized Kubota Industrial Engine Distributors can be found on the internet at www.kubotaengine.com, by calling 1-800-532-9808 or by contacting:

Kubota Engine America Corporation
505 Schelter Road
Lincolnshire, IL 60069

WHAT THE WARRANTY DOES NOT COVER
This warranty **does not** cover:

1. Damage, malfunctions or failures resulting from accidents, abuse, misuse, modifications, alteration, improper servicing, or lack of performance of required maintenance service.
2. Normal maintenance services or replacement of maintenance items such as light bulbs, preheater plugs, indicator and resistant coils, filter elements, lubricants, oils, spark plugs, coolant, or belts.
3. Installation of replacement parts, unless originally installed by an Authorized Kubota Industrial Engine Distributor or Dealer.
4. Non-genuine Kubota parts.
5. Any engines damaged by use of ether or any starting aid, or greater than a 50/50% solution of antifreeze and water.
6. Injection nozzle wear or any engine damage caused by injection nozzle wear or sticking.
7. Damage caused by water entering the engine due to any cause.
8. Used Products.
9. Any damage caused by overheating that is not a direct result of a defect in materials or workmanship.
10. Any Engine not application reviewed.

APPLICATION REVIEW PROCESS: The Kubota Engine America (KEA) application review process is intended to assist the OEM with engine installation to optimize functionality/performance within the OEM's equipment in order to maintain durability, customer satisfaction, and reduce warranty failures and expenses. Kubota cannot anticipate all potential failures and issues that may occur with the engine or product in the field during an application review. Therefore, machine durability testing by the OEM either in a test facility and/or in the field is critical to further reduce the potential for field failures.

The amount of time spent by KEA on an application review is significantly less than the amount of time spent by the OEM's design engineers on the application. Because of this, the KEA application review is intended to identify issues that are within the scope of the application review testing performed and in some cases recommend possible solutions. The KEA application review should never take the place of proper design and testing of the finished product by the OEM.

The KEA application review does not in any way express or imply any additional warranty coverage other than what is stated in Kubota's Limited Warranty Agreement. Kubota and its subsidiary companies are not responsible for (including, but not limited to): failures resulting from any components that are not manufactured by Kubota, misrepresented or incorrect information provided from an OEM, any changes made without KEA's knowledge, any decision by the OEM not to follow KEA's recommendations, or any application related problems or deficiencies that may arise that were not found by KEA's limited application review or the OEM's durability testing.

THIS IS THE ONLY EXPRESS WARRANTY ON OUR PRODUCTS
We neither assume nor authorize anyone to assume for us any other express warranty. The Kubota Distributor/ Dealer has no authority to make any representation or promise on behalf of Kubota Engine America Corporation or to modify the terms or limitations of this warranty in any way.

LIMITATIONS ON OUR RESPONSIBILITY WITH RESPECT TO PRODUCTS PURCHASED AND USED FOR PERSONAL, FAMILY OR HOUSEHOLD USE.
Our responsibility is to repair or replace defective parts as stated above. We will not be responsible for any other expenses, losses or inconvenience which you may sustain as a result of the purchase, use, malfunction or defective condition of our products. ANY IMPLIED WARRANTIES INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE SHALL BE LIMITED IN DURATION TO THE PERIOD SET FORTH ABOVE AND IN NO EVENT WILL WE BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER. Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

LIMITATIONS ON OUR RESPONSIBILITY WITH RESPECT TO PRODUCTS USED FOR RENTAL OR FOR COMMERCIAL, INDUSTRIAL OR AGRICULTURAL PURPOSES.
This warranty is in lieu of all other warranties, express or implied, and of any other obligations or liability on our part. IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED. Our responsibility for any and all losses and damages resulting from any cause whatsoever, including our negligence, alleged damage or defective goods, whether such defects are discoverable or latent, shall be limited to the repair or replacement of defective parts as stated above. IN NO EVENT WILL WE BE LIABLE FOR LOSS OF USE, LOSS OF PROFITS, LOSS OF OR DAMAGE TO OTHER PROPERTY, INCONVENIENCE, COMMERCIAL LOSS, OR OTHER SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER.

Venturi Prime Series
Operation & Maintenance Manual
(Open Bracket Style)

Manual #7501

Corporate Office

310 South Sequoia Parkway
Canby, OR 97013
Phone (503) 266-4115
Fax (503) 266-4116

Revision 000 7/25/2011

Operation and Maintenance Manual

Table of Contents

INTRODUCTION

Thank you for purchasing a Pioneer end-suction centrifugal pump. This is a heavy duty pump intended for use with non-volatile, non-flammable liquids with specified entrained solids, except as approved by the factory.

WARNING!!!

This manual provides installation, operation and maintenance instructions for your Pioneer Pump, whether of venturi-assisted self-priming or conventional configuration. It is intended to make your personnel aware of any procedure that requires special attention because of potential hazards to personnel or equipment. Read all instructions carefully and remember that pump installations are seldom identical. Therefore, this manual cannot possibly provide detailed instructions and precautions for each specific application. Thus, 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.

WARNING!!!

Centrifugal Pumps are designed for specific service and may or may not be suited for any other service without loss of performance or potential damage to equipment/personnel. If there is ever any doubt about suitability for a specific purpose; contact your **Pioneer Pump, Inc.** representative or the factory for assistance.

Remember: Pump performance may be affected by changes in pumpage such as, specific gravity, viscosity, temperature, operating speed and NPSHA (net positive suction head available).

INSPECTION

INSPECTION

All equipment is inspected at the factory prior to shipment. However, you should inspect all equipment upon arrival for shipping damage and item shortages from the packing slip. Report any damage or shortages to the carrier and **Pioneer Pump, Inc.**

RECORDING MODEL & SERIAL NUMBERS

Please record the model and serial number for your **Pioneer Pump** in the spaces provided below. The factory will need this information when you require parts or service.

Pump Model: _____
Pump Serial Number: _____
Engine/Motor Serial #: _____
Engine/Motor Model Mgf: _____

WARRANTY INFORMATION

LIMITED WARRANTY: Seller warrants for two years from the date of shipment Seller's manufactured products to the extent that Seller will replace those having defects in materials or workmanship when used for the purpose and in the manner which Seller recommends. If Seller's examination shall disclose to its satisfaction that the products are defective, and an adjustment is required, the amount of such adjustment shall not exceed the net sales price of the defective products and no allowance will be made for labor or expense of repairing or replacing defective products or workmanship or damage resulting from the same. Seller warrants the products which it sells of other manufacturers to the extent of the warranties of their respective makers. Where engineering design or fabrication work is supplied, buyer's acceptance of Seller's design or of delivery of work shall relieve Seller of all further obligation, other than as expressed in Seller's product warranty. **THIS IS SELLER'S SOLE WARRANTY. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER**. Seller neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of its engineering designs or products. This warranty shall not apply to any products or parts of products which (a) have been repaired or altered outside of Seller's factory, in any manner; or (b) have been subjected to misuse, negligence or accidents; or (c) have been used in a manner contrary to Seller's instruction or recommendations. Seller shall not be responsible for design errors due to inaccurate or incomplete information supplied by Buyer or its representative.

INSTALLATION

FOUNDATION/BASE PLATE/SKID

Pioneer pumps are available in trailer mounted, skid mounted or conventional channel base mounted configurations, or bare pumps may be mounted by a third party. Typically a channel base mounted unit is intended for a permanent installation, and the following recommendations for permanent installations should be followed.

If using a concrete foundation it should be rigid enough to inhibit vibration. Pour the foundation well in advance of installation of pump equipment to allow time for drying and curing.

If the pump is to be mounted on a steel frame, or similar structure, it should be set directly over the supporting beams. These beams and the structure must be rigid enough to prevent distortion and potential misalignment due to movement within the structure or base.

The location of this structure should be as close as possible to the pumpage source. Provide adequate space for operation, maintenance and inspection of the pump and equipment.

The concrete foundation should be provided with anchor bolts for attachment to the base plate. If required, provide adequate drainage to keep pump and motor dry and clean. Also, provide either leveling nuts or leveling wedges for mounting the base plate to the foundation.

LEVELING

When mounting the base plate to the foundation use leveling nuts or wedges to provide a level, flat base plate. Use a machinist's level on the mounting pads and make adjustments as necessary as the anchor bolts are tightened. This will provide the true alignment between the pump and motor. For portable trailer or skid mounted, engine driven units, it is important that the pump / engine assembly be level so as to assure proper fuel feed and distribution of engine lubricants. Trailer mounted units can be leveled using the tongue jack and blocking under the lower wheel. Wheels should be properly chocked so as to prevent rolling of the trailer. Skid mounted units should be leveled by preparing the ground or blocking under the skid. For portable electric units accurate leveling is not particularly important except as required for proper piping alignment.

GROUT

If a base mounted pump is to be grouted, ensure that you have the mounting surface flat and level for correct alignment of pump and motor. Build a dam around the base plate perimeter that is to be watertight. Use standard grouting practice and be sure to protect (cover) the leveling wedges with caulk or plastic tape if they are to be removed later. After the grout has thoroughly hardened, remove forms. If the wedges are removed, fill holes with grout. Seal grout by covering with a quality paint or sealer.

TRAILER MOUNTED UNITS

See “OPERATION” section.

INSTALLATION

INSTALLING PUMP

Insure that all foreign material has been removed from the pump before mounting. Be sure to remove all shipping protection prior to operation.

NOTE: Many of the bare pumps are shipped with protective guards and coatings.

SUCTION PIPING

For best performance the suction piping should be at least as large as the pump flange, never smaller. Use an eccentric reducer at the suction flange with the straight side up. The use of flow-retarding fittings is to be avoided and if necessary should never be placed closer to the pump suction than four (4) times the pipe diameter. The pump should be at the highest point of the piping. Slope the piping up to the pump to prevent air pockets. Avoid changing pipe size except to reduce a larger suction pipe diameter to the pump suction flange size using the eccentric reducer mentioned above. All suction piping and fittings are to be checked for any foreign material (rocks, bolts, wire, etc.) and also any sharp burrs that could disrupt the flow.

DISCHARGE PIPING

Use a concentric taper on the discharge side to increase from pump discharge flange size to a larger discharge pipe diameter, or maintain discharge piping the same size as the discharge size of the pump. The decision of what size discharge pipe to use in an economic one, a balance between the higher cost of larger piping versus the higher energy requirements imposed by pipe friction. Otherwise, the only detrimental effects of discharge piping size choice derive from the pump running too near shut-off or too far out on its curve. The discharge size should be adequate to maintain reasonable velocities and reduce friction losses. All valving and additional fittings should be the same size as the discharge line.

SUCTION & DISCHARGE PIPE FLANGES

All piping is to be supported, braced and lined up square before connection to the pump flanges. In fixed or permanent installations a flexible fitting is recommended on both suction and discharge, to eliminate any piping strains being transmitted to the pump. Portable installations still require support of discharge and suction piping or hose near the pump so as to avoid undue forces being carried by the pump flanges. Supporting the piping or hoses with the pump flanges can result in rubbing and wear between rotating and stationary portions of the pump, possible breakage of the case or brackets or failure of seals or couplings.

NOTE: Flexible pipe couplings must be restrained so as not to transmit any strain to the pump flanges when expanding or contracting under pressure. Unrestrained expansion fittings can transmit enormous forces to the pump flanges.

INSTALLATION

SCREENING

Make provisions for the installation of a suction screen or strainer to prevent any debris from clogging the impeller. The open area of the strainer should be equal to at least four (4) times the area of the pipe. The screen should be rigid enough to prevent collapse when flow is reduced due to clogging.

SUMP DESIGN

The submergence of the suction pipe into the liquid should be at least four (4) to five (5) times the pipe diameter. If this is not possible then provide a baffle or a floating board. This is to prevent any vortex action allowing air into the pipe. For best performance a bell mouth fitting is recommended. Refer to the Hydraulic Institute Handbooks or other Hydraulic Data books for detailed sump design information.

LIFTING

Any lifting equipment is to be rated for at least five (5) times the weight of the item being lifted. Use only established methods when lifting or moving any heavy components.

ALIGNMENT OF PUMP AND MOTOR

Precise alignment is necessary to achieve correct performance of the system. Every time a component is moved this alignment will have to be checked. The alignment can be checked with a straight edge and an outside caliper, taper thickness gauge, dial indicators or, for best results, use a laser alignment tool. Use the straight edge across the outside diameters of the coupling halves to ensure that they are concentric and parallel. The outside calipers or the taper thickness gauge is to correct for any angular misalignment and to verify the correct gap between the coupling flanges. Use a laser alignment tool or dial indicators to adjust for concentric and angular displacement. With dial indicators, rotate shafts together and take readings every ninety (90) degrees. Make adjustments by placing shims under the driver, and be sure that the mounting bolts are properly tightened while taking readings and after final adjustment then install coupling guard.

If the pump is equipped with an SAE bracket and flywheel coupling for direct mounting of the pump to the engine bell housing, alignment between crankshaft and pump shaft is automatically attained due to the register fits between the bell housing and pump bracket.

ROTATION

Before the pump is started, correct rotation must be confirmed. If the rotation is not correct, then interchange any two of the leads on a three (3) phase driver. For a single-phase driver refer to the wiring diagram. Engine rotation should be confirmed with the engine supplier.

OPERATION

VENTURI PRIMING

Figure 10039A, 10040A

Venturi prime Pioneer pumps prime using the vacuum created by the air from the engine compressor flowing through the jet pump. The vacuum of the jet pump is connected to the pump's priming spool. If this priming device is not supplied on your pump model you will need either a flooded suction or a foot valve and some other means of evacuating air from the pump case and suction line. With a flooded suction use a bleed valve at the top of the volute to allow trapped air to escape. If you are using a foot valve, then fill the suction line and pump case with water and use a bleed valve for trapped gas as above. If a hand primer is to be used it will be necessary to have an air tight check valve or closeable control valve on the discharge line to prevent the entry of air from the discharge side. Rotating the pump shaft will release trapped gas in the impeller. If the pump has a float ball priming chamber connected to the priming spool, the jet pump's vacuum line will automatically be shut when the pump is primed. If the spool does not contain a float ball priming chamber it will emit water once it is primed.

PRE-START CHECKLIST

1) Verify that rotation is correct and that the shaft rotates freely.

2) Check all piping connections for tightness.

3) Inspect all accessories and make sure they are appropriate for your installation.

4) Verify that the driver and coupling are aligned correctly and that all guards are in place.

5) Ensure that all bearings and grease seals are lubricated.

6) Oil levels should also be checked and maintained during pump operation.

7) Follow the instruction on all tags, labels and decals attached to the equipment.

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.

OPERATION

CAUTION!!!

Pump speed and operating condition points must be within the continuous performance range shown on the performance curve in the separate Part List Manual for your specific pump model.

STARTING

Any centrifugal pump must be primed before starting unless it is of a self-priming design. See preceding section on priming, and ensure suction pipe is filled with water. With discharge

valve closed, start the pump and slowly open valve. Throttle the flow gradually to fully open. Avoid any abrupt changes in the discharge flow rate to prevent pressure surges in the piping. If the design pressure is not achieved shut the pump down immediately. Ensure that pump is adequately primed and restart.

Never run the pump with the discharge valve closed for extended periods of time. Never use the suction valve to throttle the flow. Check all suction and discharge piping for leaks.

If a suction strainer is installed, check the pressure drop across the strainer. If the differential in pressure exceeds five (5) PSI have the strainer cleaned.

OPERATION OF ENGINE DRIVEN UNITS

Before Starting

Check the fuel level and oil levels in the engine, check the oil level or grease & in the pump bearing housing and seal chamber (backplate/bracket reservoir).

CAUTION!!!

Make sure the pump is level. Lower jack stands and chock the wheels. Use caution when positioning the skid-mounted unit to prevent damage to the fuel tank. Consult the engine operations manual before attempting to start the unit.

WARNING!!!

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.

MAINTENANCE

WARNING!!!

Before attempting to service this pump, read this manual carefully. Operators and maintenance personnel should have a good understanding of all aspects of this pump and the pumping conditions. Failure of operating personnel to be familiar with all aspects of pump operation outlined in this manual could contribute to equipment damage, bodily injury or possible death.

WARNING!!!

Before any servicing:

1) Read this manual carefully.
2) Shut down driver and lock out incoming power to ensure that the pump will remain inoperative.
3) If the pump or components are hot, allow adequate cooling prior to servicing the unit.
4) Close the suction and discharge valves.
5) Vent the pump slowly and drain completely.

WARNING!!!

If this pump is used to handle any hazardous materials that can cause illness, either directly or indirectly, take precautions by wearing approved protective clothing and use appropriate safety equipment.

WARNING!!!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Attach lifting equipment to the lifting device fitted to the pump. If chains or cable are wrapped around the pump to lift it make certain that they are positioned so as not to damage the pump and so that the load will be balanced. The bail on trailer or skid mounted units is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.

CAUTION!!!

When servicing this pump, use only components provided by **Pioneer Pump, Inc.** Any use of non-authorized parts could result in sub standard performance, damage to equipment and possible injury to personnel. Non-authorized parts will also void the warranty.

When using this manual any reference to part numbers or names will be directed to the applicable cross section drawing. These parts will also be called out in the bill of materials for full description.

Drain volute case of pumpage when unit is idle to avoid freezing and possible cracking of pump case, etc.

This manual also provides a troubleshooting section to diagnose many operational or performance problems. The equipment covered in this section is limited to the pump, priming and drive components only. Refer to the applicable vendor's manual for motors, engines and other accessory equipment. Use the troubleshooting section to help determine the cause of any problems, and only disassemble the pump components required to remedy the existing condition.

This manual provides installation, operation and maintenance instructions for your Pioneer Venturi Prime Pump. The manual will also make your personnel aware of any procedure that requires special attention because of potential hazards to personnel or equipment. Read all instructions carefully and remember this manual cannot anticipate or warn of every situation that could occur. Because of this the owner is responsible that only safe procedures be used, if not addressed in this manual. If any question regarding the pump is not covered adequately please contact **Pioneer Pump, Inc.**

WARNING!!!

Select a clean suitable location for any required maintenance, and note that all work must be performed by qualified personnel.

An ongoing record of performance will assist in any troubleshooting and/or analysis of problems. A pressure gauge can be installed on the suction and discharge side of the pump to monitor any changes in differential pressure. Differential pressure is useful in monitoring and diagnosing any possible degradation in pump performance.

MAINTENANCE

VENTURI JET PUMP

(Figure 10039A, 10040A)

Disconnect the priming chamber hose from the venturi jet pump. Unthread the venturi jet pump

from the bracket.

PRIMING CHAMBER
Figure 10039A, 10040A & 10045A

Disconnect and remove suction piping and air tubing from the **priming chamber/suction spool** assembly. While supporting the assembly with a sling, remove the nuts and bolts connecting the suction spool to the pump suction flange.

PRIMING VALVE SERVICING
Figures 09094A-VP, A1784A

The **priming valve** system, housed inside the priming chamber, is adjusted at the factory and should rarely require service. It is possible, after extended use, that wear of the holes in the **upper arm, lower arm, link** or **pins** could necessitate slight adjustment of the **stem washer** to upper arm clearance. Furthermore, it may become necessary to adjust the **valve spring** tension. The procedures for both of these adjustments are delineated in figure A1784A. The only other potential service requirement is replacement of the **stem o-ring**. To replace this o-ring, remove the elbow attached to the outlet of the priming chamber. This will expose the internal valve components. Grasping the lower end of the valve stem, remove the nut and washer located on top of the **valve washer**. Remove the valve washer and valve spring. The valve stem can now be removed through the bottom side of the **priming chamber lid**. Cut the old stem o-ring to remove it, and simply "roll" a new o-ring into place. Reassembly is the opposite of disassembly.

DISCHARGE CHECK VALVE (Venturi Prime only)
Figures 10039A, 10040A, A2170A

Support the **check valve** with a sling and remove the nuts, bolts, and gasket between the check valve and pump discharge flange. If the check valve disc (3) needs to be replaced, remove the top cover (2) and insert new disc. The top cover gasket (4) should be replaced at this time.

SUCTION COVER AND WEAR RING
Figure A2048A

If the pump is equipped with an **external balance line** it must be removed prior to removing the suction cover. Disconnect the balance line from either the **suction cover** , **suction spool** or the **backplate.**

Support the **suction cover** using a suitable sling. Remove the capscrews between the suction cover and **volute**. Jackscrew holes are provided in the suction cover to aid removal from the volute. Insert two of the capscrews attaching the suction cover to the volute into the jackscrew holes, and tighten them evenly to jack the suction cover free of the volute. If the **suction wear ring** shows grooves or uneven wear it should be replaced. Minor irregularities can be dressed with a fine file and crocus cloth. Wear rings may be reworked by light machining, if proper equipment is available to correct minor irregularities. After the removal of any stock, the ring must remain within allowable clearances for maximum performance. (Consult factory for clearances for specific models).

When the pump performance drops below acceptable limits the **suction wear-ring** and **hub**

wear ring (if so equipped) should be replaced. These rings can be removed by drilling two holes of the adequate size, axially, through the ring 180° apart. The ring can now be collapsed and removed.

Tap new ring into place evenly around circumference with chamfer toward suction flange. Anti-seize lubrication should be applied to the "OD" of the ring prior to installation in suction cover. Make sure wear ring is installed tight against shoulder.

MAINTENANCE

ONE PIECE VOLUTE AND WEAR RING

(Figure A2049A)

Support the **volute** using a suitable sling and remove the capscrews between the volute and **backplate**. There are jackscrew holes in the backplate flange to aid in removal of the volute. Insert two of the volute capscrews in the jackscrew holes, and tighten them evenly to push the volute free of the backplate. If the **suction wear ring** shows grooves or uneven wear it should be replaced. Minor irregularities can be dressed with a fine file and crocus cloth. Wear rings may be reworked by light machining, if proper equipment is available to correct minor irregularities. After the removal of any stock, the ring must remain within allowable clearances for maximum performance. When the pump performance drops below acceptable limits the **volute wear ring** should be replaced. This ring can be removed by drilling two holes, of the proper size, axially, through the ring 180° apart. The ring can now be collapsed and removed.

Tap new ring into place evenly around circumference with chamfer toward suction flange. Anti-seize lubrication should be applied to the outside diameter of the ring prior to installation in volute, make sure wear ring is installed tight against shoulder.

NOTE: If this pump is equipped with Pioneer's run-dry feature for mechanical seal protection, then, prior to any further disassembly of this pump, the external **oil reservoir** and **auxiliary gland** should be drained. First drain the reservoir via the plug in the bottom. Then disconnect the oil line from the reservoir, and lower this disconnected end into a suitable container.

IMPELLER REMOVAL

Figure A2050A

Remove the **impeller lockscrew** and **washer** at the center of the **impeller**. Utilizing a properly sized gear puller, evenly pry between the back shroud of the impeller and the **backplate**. Take care not to lose or damage any **impeller shims** that may be inside the impeller bore, and do not lose the **impeller key**. As the impeller is being removed from the **shaft** ensure that the **seal spring**, if present, is not lost or damaged. Inspect the impeller and replace or repair if warranted.

SEAL REMOVAL (Rotating Element)

Figure A2051A

Once the **impeller** is removed, the **rotating assembly** of the seal (bellows, spring and retainer) can slide off of the **shaft** as a unit. Apply a light coat of oil to the shaft to help free the rotating assembly. Take care to protect this assembly from any foreign matter or damage.

MAINTENANCE

BRACKPLATE REMOVAL

Figure A2052A / Figure A2053A

The "**brackplate"** can now be removed by removing the capscrews between the **brackplate** and the **bearing housing**. A sling or other support should be attached to the brackplate prior to its removal. Slide the brackplate straight off of the **shaft** to prevent any damage to the **stationary seal seat** or the surface of the shaft. Care should also be taken to avoid damaging the **brackplate lipseal(s)** or the **run-dry gland lipseal.** The stationary seal seat can now be pressed out of the brackplate bore, taking care not to break the seat. The entire **seal assembly** can now be inspected for any damage that will require replacement or reconditioning.

BEARING HOUSING

Figure A2054A

If the frame **bearings** require servicing it will be necessary to remove the **bearing housing** from the driver and the pump end from the bearing housing. Remove the coupling guard as necessary. With the bearing housing supported with a hoist and sling remove bolts holding the housing to the baseplate. Now the bearing housing can be moved away from the driver for further servicing.

On the drive-end of the bearing housing remove the capscrews holding the **bearing housing cover** or the **SAE bracket** to the housing. Gently slide the housing cover or the SAE bracket off of the shaft to protect the lip seal(s) if it is to be reused.

Now the shaft assembly, including the **shaft, bearings and the bearing locknut and washer** can be removed through the drive-end of the bearing housing. This operation may require placing a block of wood against the impeller-end of the shaft and tapping with a "dead blow" hammer or using a mechanical or hydraulic press against the impeller end of the shaft. If the bearings are to be re-used, the shaft should be pressed out rather than tapped out with a hammer. With the shaft and bearing assembly out of the housing the bearings can be inspected and replaced as necessary.

CAUTION!!!

Any work on the **shaft** and bearing assembly should be done in a properly equipped shop by experienced personnel. We recommend that the **bearings** be replaced any time they are removed from the **bearing housing**. Clean the bearing housing and the shaft and other components except the bearings, with cleaning solvent and a string / lint free cloth. Inspect all parts and blow components dry with compressed air. If the **bearings** are to be replaced, the old bearings can be removed using a suitable gear puller. It is recommended that brackplate and **bearing cap lip seals** also be replaced at this time. These lip seals can be driven out of their bores with a drift, punch or screw driver. Before removing the lip seals note the orientation of the lips, and be certain to install the new seals with the same orientation. When driving or pressing in the lip seals use a flat block or plate which applies pressure around the entire circumference of the seal – **do not drive the seal in with a drift or punch.**

WARNING!!!

When using cleaning solvent be sure to have adequate ventilation, as most solvents are toxic

and flammable. Follow all precautions pertaining to the solvent and keep area free from excessive heat, sparks and flame.

Rotate the bearings by hand and check for any roughness or wear. If any roughness, wear or discolored areas are present, replace the bearings. Also, check the fit between the bearings and shaft for a tight press fit and between the bearings and the housing for a snug slip fit. If the fits are not correct then replace the bearings, shaft or the bearing housing as indicated by wear. If bearings are to be replaced use a bearing puller to remove then from the shaft.

BEARING HOUSING REASSEMBLY

Figure A2054A / A2055A

After all components have been inspected, repaired, and or replaced ensure all parts are clean and ready for assembly as indicated above. Use extreme caution, during assembly, to protect all parts from dirt and damage. The bearings should be installed using the bearing manufacturer's recommended installation procedure.

CAUTION!!!

If heat is used to install the **bearing** use an induction heater, electric oven or hot plate. Do not use a direct flame. Heat the bearings to a uniform temperature of 220E F (105EC) maximum, and slide each bearing onto the **shaft** until firmly seated against the shaft shoulder. Once the bearing is removed from the heat it must be placed over the shaft and seated against the shoulder very quickly or it will seize to the shaft in the wrong position. After the bearings have cooled; ensure that they are still seated against the shaft shoulder. If they are not seated use a sleeve, of the correct size, and a press to seat bearing. This sleeve and press can be used if heating the bearing is not practical, but only press against the inner race of the bearing.

CAUTION!!!

With the **Drive-End bearing** firmly seated against the shaft shoulder install the **bearing lockwasher** and the **bearing locknut**. Refer to **figure A2055A** for the correct orientation. Ensure the washer tab on the inside diameter is engaged in the slot in the shaft and the tab pointed toward the bearing. After the bearing nut has been tightened, bend one of the tabs on the outside diameter of the washer to engage one of the slots in the nut.

Some pumps are equipped with double angular contact bearings at the drive end. It is imperative that these bearings be installed in the correct orientation relative to one another. When installing the first of the two angular contact bearings onto the shaft make certain that the side of the inner race with the largest diameter is located against the shaft shoulder. The next bearing must be installed with smaller diameter side of the inner race against the first bearing. **Refer to illustration A2056A.**

Check that the **bearing housing** is clean and that the bearing bores are free of any burrs or nicks. Ensure that the **bearing housing spacer** (not used with double drive-end bearings) is installed in the drive-end bore of the housing. Wait for bearing to cool, then, from the drive-end of the bearing housing, slide the shaft/bearing assembly into the drive-end of the housing. Press the drive end of the **shaft** until the **drive-end bearing** contacts the housing or bearing spacer shoulder.

Apply a light coat of oil or grease to the **bearing cap lipseal(s)** that is installed in the or **SAE bracket lip seal(s)**. Slide the bearing cap or SAE bracket over the drive end of the shaft taking

care to protect the lip seal. Secure the bearing cap to the bearing housing using the capscrews. For oil lubricated bearing frames make sure that the **bearing cap o-ring** is installed on the bearing cap register. Moving the shaft in both axial directions should produce a total endplay between 0.002"and 0.010". Use **bearing shims** to limit endplay to this range.

MAINTENANCE

BEARING HOUSING TO DRIVER REASSEMBLY

Figures A2054A, A2184A

Install the **shaft key** and **flexible coupling hub** onto the pump shaft, but do not secure. Position the bearing housing assembly into its running location and align to the driver as per the alignment section in this manual.

After the **bearing housing** assembly and driver have been aligned, secure the bearing housing assembly to the baseplate, then recheck alignment. Check that the coupling hub is secured to the **shaft** and install the coupling guard.

NOTE: For SAE bracket equipped bearing frames, coupling alignment is attained by simply bolting the bearing frame SAE bracket to the engine bellhousing.

FLYWHEEL COUPLING INSTALLATION / SAE BRACKET EQUIPPED PUMPS

Figure A2184A

Pioneer pumps purchased with SAE brackets and Flywheel couplings are shipped with the coupling mounted to the shaft in the correct axial location for engines with bell housings and flywheels manufactured to SAE standard dimensions.

CAUTION!!!

If the pump is to be mounted to the engine by other than Pioneer Pump, Inc. factory personnel, the assembler must take full responsibility to verify that the pump shaft does not bear against or make any contact with the engine crankshaft or flywheel and that the flywheel coupling is mounted in such a position so as not to transmit any axial thrust to the flywheel. Failure to verify this could result in severe engine damage.

Bolt the aluminum drive ring of the flywheel coupling to the flywheel register, and torque the fasteners (grade 8) to 372 in-lbs. Place the notched key (provided by Pioneer) into the taperlock bushing, and position the rubber element and taperlock bushing on the shaft as shown on illustration A2184A (refer to the preceding caution). Torque the taperlock bushing screws to 430 in-lbs.

MAINTENANCE

BRACKPLATE TO BEARING HOUSING REASSEMBLY

Apply a coat of oil or grease to the **brackplate lip seal(s)** and to the **run-dry gland lip seal** (if present). Slide the **brackplate** over the pump-end of the **shaft**, protecting the lip seals. Check that the **brackplate drain port** is located in the bottom position. Secure the brackplate to the **bearing housing** using capscrews provided.

reinstalling the bearing cap and brackplate. For oil lubricated bearing housings note that there is a grease fitting on the face of the brackplate. This fitting is there to allow grease to be injected between the two brackplate lipseals so as to provide lubrication for the outermost of the two lip-seals. A hand operated grease gun should be used, after reassembly of the brackplate to the bearing housing, to inject two or three "pumps" of grease between these seals.

SEAL REASSEMBLY

Figure A2051A

Always handle all seal parts with extreme care to prevent damage. Be especially cautious not to contaminate the precision finished mating faces as even fingerprints can shorten seal life. If required, clean the faces with a non-oil based solvent and a clean, lint-free cloth. Use a concentric pattern while wiping to prevent scratching the faces.

Carefully inspect all seal parts for any damage or wear. Any scoring or grooves in the mating faces could cause the seal to leak, so it should be refurbished and mating faces relapped or replaced with a new complete **seal assembly**.

Clean the **shaft** and remove any nicks, cuts or burrs. Lubricate the outside diameter of the **seat o-ring** with 30 wt. to 80 wt. motor oil or hydraulic hose assembly lube and apply a drop of light lubricating oil to the seal faces. Lubricate the seat bore of the **backplate** and ensure it has a chamfer.

Slide the **stationary seat** over the shaft and carefully press into the bore of the **brackplate.** Ensure that it is squarely seated into the brackplate. Lubricate the shaft surface and the inside diameter of the rubber bellows. Also spray the stationary seal face with penetrating oil to create a film. Now slide the **rotating element** over the **shaft** up to the stationary seat with the polished face (primary ring) of the rotating element toward the polished face of the seat. Slide the spring over the outside of the seal assembly up to the retainer flange.

IMPELLER REASSEMBLY

Figure A2050A

Inspect the **impeller** for any cracks or badly worn areas. Replace if necessary. Install the **impeller key** and slide impeller over the **shaft**. Ensure that the **seal spring** is in place over the outside diameter of the impeller hub. Install the **impeller washer** and **impeller lockscrew** (use #262 red loctite™ on threads of the impeller lockscrew when reinstalling in the shaft) and tighten (See torque specs, page 19).

For impellers that are equipped with "backvanes" rather than a hub wear-ring, use the following procedure:

With the impeller firmly against the shaft end, measure the gap between the back vanes of the impeller and the face of the **brackplate**. Remove the impeller and place **impeller shims** (0.005, 0.010 and 0.015 thick) in the bore of the impeller until the gap is the same as it was when originally removed. Each time the impeller is installed on the shaft make sure the seal spring is in place over the outside diameter of the impeller hub. Once the desired gap between the back vanes and backplate is attained, install the **impeller washer** and **impeller lockscrew** (use #262 red loctite™ on threads of the impeller lockscrew when reinstalling on the shaft) and tighten (See torque specs, page 19).

MAINTENANCE

VOLUTE REASSEMBLY

Figure A2049A

For a one-piece **volute** and suction cover, inspect the **suction wear-ring** and review the wear ring section in this manual if replacement is required. Slide a new **o-ring** over the register of the **brackplate**. Make sure the o-ring is up against the face of the brackplate flange. Lubricate the o-ring with grease. Position the volute, with the discharge nozzle in the same orientation as the piping, and secure with capscrews.

For separate volute and **suction cover**, check on the wear ring section in this manual for replacement, if required. Place a new **o-ring** over the register of the suction cover, lubricate with grease and seat it against the cover face. Secure to **volute** with appropriate capscrews.

DISCHARGE CHECK VALVE REASSEMBLY

Figures A2170A

Refer to the **discharge check valve** parts illustration if any repairs are to be made. Install the **gasket** and secure to the discharge nozzle with bolts and nuts. Ensure that the check valve is installed for the correct flow direction.

PRIMING CHAMBER REASSEMBLY

Figure A2169A

Refer to the **Priming Chamber / Valve** section if any repairs or adjustments are required. Install the gasket and use nuts and bolts to attach the priming chamber, with spool, to the suction flange of the pump.

MAINTENANCE

LUBRICATION – BEARING FRAME

The lubrication of the ball bearings will depend on speed, load, ambient temperature, contamination, moisture, intermittent or continuous service and other factors. These regreasing recommendations are general in nature and are to be used with good judgment and consideration of the pump service. The following is a suggested lubrication interval chart:

Pioneer Frame Size	2200 RPM	1800 RPM	1200 RPM
8.5 AK Frame	5,000 hrs.	7,500 hrs.	10,000 hrs.
12.5 AK Frame	2,500	3,500	5,000

To lubricate the ball bearings, remove the plastic covers from the zerk fittings. Ensure that the zerk fitting and the end of the grease gun are clean. Use only a hand-operated grease gun with ball bearing grease as shown below, or equal:

Texaco Starplex Moly 2
Mobile MobiLux No. EP2
Shell Alvania EP2
Chevron SRI

An oil level gauge is attached to the bearing frame and marked at the factory for proper oil level. ISO viscosity grade 32 turbine oil is installed at the factory. This oil is suitable for a wide range of temperatures. However, during operation temperature measurements should be taken on the bearing frame at the oil sump location. If the indicated temperature is greater than 160°F then the oil should be changed to an ISO viscosity grade 68 turbine oil at the next maintenance interval. Oil should be changed approximately every three months of continuous operation.

LUBRICATION – SEAL OIL RESERVOIR

See Figure A2049A / A2056A

This pump is provided with a seal oil reservoir that permits this unit to run dry. The reservoir supplies lubrication and cooling to the outboard side of the mechanical seal without any liquid in the pump. Monitor the oil level sight gauge and add oil as indicated. During normal operation it is suggested to change this oil every three (3) months. If the sight gauge shows indications of contamination or discoloration, change oil more frequently. The external oil reservoir is filled via a plug on the top of the tank. There is a petcock located on the opposite side of the run-dry gland from the oil inlet line. During initial filling, this petcock should be opened to allow the air to vent from the gland.

Use turbine oil with an ISO rating of 32 or lower. If you have unusual pumping conditions consult **Pioneer Pump, Inc**. Oil used in the reservoir should be ISO VG 32 Turbine Oil or Automatic transmission oil, equivalent to one of the following manufacturer's products:

Chevron Turbine oil GST 32
Mobile DTE 797
Shell Turbo T oil 32

MAINTENANCE

TORQUE VALUES FOR FASTENERS

SIZE UNC	MATERIAL		
	304 SS	**GRADE 5 BOLTS**	**GRADE 8 BOLTS**
¼	3.0 lb-ft	9 lb-ft	13 lb-ft
5/16	7.0 lb-ft	19 lb-ft	27 lb-ft
3/8	13 lb-ft	34 lb-ft	48 lb-ft
7/16	20 lb-ft	54 lb-ft	77 lb-ft
1/2	31 lb-ft	83 lb-ft	117 lb-ft
9/16	45 lb-ft	120 lb-ft	170 lb-ft
5/8	63 lb-ft	165 lb-ft	234 lb-ft
3/4	112 lb-ft	293 lb-ft	415 lb-ft
7/8	180 lb-ft	474 lb-ft	670 lb-ft
1	270 lb-ft	710 lb-ft	1000 lb-ft
1 1/4	540 lb-ft	1421 lb-ft	2000 lb-ft

The above values are general in nature. If a grade 2 or 5 capscrew is threaded into stainless steel, use the lower value i.e. 304 stainless.

PARTS ORDERING

When ordering parts from **Pioneer Pump, Inc.** please provide the following information:

1) Pump serial number
2) Pump model
3) Cross section drawing number
4) Part number from cross section drawing
5) Description of part
6) Quantity required
7) Package VIN (Vehicle Identification Number)

SPARE PARTS

Spare parts should be kept on hand to reduce downtime. Service of a particular pump determines the quantity and range of spares. At a minimum the following parts should be stocked.

Suction wear ring
All O-rings
Set of bearings
Mechanical seal
Set of grease seals

If you have unusual pumping conditions, consult **Pioneer Pump, Inc.** for additional recommended spare parts

TROUBLESHOOTING

Symptom	Possible Causes	Symptom	Possible Causes
No Discharge	1,2,3,4,5,7,8,9,10,17,18,19,20, 37	Vibration and noise	2,4,9,10,14,15,17,26,27,28,29 30,31,32,33,34,35,36,39,40, 41,42,43,44,48
Reduced Capacity	2,3,4,5,7,8,9,10,11,17,19,20,21,3839, 40,47	Seal: excessive leakage, short life, seal housing overheating	22,23,25,33,34,35,36,41,44, 45,46
Reduces Pressure	5,7,8,11,13,18,19,38,39,40,47		
Loss of Prime	2,3,4,7,10,11,20,21,22,23	Bearings: over heating, short life, noise	26,27,28,29,30,31,32,33,34, 35,36,41,42,43,44
Power consumption excessive, driver runs hot	6,12,13,17,18,19,24,33,34,35,3637,38 ,41,42,43,44	Pump overheating, seizes	1,8,9,14,33,34,35,36,41,42,43, 44
		Corrosion, erosion, pitting, oxidation or other loss of material	7,8,11,14,15,16

1. Pump not primed
2. Suction line not filled
3. Air pocket in suction line
4. Suction inlet or foot valve obstructed, insufficiently submerged, or too small
5. System head higher than pump design head
6. System head lower than pump design head
7. Insufficient NPSH
8. Parallel pump application is incorrect
9. Suction pressure to vapor pressure below minimum
10. Suction lift too high
11. Excess vapor in pumpage
12. Specific gravity of pumpage different than design
13. Viscosity of pumpage different than design
14. Operation at below rated capacity
15. Cavitation
16. Electrolysis
17. Impeller obstructed with foreign material
18. Rotation direction wrong
19. Low speed
20. Air leak into suction line
21. Air leak through mechanical seal
22. Seal fluid contaminated, hot or insufficient
23. Seal fluid system not vented
24. High speed
25. Mechanical seal insufficient
26. Bearing housing excessively cooled
27. Low oil pressure (oil lube bearings)
28. Improper or poor lubrication
29. Lubrication defective
30. Dirt in lubrication/bearings
31. Moisture in lubricant/bearing housing
32. Lubricant excess
33. Pipe strain
34. Temperature growth
35. Misalignment
36. Coupling improperly installed
37. Impeller installed backwards
38. Worn wear rings
39. Impeller damage
40. Improper balance (after repair)
41. Bent shaft
42. Excessive thrust
43. Rotational element dragging
44. Worn or incorrectly installed bearings
45. Mechanical seal not properly set, O-rings damaged or hardened
46. Shaft scored at seal
47. Volute O-ring
48. Foundation not rigid or settled

STORAGE

This is adequately prepared for outside storage prior to shipment, but use the following list of additional suggestions for extended storage.

1) Store the unit off the ground so no water will accumulate around the equipment.

2) Protect unit from blowing sand and dirt.

3) Stack no other items on top of pump/equipment.

4) Protect unit from the entry of any animals.

5) Periodically rotate shaft to lubricate bearings and protect bearings from brinelling.

6) Protect unit with approved drying agents.

7) Ensure all bare metal areas are coated with a rust preventive.

8) Inspect unit every four (4) weeks and replace drying agents (Silica Gel) as required or a minimum of ever six (6) months.

9) Keep and inspection record showing dates of inspection with any maintenance preformed and condition of drying agents.

10) Before installation ensure that all rust protection has been removed. Also, remove any foreign material that may have accumulated during storage.

11) Before installation remove all drying agents (Silica Gel).

CONDITIONS AND TERMS OF SALE

CONTROLLING PROVISIONS: These terms and conditions shall control with respect to any purchase order or sale of Seller's products. No waiver, alteration or modification of these terms and conditions whether on Buyer's purchase order or otherwise shall be valid unless the waiver, alteration or modification is specifically accepted in writing and signed by an authorized representative of Seller.

DELIVERY: Seller will make every effort to complete delivery of products as indicated on Seller's acceptance of an order, but

Seller assumes no responsibility or liability, and will accept no backcharge, for loss or damage due to delay or inability to deliver caused by acts of God, war, labor difficulties, accident, delays of carriers, by contractors or suppliers inability to obtain materials, shortages of fuel and energy, or any other causes of any kind whatever beyond the control of Seller. Seller may terminate any contract of sale of its products without liability of any nature, by written notice to Buyer, in the event that the delay in delivery or performance resulting from any of the aforesaid causes shall continue for a period of sixty (60) days. Under no circumstances shall Seller be liable for any special or consequential damages or for loss, damage, or expense (whether or not based on negligence) directly or indirectly arising from delays or failure to give notice of delay.

SELLER'S LIABILITY: Seller will not be liable for any loss, damage, cost of repairs, incidental or consequential damages of any kind, whether based upon warranty (except for the obligation accepted by Seller under "Warranty" above), contract or negligence arising in connection with the design, manufacture, sale, use or repair of the products or of the engineering designs supplied to Buyer.

RETURNS: Seller cannot accept return of any products unless its written permission has been first obtained, in which case same will be credited subject to the following: (a) All material returned must, on its arrival at Seller's plant, be found to be in first-class condition; if not, cost of putting in saleable condition will be deducted from credit memoranda. (b) A handling charge deduction of twenty percent (20%) will be made for all credit memoranda issued for material returned. (c) Transportation charges, if not prepaid, will be deducted from credit memoranda.

CANCELLATION OR ALTERATION: Cancellation or unless made in writing within ten (10) days of receipt of a shipment. Claims for products damaged or lost in transit should be made on the carrier, as Seller's responsibility ceases, and title passes, on delivery to the carrier.

alteration of an order by Buyer may not be made without advance written consent of Seller and shall be subject to a cancellation charge. The cancellation charge will be a minimum of fifteen percent (15%) or actual cost incurred by Seller at the time of cancellation or alteration, whichever is greater.

SHIPMENTS: All products sent out will be carefully examined, counted and packed. The cost of any special packing or special handling caused by Buyer's requirements or requests shall be added to the amount of the order. No claim for shortages will be allowed

SPECIAL PRODUCTS: Orders covering special or non-standard products are not subject to cancellation except on such terms as Seller may specify on application.

QUOATIONS: All quotations are subject to approval, acceptance and correction at the home office. Any errors in quotations resulting in orders will be corrected and re-submitted to the customer for their acceptance or refusal. All quotations are valid for 45 days from the date on the quotation.

PRICES AND DESIGNS: Prices and designs are subject to change without notice. All prices are **F.O.B. Point of Shipment**, unless otherwise stated.

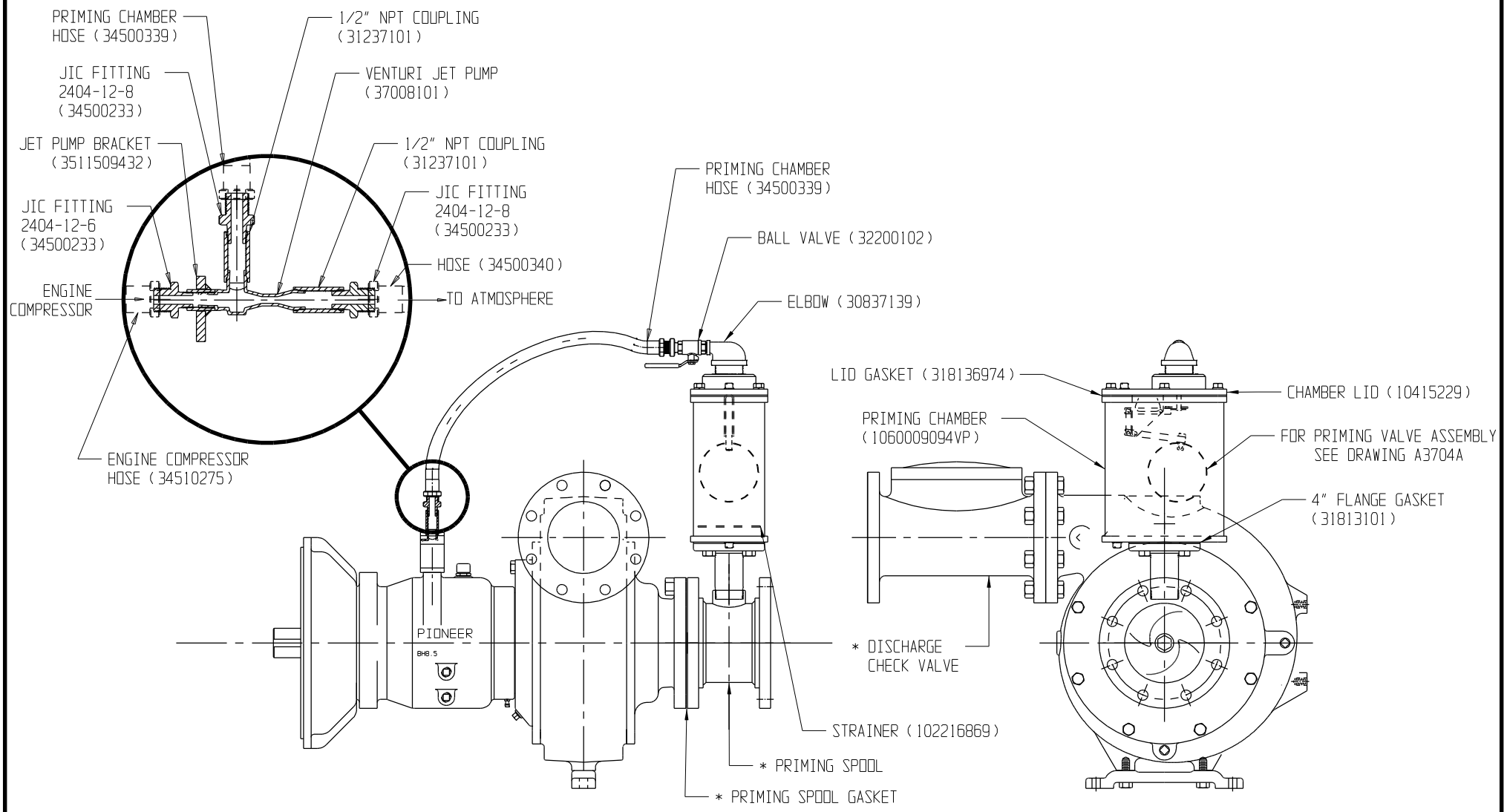
TAXES: The amount of any sales, excise or other taxes, if any, applicable to the products covered by this order, shall be added to the purchase price and shall be paid by Buyer unless Buyer provides Seller with an exemption certificate acceptable to the taxing authorities.

TERMS OF SALE: For value received, Buyer agrees to honor all terms of the sale, as outlined on the reverse hereof, including, but not limited to the following:

- 3% 10, net 30 days unless otherwise specified in writing.
- Buyer agrees and understands that payments will be considered past due if payment is not received within thirty (30) days of the invoice date.
- Buyer agrees that all past due payments shall bear interest at the rate of 1.5% per month (18% per annum) until paid in full.
- Buyer agrees that it is the intention of Buyer and Seller to conform strictly to all usury laws now in force and effect in the state of purchase.
- Buyer further agrees not to suffer or permit any charge, lien, security interest, adverse claim or encumbrance of any and every nature whatsoever against the equipment until the indebtedness secured thereby is satisfied in full.
- Minimum invoice amount will be no less than $25.00 plus transportation.

USE OF EQUIPMENT: Buyer agrees to maintain and use the equipment solely in the conduct of its own business, in a careful and proper manner, and in conformity with all applicable permits, licenses, statues, ordinances, regulations and laws.

INSURANCE: Buyer shall have and maintain at all times with respect to all equipment insuring against risk of fire, theft and other risks as Seller may require, until the indebtedness secured thereby is satisfied in full.

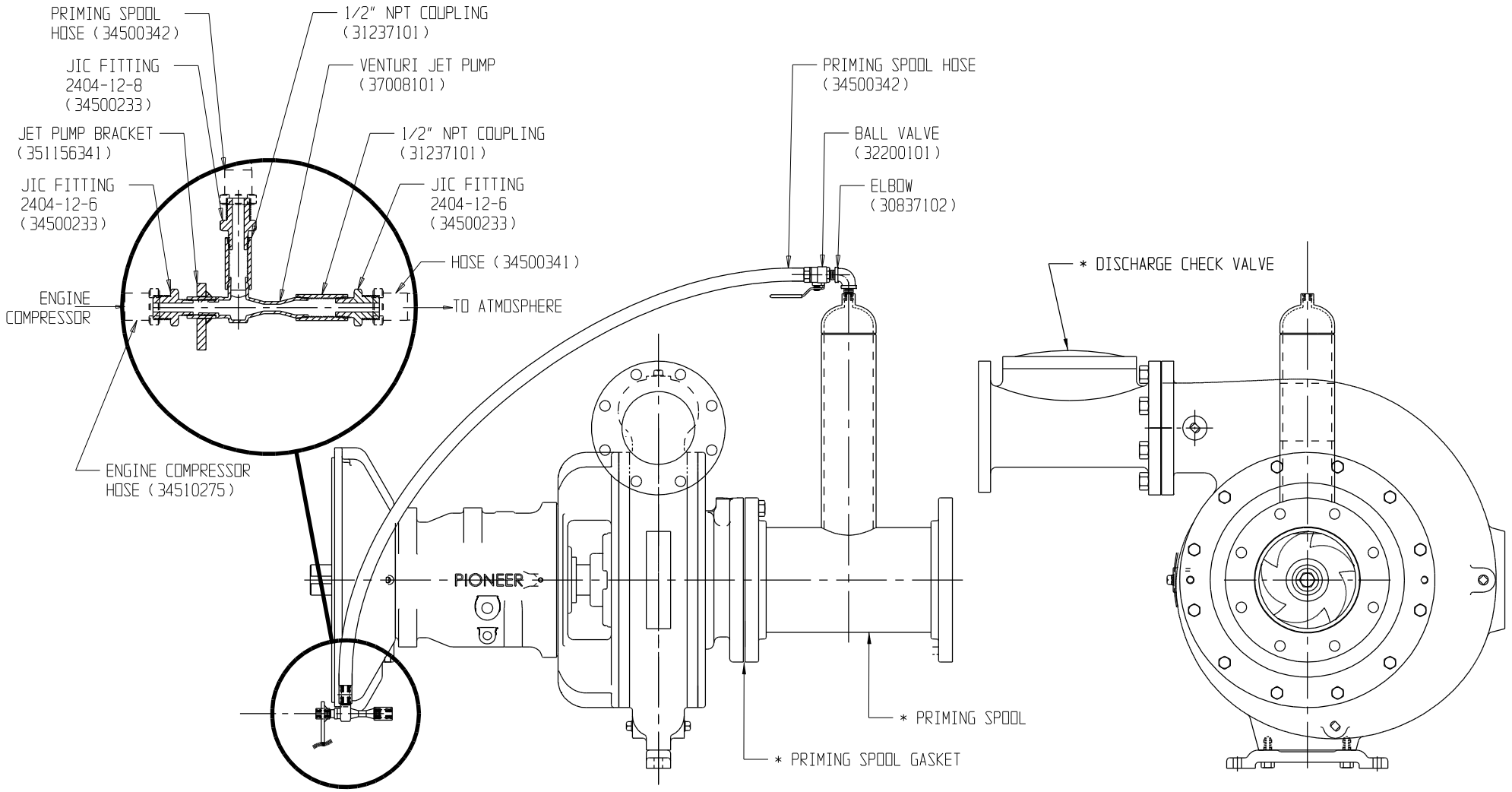


NOTE:
-PIONEER PUMP PART NUMBERS IN ( )
-* CONTACT PIONEER PUMP FOR DIFFERENT SIZES

PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

MODEL: VENTURI PRIMING COMPONENTS WITH POSIVALVE

DWG NO. 10039A
REVISION: 001
DRAWN BY: ESW
DATE: 7/22/2011

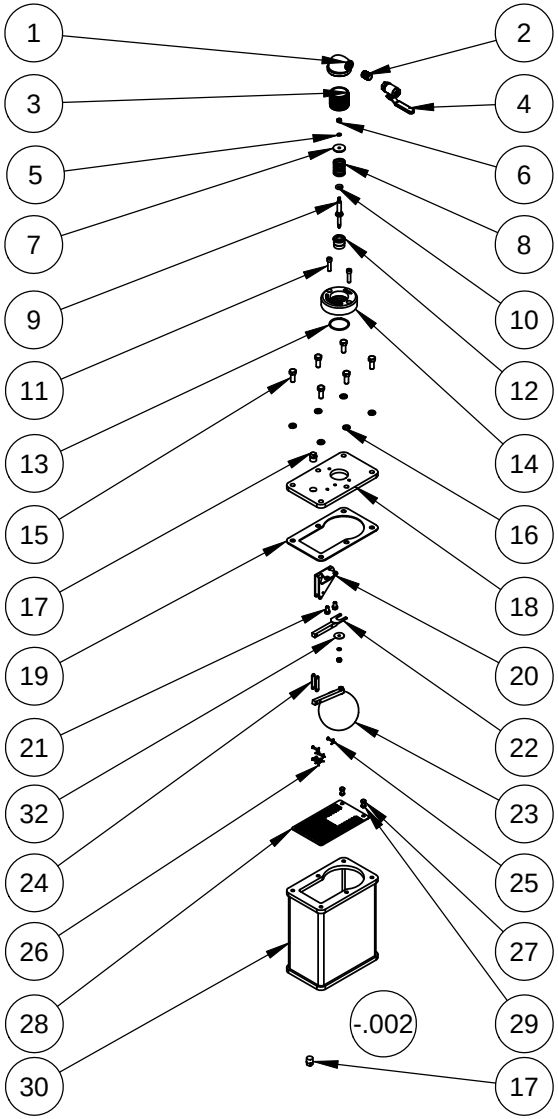


NOTE:
-PIONEER PUMP PART NUMBERS IN ( )
-* CONTACT PIONEER PUMP FOR DIFFERENT SIZES

PIONEERPUMP
PERFORMANCE THROUGH INNOVATION™

MODEL: VENTURI PRIMING COMPONENTS WITHOUT POSIVALVE

DWG NO. 10040A
REVISION: 001
DRAWN BY: ESW
DATE: 7/22/2011



ITEM NO.	PART NUMBER	Description	QTY.
1	30837139	ELBOW 2" X 1/2" NPT 90°	1
2	30637301	NIPPLE 1/2" NPT x CLOSE	1
3	30638339	NIPPLE 2.0" NPT x CLOSE	1
4	32200101	VALVE 1/2" BRONZE BALL	1
5	37821208	WASHER SPLIT LOCK .25 304SS	2
6	37721204	NUT HVY MACHINE .25-20 304SS	2
7	10621597	VALVE WASHER	1
8	33021108	SPRING 2" LONG x 1.46 OD	1
9	10621799	VALVE STEM 304SS	1
10	30103310	O-RING 2-310 VITON	1
11	37621038SC0150	BOLT SOC HD .38-16UNC x 1.5 304SS	2
12	10621800	VALVE SEAT	1
13	30103228	O-RING 2-228 VITON	1
14	106042033	VALVE ADAPTER	1
15	32632050C125	BOLT .50-13UNC x 1.25 G5 PL	6
16	32839401	WASHER SPLIT LOCK .50 STLPL	6
17	31138103	NPT PIPE PLUG, SQUARE HEAD, 1/2"	2
18	104157207	LID FOR PRIMING CHAMBER (COMPACT)	1
19	318136974	LID GASKET, PRIMING CHAMBER	1
20	10621594	LINKAGE BRACKET 304SS	1
21	37621038C062	BOLT .38-16UNC x .63 304SS	2
22	10621595	LINKAGE UPPER ARM	1
23	1060008527	FLOAT BALL AND ARM FOR COMPACT PRIMING CHAMBER	1
24	10621605	LINK UPPER & LOWER ARM	2
25	33021101	CLEVIS PIN .187 DIAx1.0 304SS	5
26	33021102	COTTER PIN .094 DIAx.50 304SS	5
27	37621031C075	BOLT .31-18UNC x .75	2
28	102216896	STRAINER PLATE, PRIMING CHAMBER	1
29	37821213	WASHER SPLIT LOCK .31 304SS	2
30	103156969	PRIMING CHAMBER	1
32	37821209	WASHER FENDER .25 x1.25OD 304S	1

BY	REV.	DESCRIPTION	DATE
JAW	-.002	REMOVED BOTTOM FLANGE, GASKET, & NIPPLE	5/11/2011
JAW	-.001	CORRECTED BALL VALVE DIRECTION	4/30/2011
JAW	-.000	INITIAL CHECK IN	3/11/2011

REVISIONS

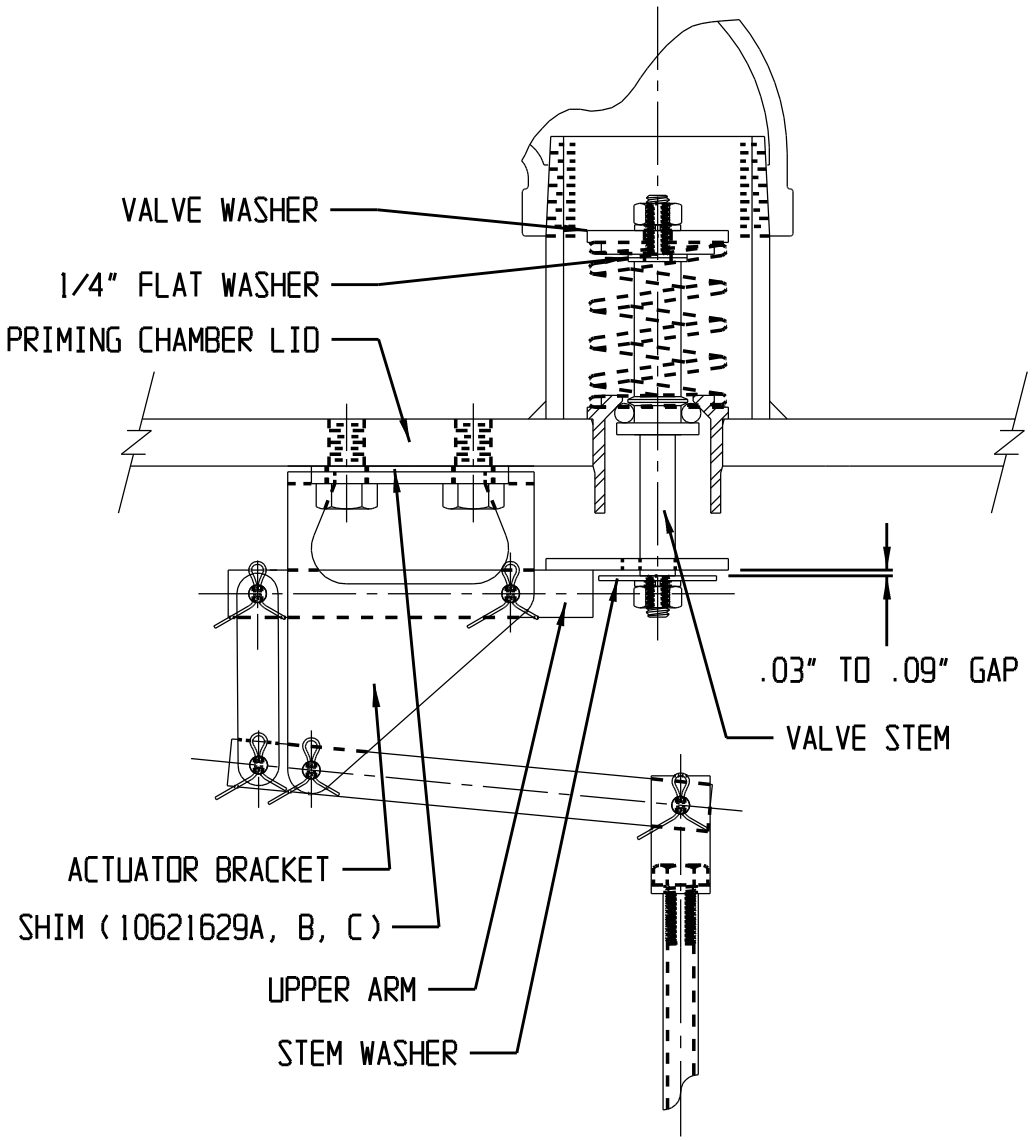
TITLE:
PARTS PAGE, COMPACT PRIMING CHAMBER VENTURI PRIME

PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

	NAME	DATE	SIZE	DWG. NO.	REV.
WEIGHT:			A	09094A-VP	-.002
DRAWN BY	JAW	6/27/2011			
CHECKED BY	XXX	X/X/XXXX	SCALE: 1:24	DO NOT SCALE DRAWING	SHEET 1 OF 1

5 4 3 2 1

DWG NO.
A1784A



ADJUSTMENT INSTRUCTIONS:

WITH THE FORKED PORTION OF THE UPPER ARM PARALLEL TO THE STEM WASHER, THE GAP BETWEEN THEM SHOULD BE .03" - .09".

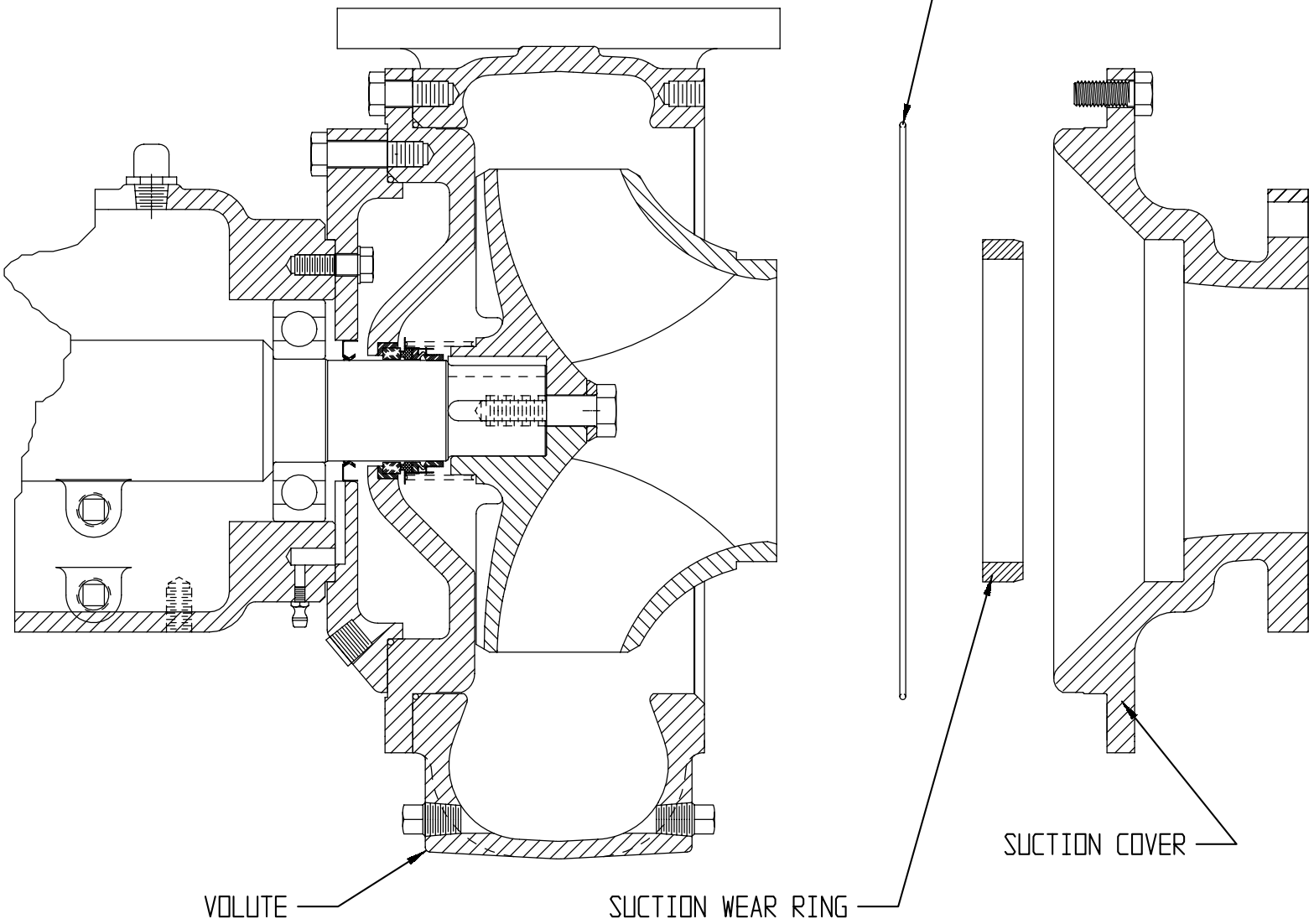
IF THIS GAP IS TOO LARGE, PLACE A SHIM BETWEEN THE THE ACTUATOR BRACKET AND THE PRIMING CHAMBER LID.

- (10621629A = 10 GAGE SHIM = .125" THICK),
- (10621629B = 16 GAGE SHIM = .062" THICK),
- (10621629C = 12 GAGE SHIM = .099" THICK)

THIS WILL LOWER THE BRACKET AND REDUCE THE GAP ALLOWING THE VALVE TO OPEN UP AS NECESSARY TO DRAW A VACUUM MORE EFFICIENTLY.

NOTE: THERE HAVE BEEN SOME CASES WHERE THE VALVE HAS STILL FAILED TO OPEN PROPERLY WHEN THE GAP IS SHIMMED CORRECTLY. AT THIS POINT THE SPRING TENSION NEEDS TO BE REDUCED, THIS DONE BY ADDING ONE OR TWO 1/4" STAINLESS FLAT WASHERS (32821201) BETWEEN THE STEM AND VALVE WASHER.

DWG NO.
A2048M



REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

**DRAWING CONTAINS PROPRIETARY DATA
NO DISCLOSURE WITHOUT WRITTEN
AUTHORIZATION FROM PIONEER PUMP, INC.**

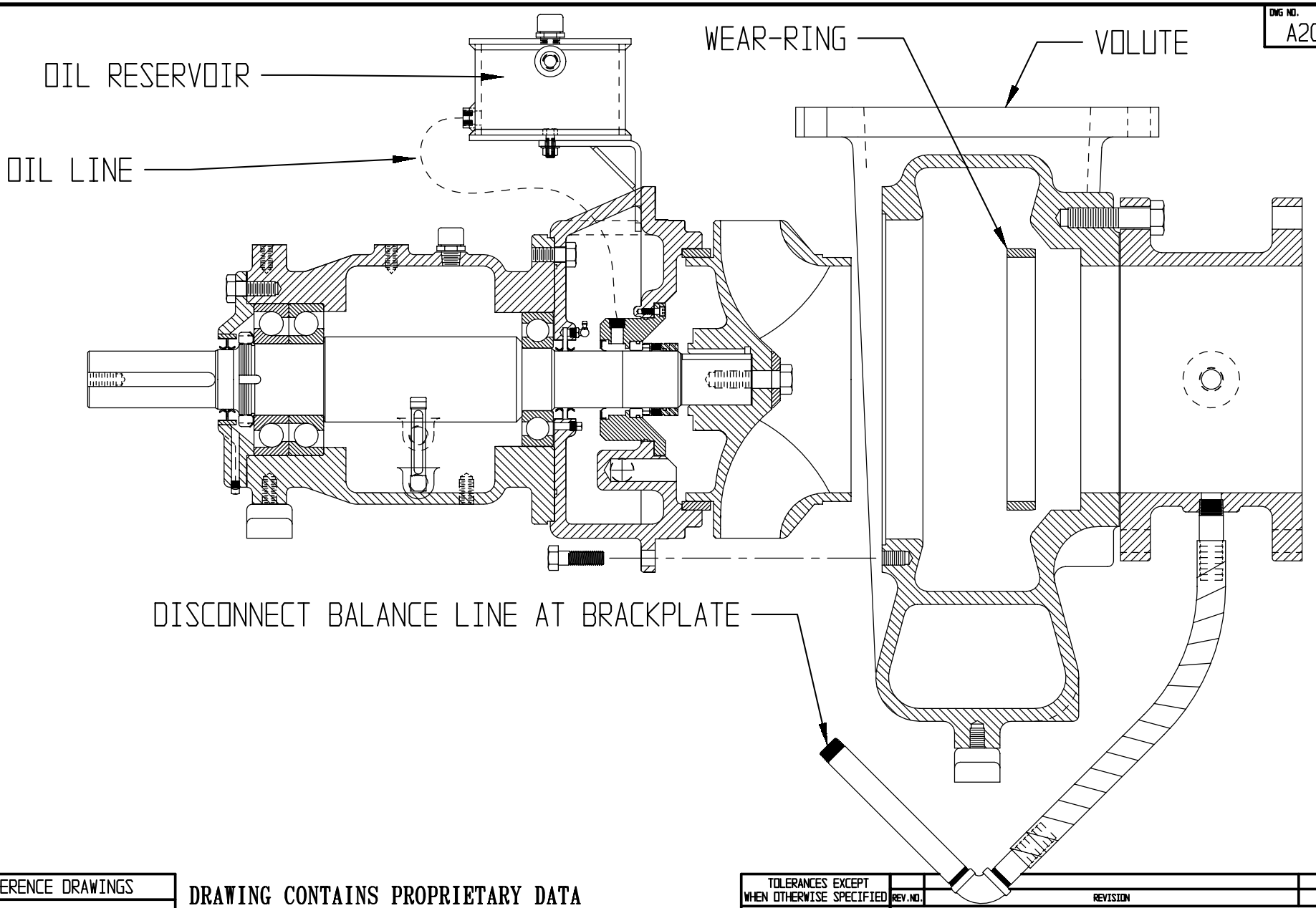
TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1°			
.XX = ±.010 MAX MACH R. .03			
.X = ±.03			

MANUAL ILLUS.- SUCTION COVER AND WEAR RING REMOVAL

DR. BC	CHECKED	DATE 8/19/02	SCALE 1/4	DWG NO. A2048M

PIONEER PUMP, INC. - CANBY, OREGON

DWG NO. A2049A



REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

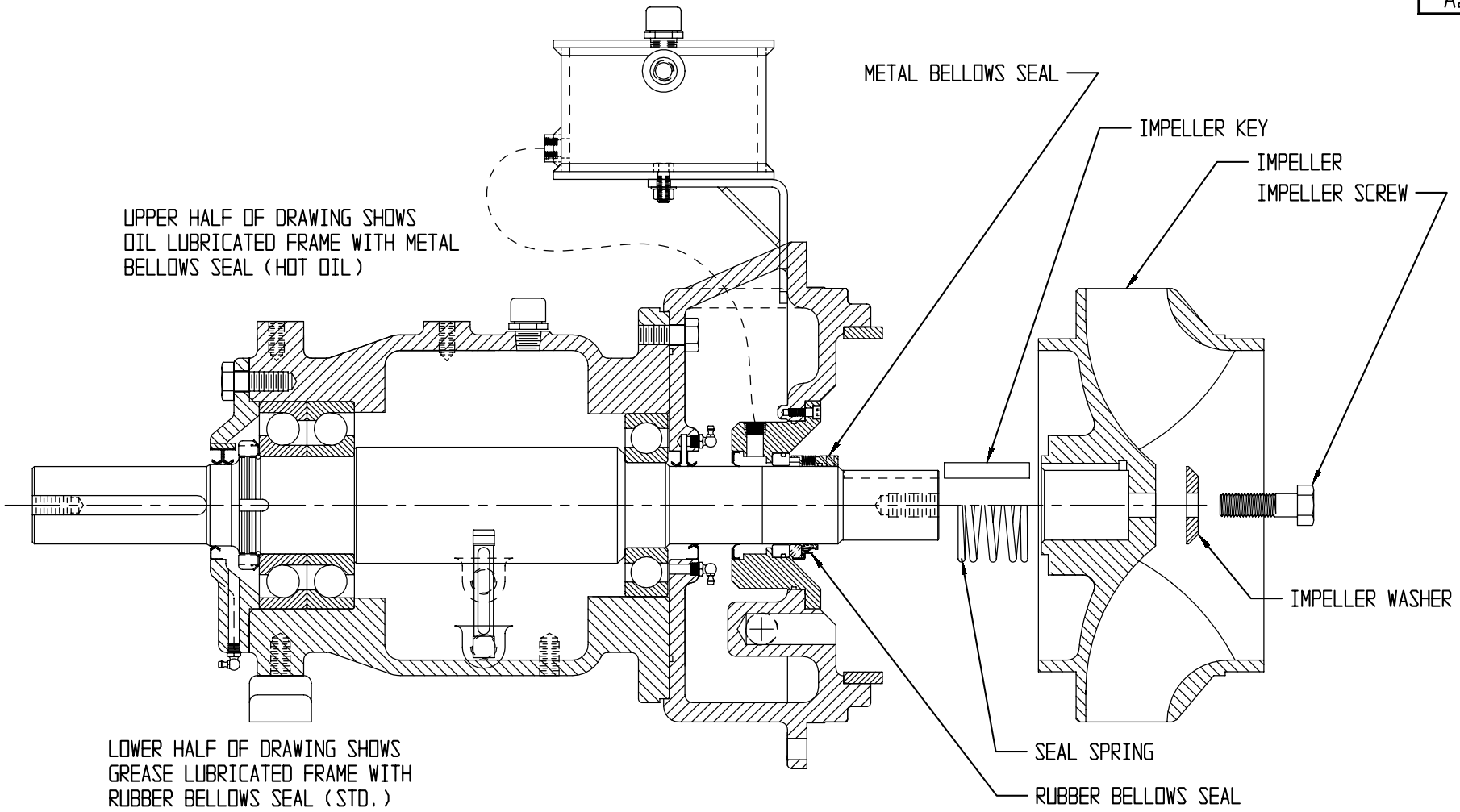
TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1°			
.XX = ±.010 MAX MACH R. .03			
.X = ±.03			

MANUAL ILLUSTRATION - VOLUTE / WEAR-RING REMOVAL

DR. BC	CHECKED	DATE 8/19/02	SCALE 1/6	DWG NO. A2049A

PIONEER PUMP, INC. - CANBY, OREGON

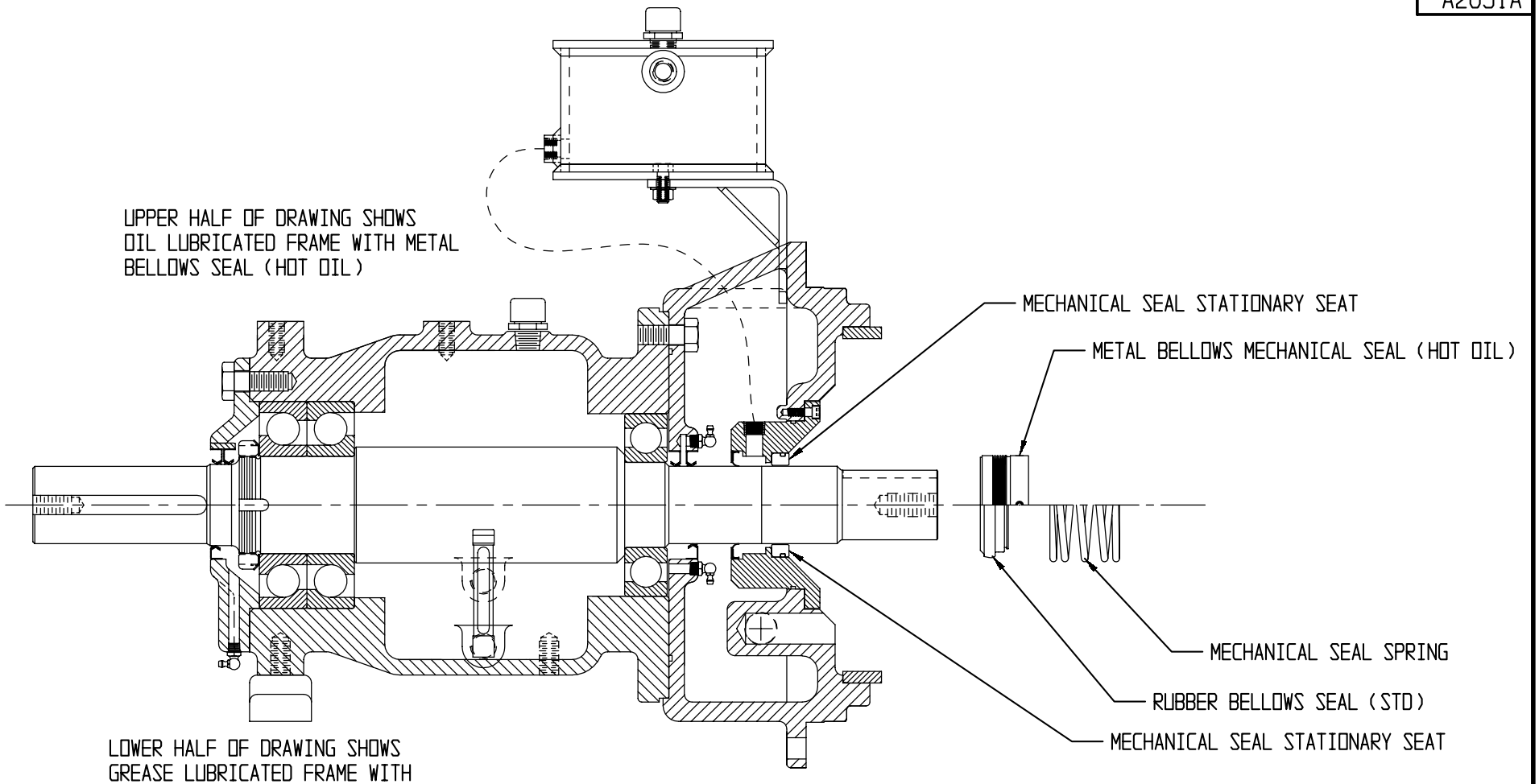
DWG NO.
A2050A



REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1° .XX = ±.010 MAX MACH R. .03 .X = ±.03	MANUAL ILLUSTRATION - IMPELLER REMOVAL		
DR. BC	CHECKED	DATE 6/18/01	SCALE 1/5
PIONEER PUMP, INC. - CANBY, OREGON			DWG NO. A2050A

DWG NO.
A2051A



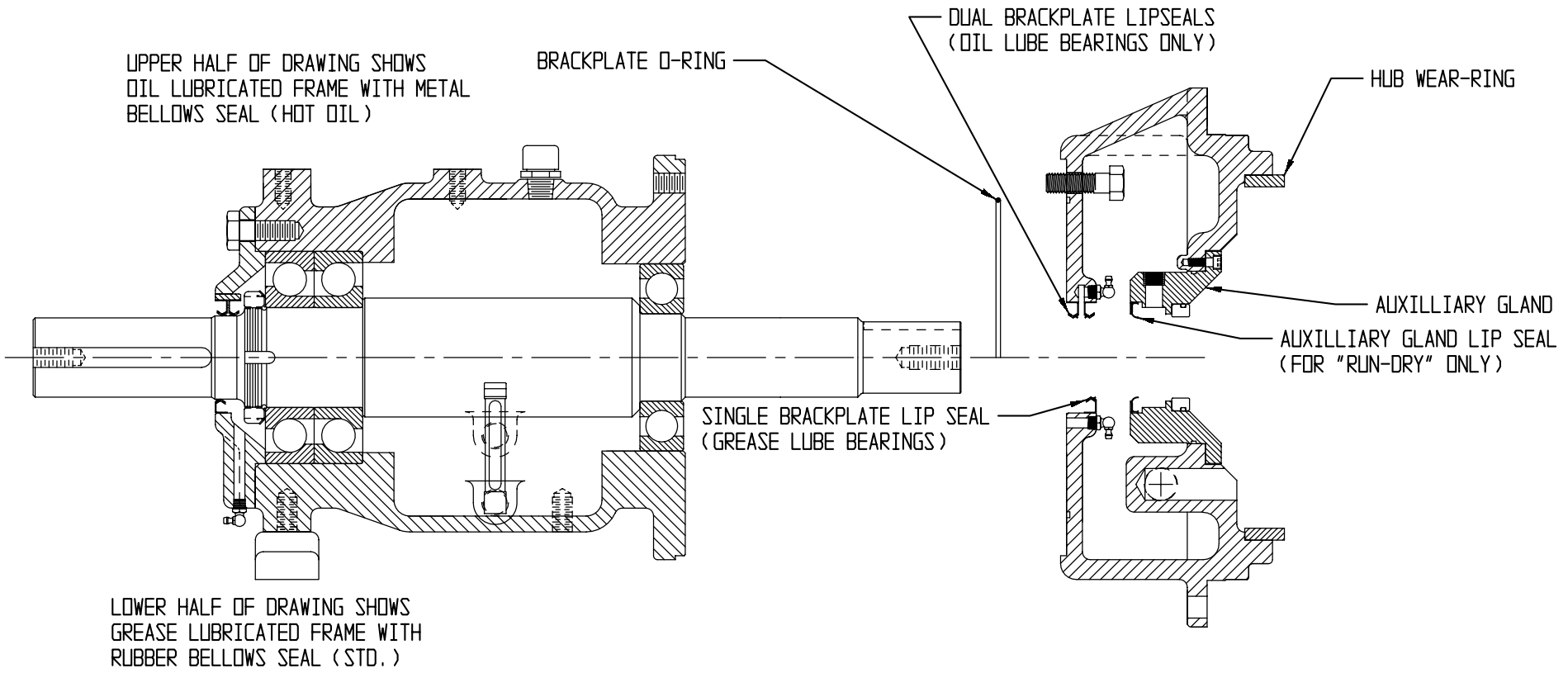
REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED			
.XXX = ±.003 ANGLES = ± 1°	REV.NO.	REVISION	DATE
.XX = ±.010 MAX MACH R. .03		MANUAL ILLUSTRATION - SEAL REMOVAL	
.X = ±.03	DR. BC	CHECKED	DATE 6/18/01 SCALE 1/5

PIONEER PUMP, INC. - CANBY, OREGON

DWG NO. A2051A

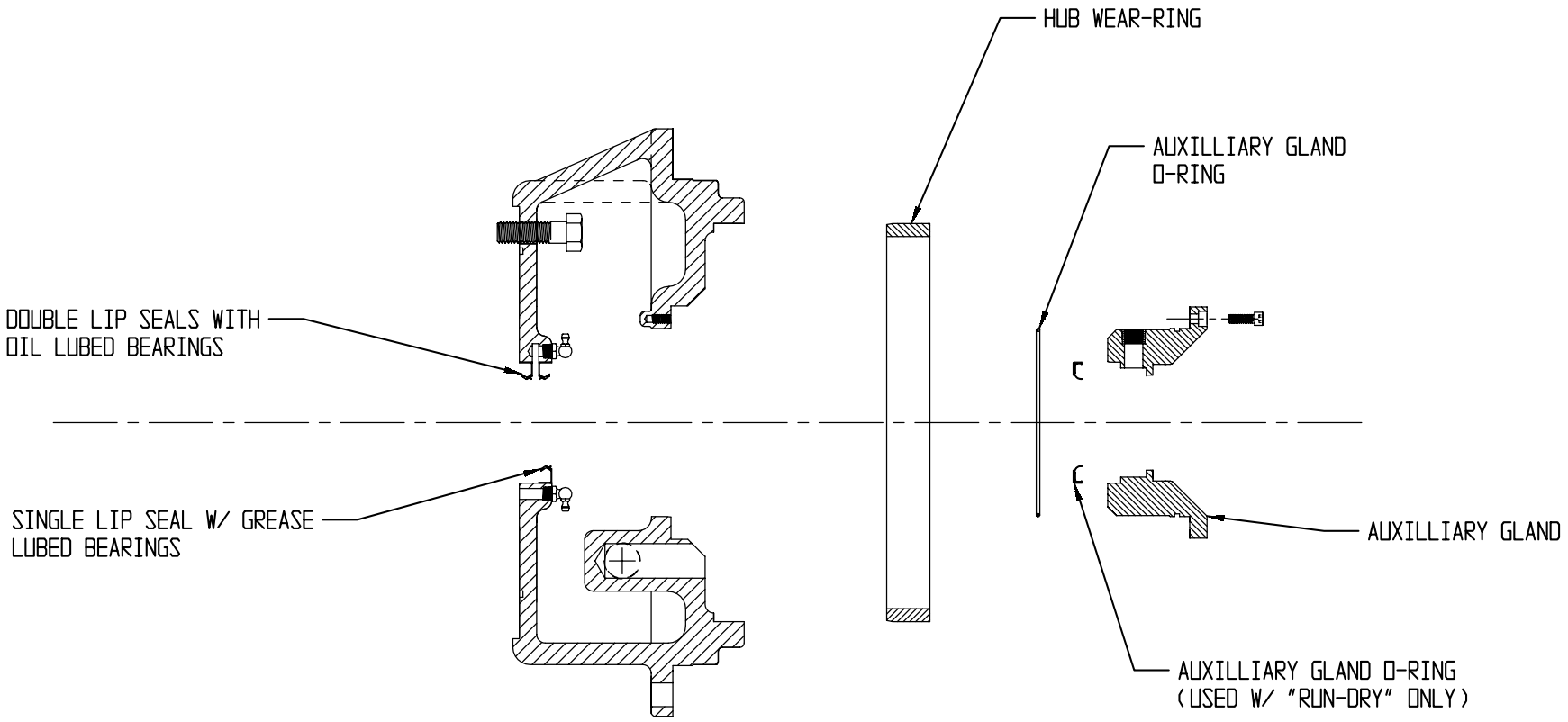
DWG NO. A2052A



REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1° .XX = ±.010 MAX MACH R. .03 .X = ±.03	MANUAL ILLUSTRATION - BRACKPLATE REMOVAL		
DR. BC	CHECKED	DATE 8/19/02	SCALE 1/5
PIONEER PUMP, INC. - CANBY, OREGON			DWG NO. A2052A

DWG NO.
A2053A



REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

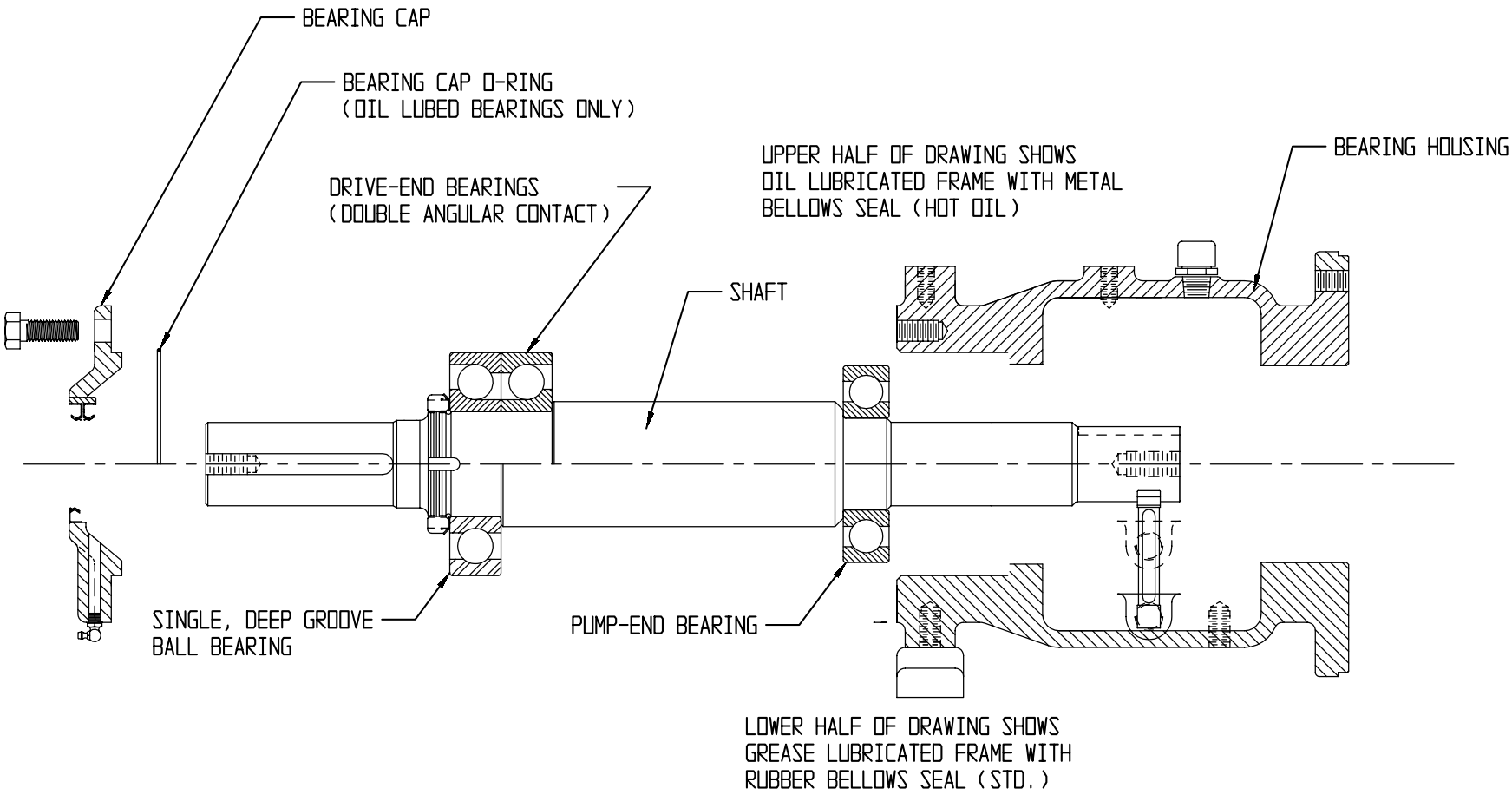
TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1°			
.XX = ±.010 MAX MACH R. .03			
.X = ±.03			

MANUAL ILLUSTRATION - BRACKPLATE DISASSEMBLY

DR. BC	CHECKED	DATE 8/19/02	SCALE 1/5	DWG NO. A2053A

PIONEER PUMP, INC. - CANBY, OREGON

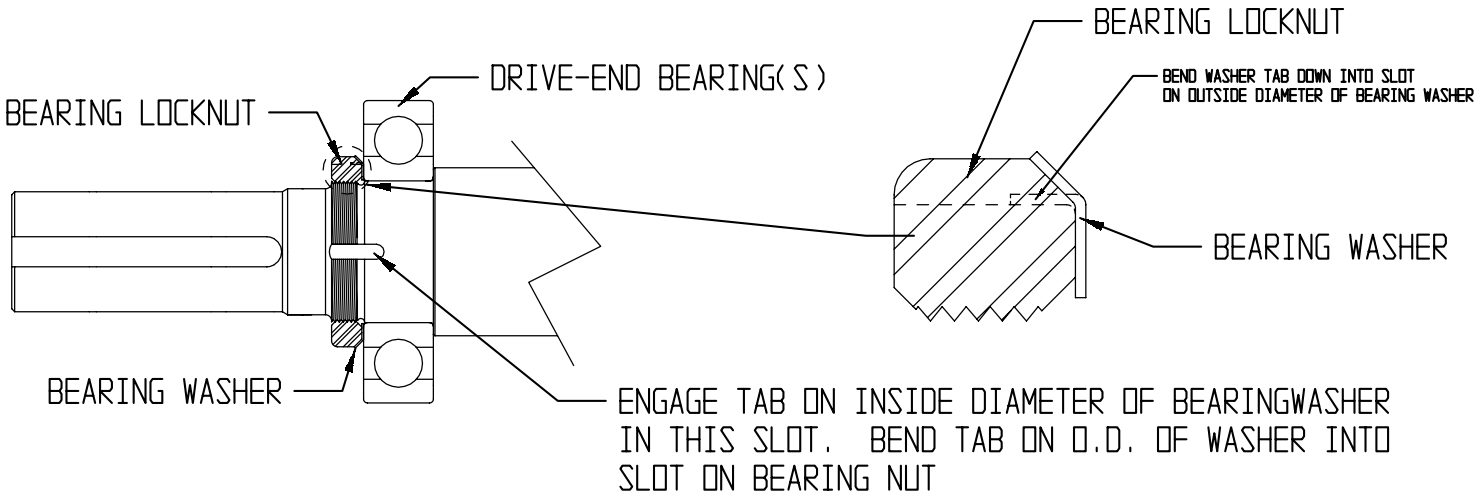
DWG NO.
A2054A



REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1° .XX = ±.010 MAX MACH R. .03 .X = ±.03	MANUAL ILLUSTRATION - BEARING FRAME DISASSEMBLY		
DR. BC	CHECKED	DATE 8/19/02	SCALE 1/5
PIONEER PUMP, INC. - CANBY, OREGON			DWG NO. A2054A

DWG NO.
A2055M



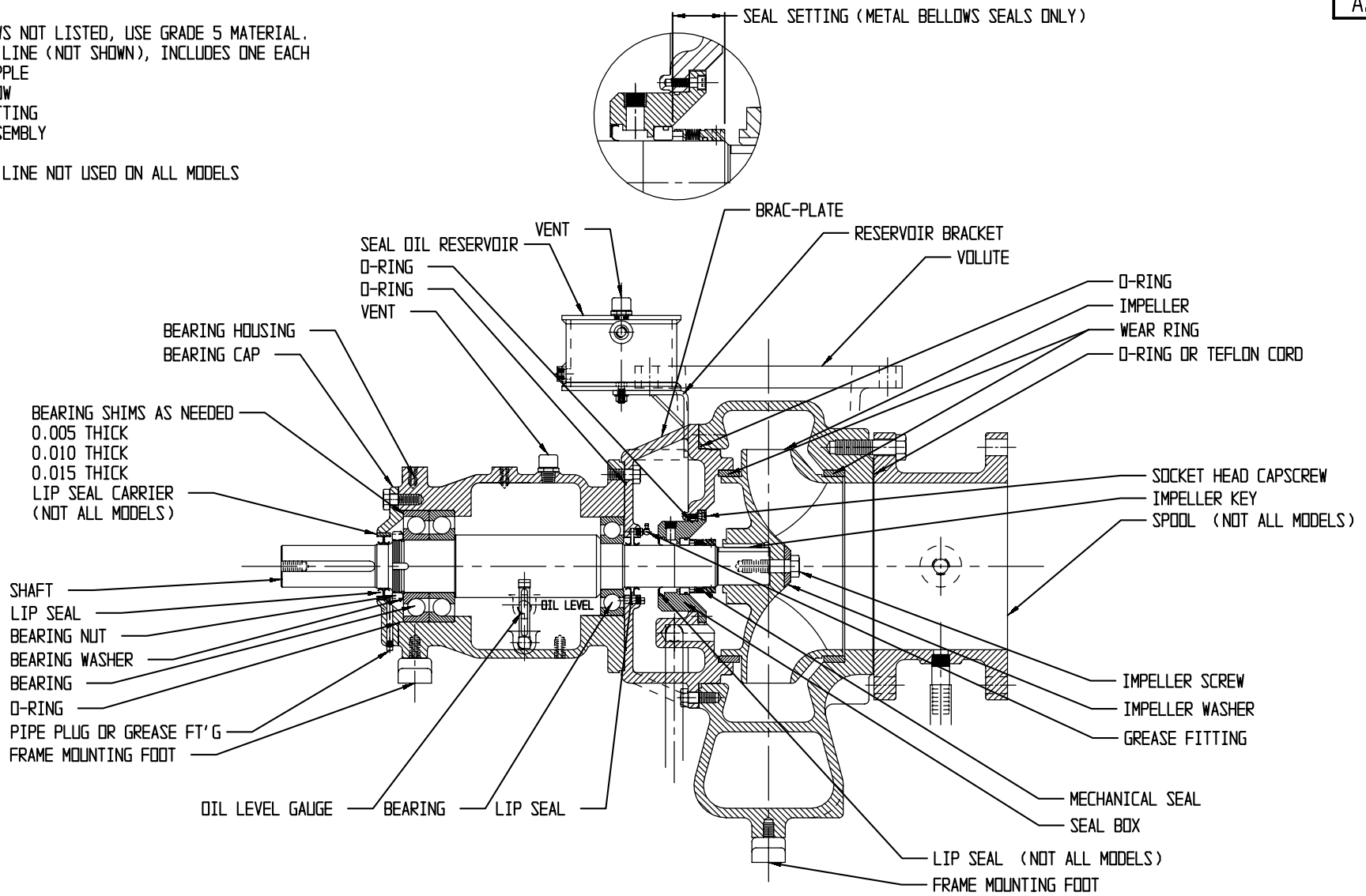
REFERENCE DRAWINGS
PATTERN DWG.
MACHINE DWG.
HYDRAULIC DWG.
PATTERN NO.

TOLERANCES EXCEPT WHEN OTHERWISE SPECIFIED	REV.NO.	REVISION	DATE
.XXX = ±.003 ANGLES = ± 1° .XX = ±.010 MAX MACH R. .03 .X = ±.03	MANUAL ILLUSTRATION - DRIVE-END BEARING ASSEMBLY		
DR. BC	CHECKED	DATE 8/19/02	SCALE 1/4
PIONEER PUMP, INC. - CANBY, OREGON			DWG NO. A2055M

DWG NO.
A2056A

NOTES:
- CAPSCREWS NOT LISTED, USE GRADE 5 MATERIAL.
- BALANCE LINE (NOT SHOWN), INCLUDES ONE EACH
  PIPE NIPPLE
  90° ELBOW
  HOSE FITTING
  HOSE ASSEMBLY

  BALANCE LINE NOT USED ON ALL MODELS

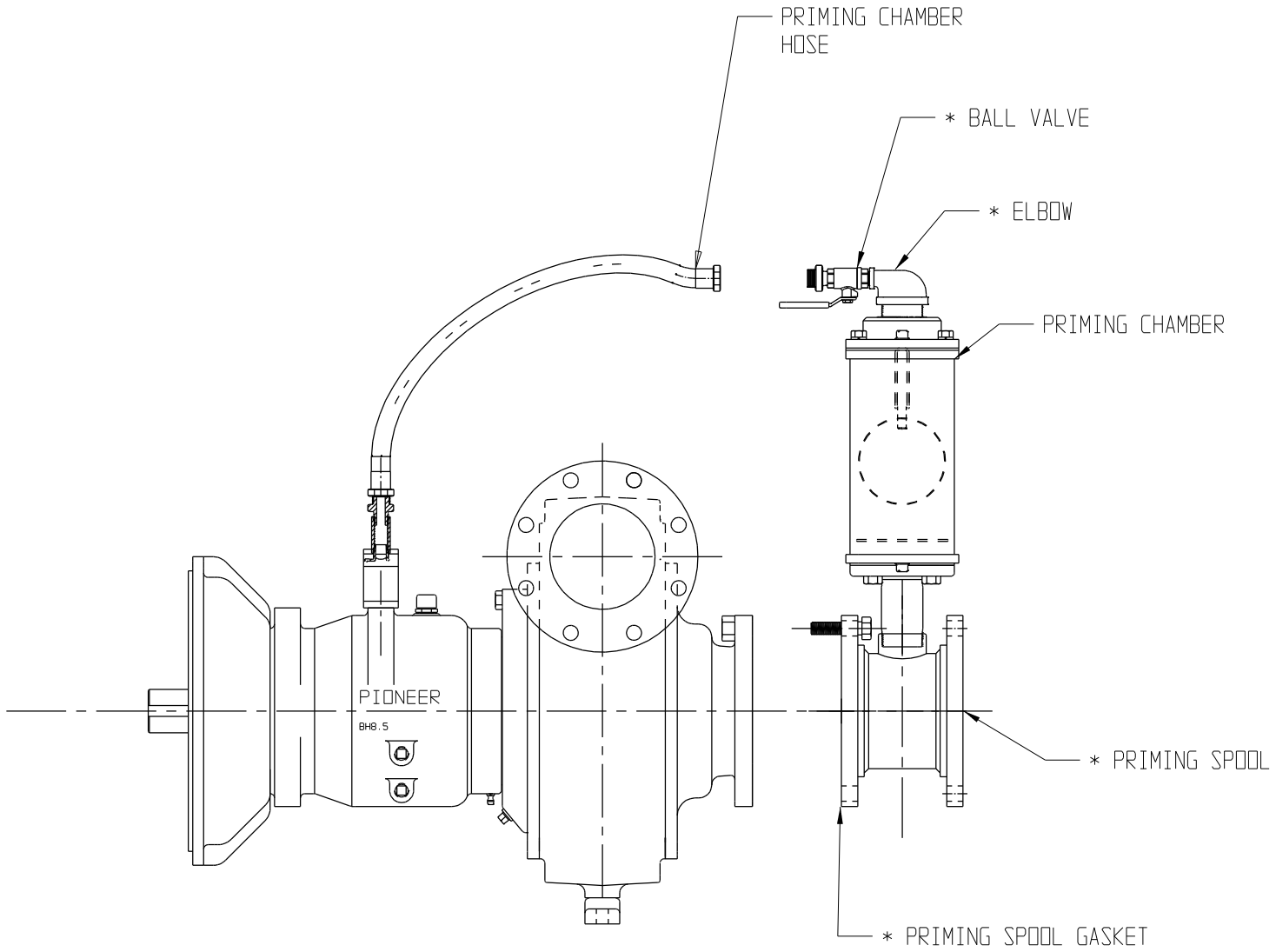


8/1/02

PIONEER PUMP, INC.

MODEL: FRAME MOUNTED "BRACKPLATE STYLE"

DWG NO.
A2056A



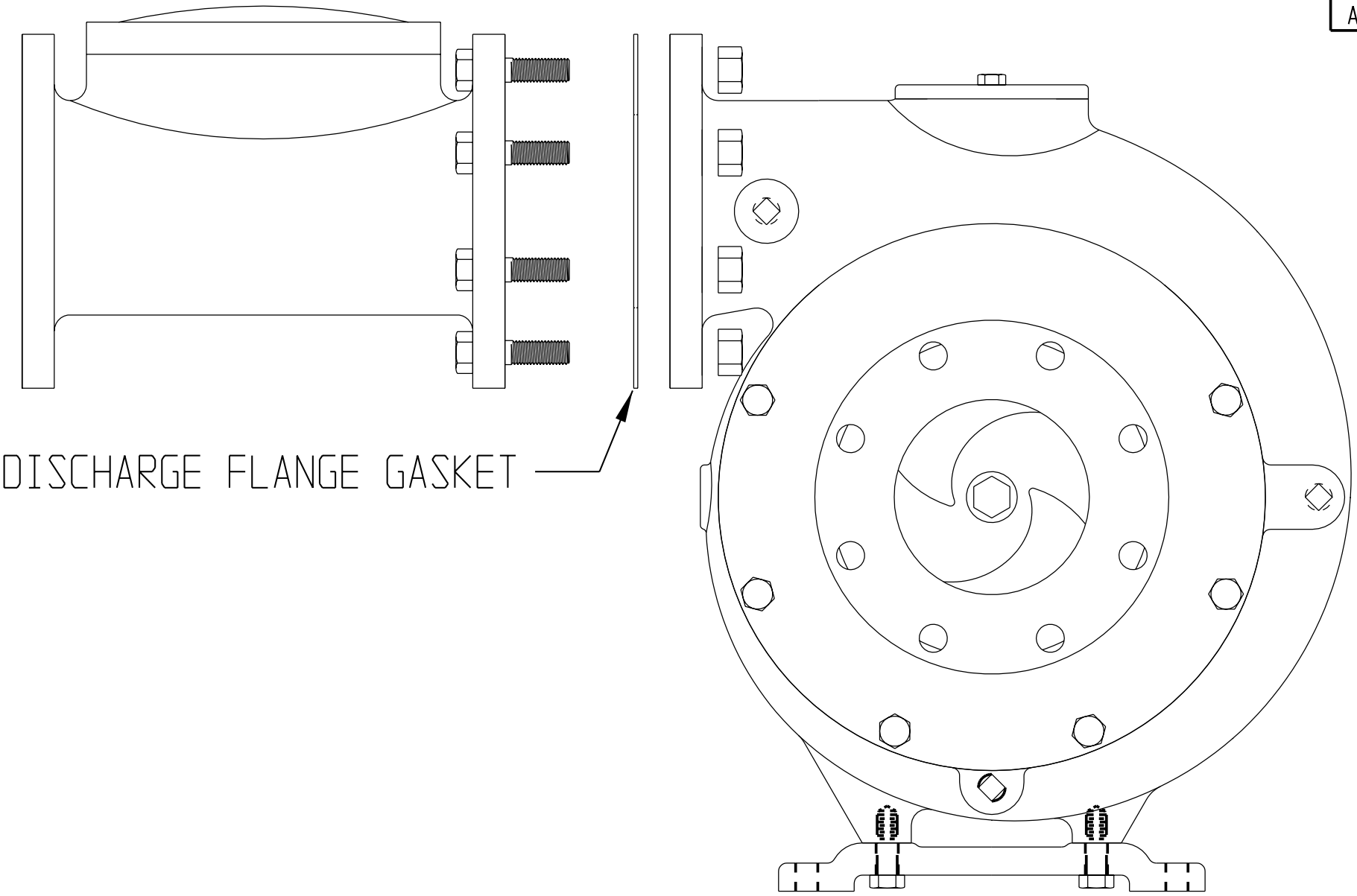
NOTE:
-PIONEER PUMP PART NUMBERS IN ( )
-* CONTACT PIONEER PUMP FOR DIFFERENT SIZES

PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

REMOVING PRIMING CHAMBER & SPOOL

DWG NO. 10045A
REVISION: 000
DRAWN BY: ESW
DATE: 7/24/2011

DWG NO.
A2170A



PIONEER PUMP, INC.

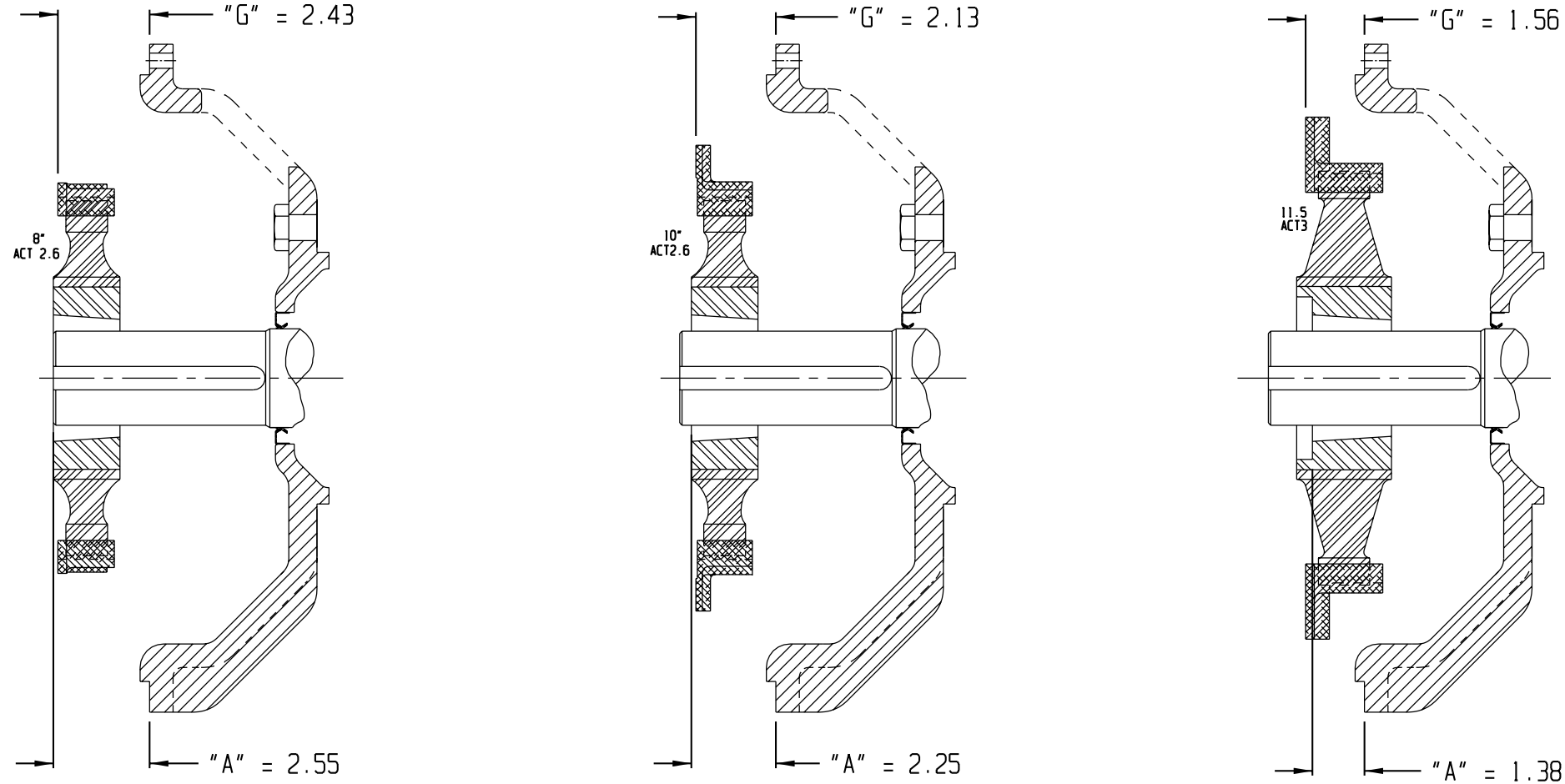
REMOVING DISCHARGE CHECK VALVE

DWG NO.
A2170A

INSTALLER MUST CONFIRM THAT PUMP SHAFT MAKES NO DIRECT CONTACT WITH ENGINE FLYWHEEL OR CRANKSHAFT AND THAT COUPLING IS INSTALLED SO AS TO TRANSMIT NO AXIAL THRUST TO THE ENGINE FLYWHEEL OR CRANKSHAFT

DIMENSIONS SHOWN ARE BASED ON SAE STANDARD BELLHOUSING AND FLYWHEEL DIMENSIONS. INSTALLER ASSUMES FULL RESPONSIBILITY FOR VERIFYING DIMENSIONS CORRECT FOR ANY PARTICULAR ENGINE

DWG NO. A2184A

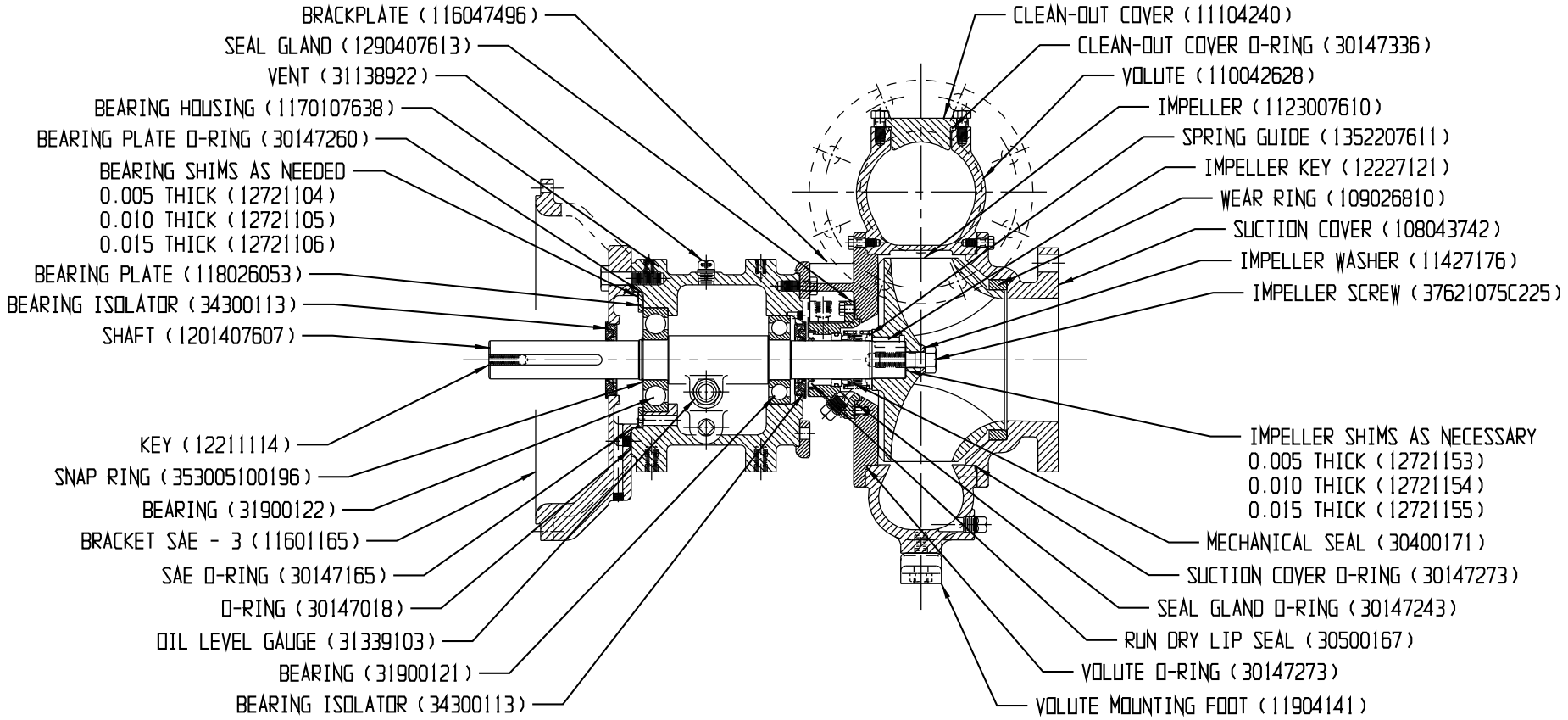


PIONEER PUMP, INC.

CORRECT COUPLING POSTION FOR SAE 3 & 4 W/8",10" & 11.5" DRIVES

DWG NO. A2184A

NOTES:
- PIONEER PUMP PART NUMBERS IN ( ).
- CAPSCREWS NOT LISTED, USE GRADE 5 MATERIAL.
- FOR VACUUM ASSIST COMPONENTS SEE DRAWING 10509A.
- COUPLING (30200102) AND BUSHING (32500122) NOT SHOWN



PIONEERPUMP
PERFORMANCE THROUGH INNOVATION™

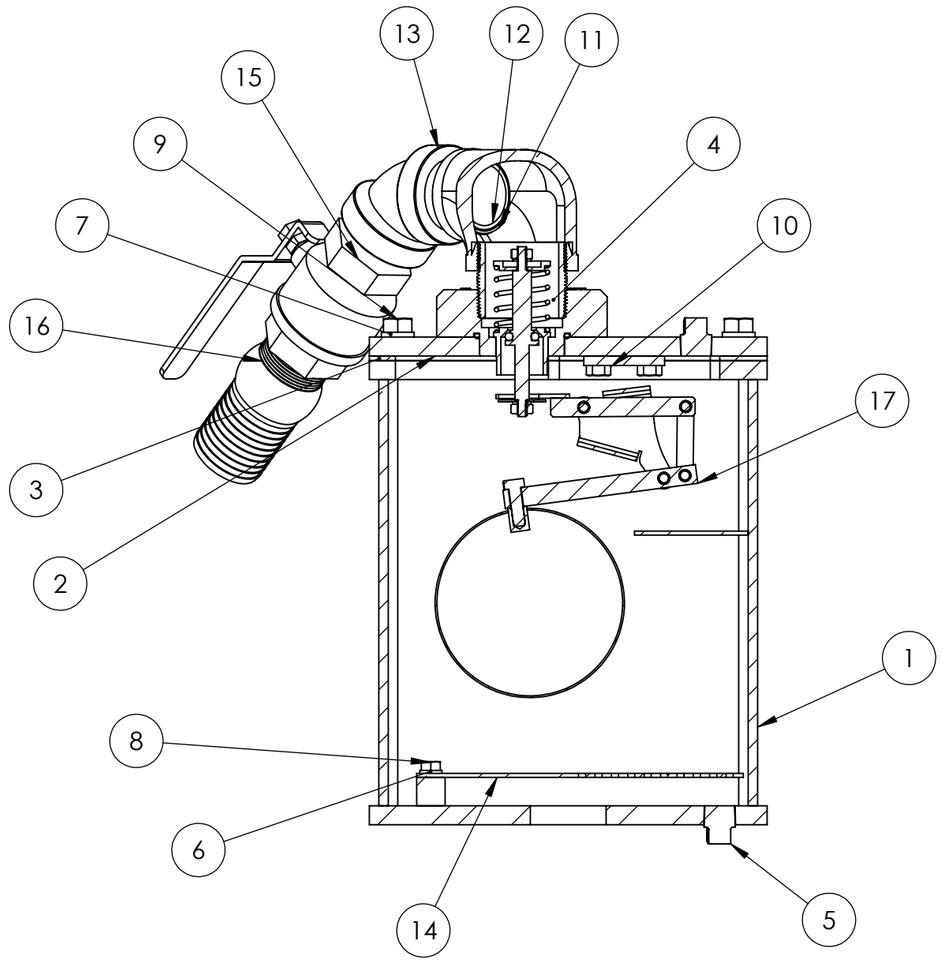
MODEL: PP66S10L71-E038

REFERENCE: BOM PPEM66S10-018

DWG NO. 09207A
REVISION: 002
DRAWN BY: JAW
DATE: 02/11/2013

ITEM NO.	PART NUMBER	Description	QTY
1	103156969	PRIMING CHAMBER	1
2	104157207	LID FOR PRIMING CHAMBER (COMPACT)	1
3	318486974	LID GASKET, PRIMING CHAMBER	1
4	106003704C	PRIMING VALVE (SUB-ASSY)	1
5	31138103	NPT PIPE PLUG, SQUARE HEAD, 1/2"	2
6	37821213	WASHER SPLIT LOCK .31 304SS	2
7	32839401	WASHER SPLIT LOCK .50 STLPL	6
8	37621031C075	BOLT .31-18UNC x .75	2
9	32632050C125	BOLT .50-13UNC x 1.25 G5 PL	6
10	37621038C062	BOLT .38-16UNC x .63 304SS	2
11	30838110	ELBOW 2" x 1-1/2" NPT 90 DEG	1
12	30638311	NIPPLE 1-1/2" NPT x CLOSE	2
13	30838133	ELBOW 1-1/2" NPT 45 DEG	1
14	102216896	STRAINER PLATE, PRIMING CHAMBER	1
15	32200102	VALVE 1-1/2" BRONZE BALL	1
16	31638104	NIPPLE KING 1/1-2" MPT x 2" HO	1
17	1060015893	LINKAGE ASSEMBLY, GEN2, FIXED BALL	1

REVISION				
BY	REV.	DESCRIPTION	DATE	ECN
DPC	-.000	INITIAL CHECK IN	5/2/2016	



TITLE:

COMPACT PRIMING CHAMBER, SUB. ASSY'S

REFERENCE DRAWINGS	
PATTERN	XXX
MACHINE	XXX
HYDRAULIC	XXX
PATTERN NO.	XXX

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL: ±.032
ANGULAR: MACH± 1°
ONE PLACE DECIMAL: ±.030
TWO PLACE DECIMAL: ±.010
THREE PLACE DECIMAL: ±.003

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5

PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN BY	DPC	5/2/2016
CHECKED BY	XXX	XX/XX/XXXX

SIZE B | DWG. NO. 16446A | REV. -.000

SCALE: 1:8 | WEIGHT: | SHEET 1 OF 1

Hourmeters

ETM-97030B
Revised 11-01
Catalog Section 20
(00-02-0259)

TM Series

- 2 in. (51 mm) Diameter Dial
- Tamperproof and Environmentally Sealed
- Mechanical Counter–No Battery Needed to Maintain Elapsed Time
- Reversed Polarity Protected
- Quartz-Crystal Time Base for Accurate Long-Term Timekeeping
- Powered by 12 to 24 VDC

Description

The TM Series hourmeters record the operating time of vehicles or powered equipment. They are electromechanical and have a quartz base time counter that insures accuracy (better than ±0.02% over the entire range). They can record up to 99,999.9 hours (9,999.9 for TM612/624) and include an automatic recycle to zero hours feature. The TM Series models have a shock-proof and tamperproof, totally sealed case made of an engineered plastic. These small, light weight time meters are rugged and durable. They are the answer to applications requiring a low DC power, reliable hourmeter.

The TM612/624 model includes a 3-hole mounting shock ring for extreme-shock protection.

Basic Models

6-Digits Hourmeters

Model	*Bezel Type*
TM4592	Bright Stainless Steel Bezel
TM4593	Black Stainless Steel Bezel
TM4594	SAE Bright Stainless Steel Bezel
TM4595	SAE Stainless Steel Black Bezel

5-Digits Hourmeter with Shock Ring Mounting

TM612/624	3-Hole Mount, Black Bezel

Applications

These hourmeters can be used on any engine where operating time needs to be recorded. All it requires is a DC power source (refer to Specifications, at right).

Outstanding Features

- Solid-State Electronic Drive Circuit
- Quartz-Crystal for Accurate Timing
- Quiet Operation–Permanently Lubricated
- High-Impact, Tamperproof Plastic Case
- Sealed Against Moisture and Dirt
- Indicates Operating Time in Hours and Tenths
- No Battery Back Up Required
- Made in the U.S.A.

Specifications

Power Input: 12 to 24 VDC
Power Consumption: Less than 0.03 W @ 12 VDC; 0.4 W @ 24 VDC.
Accuracy: ± 0.02% over entire range.
Temperature Range: -40°F to 185°F (-40°C to +85°C).
Dial (Face Plate): White numerals (over black background).
Time Scale: TM4592-95 models: 6-digits 99,999.9 hours; TM612/624 models: 5-digits 9,999.9 hours. Automatic recycle to zero.
Vibration Resistance: Withstands 10 to 75 Hz @ 1 to 8 G's.
Case Material: Plastic.
Bezel: Stainless Steel.
Terminations: 1/4 in. (6 mm) male blade terminals.
TM4592/4595 Shipping Weight: 5 ozs. (140 g).
Shipping Dimensions: 3-1/8 x 3 x 3 in. (79 x 76 x 76 mm) approximately.
TM612/624 Shipping Weight: 8 ozs. (230 g).
TM612/624 Shipping Shipping Dimensions: 5 x 5 x 3-1/4 in. (127 x 127 x 83 mm) approx.

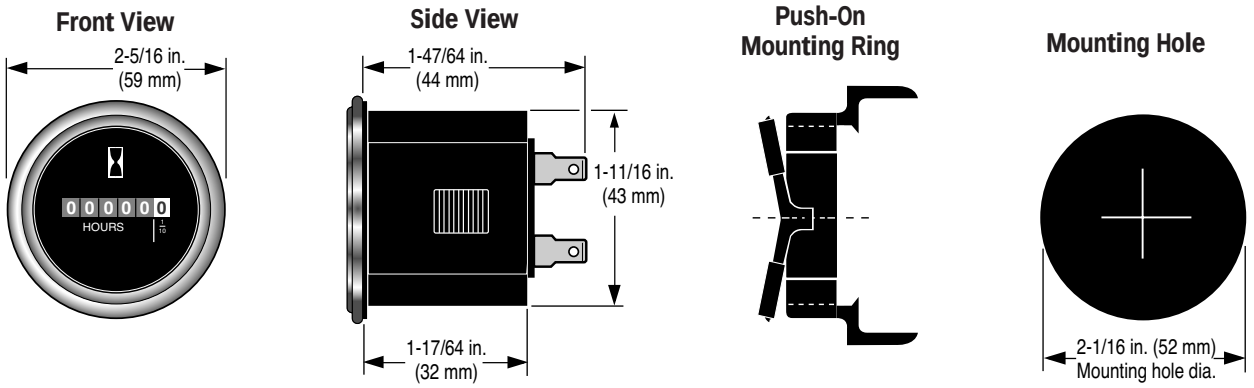
Warranty

A limited warranty on materials and workmanship is given with this FW Murphy product. A copy of the warranty may be viewed or printed by going to www.fwmurphy.com/support/warranty.htm

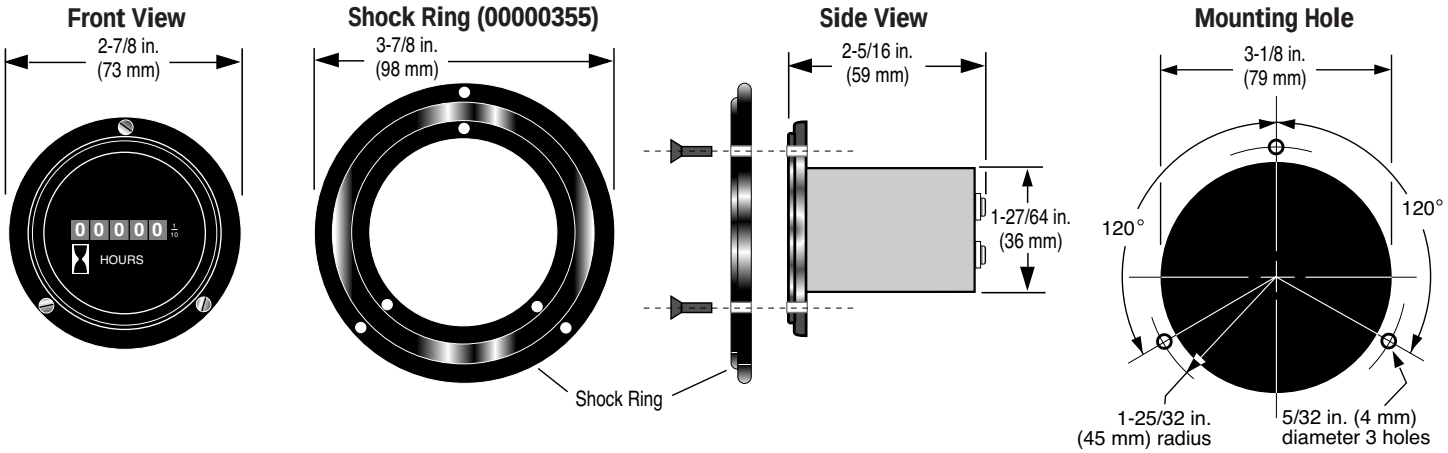
* Products covered by this bulletin comply with EMC Council directive 89/336/EEC regarding electromagnetic compatibility except as noted. The CE mark does not apply to the TM612 and TM624 models.

MURPHY®

TM4592–TM4595 Models

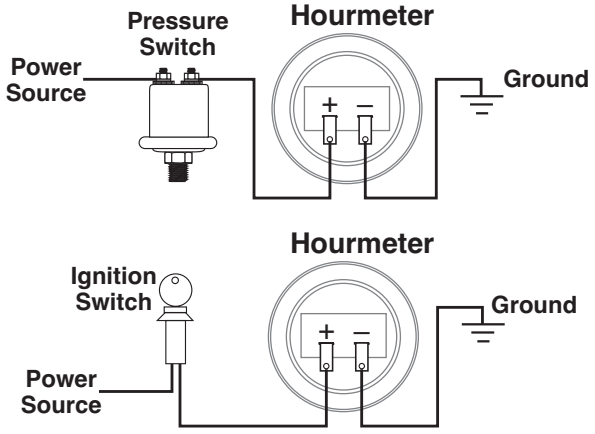


TM612/624 Model with Shock Ring



Typical Wiring Diagrams

WARNING: Turn the power source OFF before wiring.



How to Order

Example: **TM4592**

Model Designation

Model	*Description*
TM4592	6-digits w/Bright Stainless Steel Bezel
TM4593	6-digits w/Black Stainless Steel Bezel
TM4594	6-digits w/SAE Bright Stainless Steel Bezel
TM4595	6-digits w/SAE Stainless Steel Black Bezel
TM612/624	5-digits w/Shock Ring Mount Black Bezel
00000355	Shock Ring only for TM612/624

MURPHY
www.fwmurphy.com
918.317.4100 Email: sales@fwmurphy.com

MURPHY®

Tachometers and Tach/Hourmeters

AT and ATH Series

Installation Instructions

IMPORTANT! These instructions are specific to tachometer models with a power input operating range of 11-28 VDC and calibration using dip switches. If your tachometer is a type using selector switch calibration, please locate installation instructions in the discontinued product literature section of the FW Murphy Website (www.fwmurphy.com). Refer to Tachometer and Tach/Hourmeter Installation Instructions Series: ATS, ATHS, ATA, ATHA, ATHI (00-02-0258).

CE

00-02-0260
2012-05-18
Section 20

Warranty - A limited warranty on materials and workmanship is given with this FW Murphy product.
A copy of the warranty may be viewed or printed by going to http://www.fwmurphy.com/warranty

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT:

- A visual inspection of this product for damage during shipping is recommended before installation.
- It is your responsibility to ensure that qualified mechanical and electrical technicians install this product.
- Disconnect all electrical power to the machine.
- Make sure machine cannot operate during installation.
- Follow all safety warnings of the machine manufacturer.
- Read and follow all installation instructions.
- Please contact FW MURPHY immediately if you have any questions.

Table of Contents

THIS PAGE INTENTIONALLY LEFT BLANK

General Information

These tachometers are indicators of engine speed, in revolutions per minute (RPM). Models equipped with hourmeters also record elapsed engine running time. The hourmeter counts when the engine speed is greater than 100 RPM.

For magnetic sensor (pickup) driven models, the pulses are obtained from the ring gear of an engine flywheel (having from 50 to 304 teeth). Alternator driven models function from pulses generated by the engine driven alternator that charges the battery. The alternator must have a terminal for the tachometer.

Ignition models get their signal from the ignition system. This can be from the coil, or a tachometer output from the ignition.

All units are for negative ground or isolated electrical systems. If the instrument is connected to reverse polarity, it will not operate until proper connections are made. All units are powered by a voltage range of 11 to 28 VDC.

Case Mounting Instructions

It is preferred that the units are mounted in a place where they will be protected from rain and splashing water. A minimum distance of 12 in. (305mm) from any coil, coil leads, or high voltage wiring should be maintained. These units are intended for mounting on a flat panel with a cut out of 3-3/8 in. (86mm), diameter hole as shown below. The maximum panel thickness recommended is ½ in. (12.7mm). Remove the mounting bracket from the back of the unit. Insert the instrument from the front side of the panel and place the mounting bracket to secure the instrument in place.

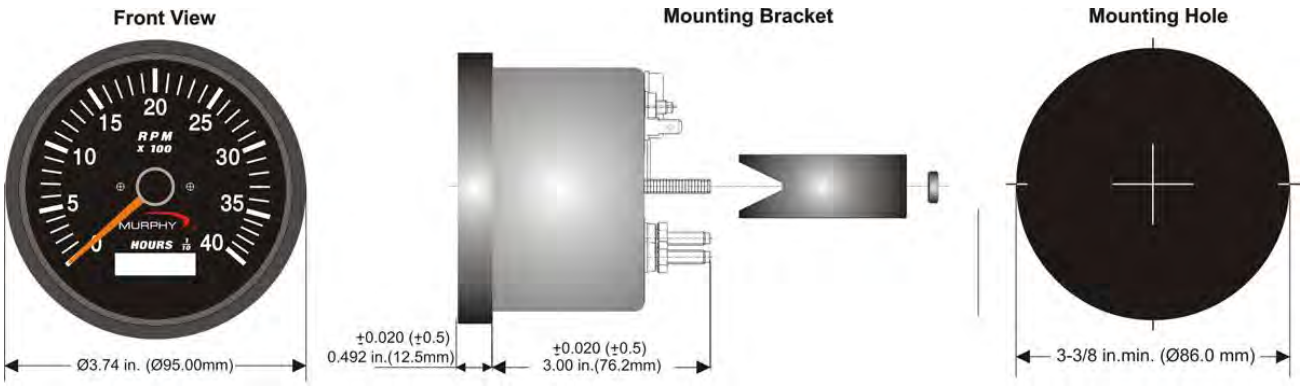


Figure 1

Mounting Requirements

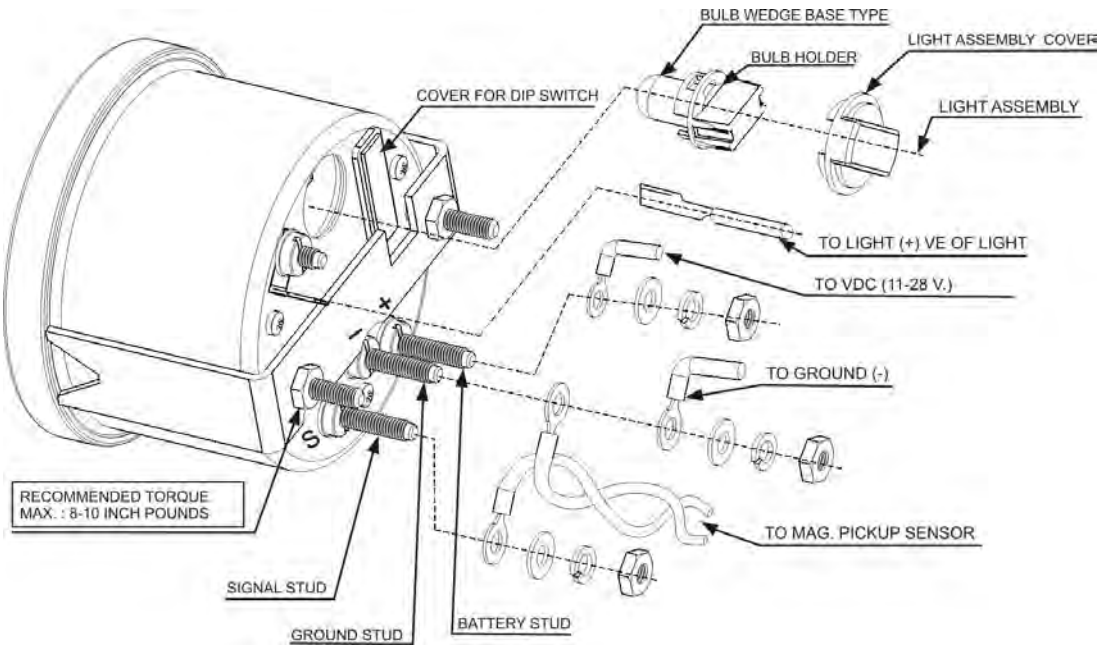


Figure 2 - Back of AT TACH

Tools and Supplies Required for Installation

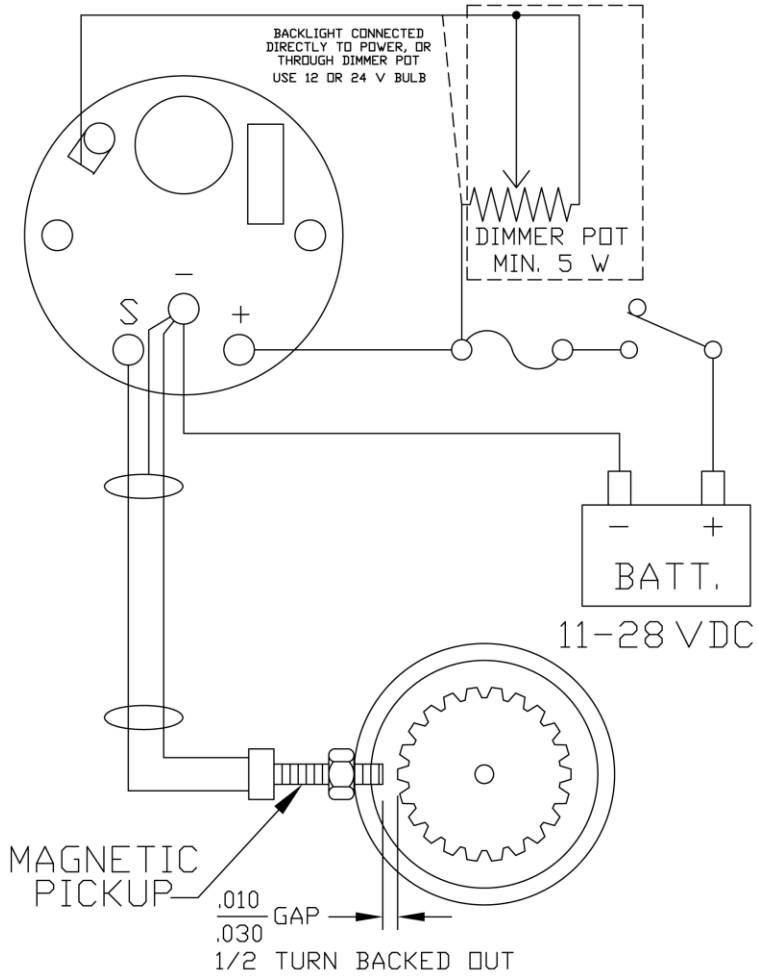
1.	11/32” and 3/8” Nut Drivers
2.	Wire Cutting & Stripping Tool
3.	Wire terminal Crimping Tool
4.	#10 crimp on ring terminals, and Faston™ or slip-on crimp terminals (for backlight)

Connection Instructions

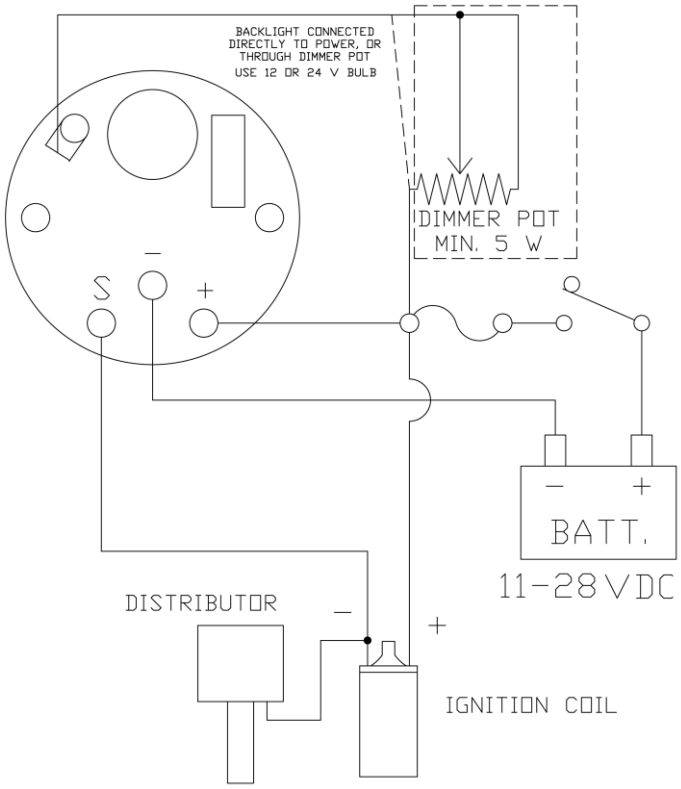
CAUTION: For safety of both personnel and equipment, disconnect the battery/power source before beginning installation.

Determine voltage and polarity of the application before wiring the unit. Use the appropriate wire size. To wire the magnetic sensor pickup, use 18 AWG (1.0mm) twisted pair, shielded cable. Use insulated crimp-on (solderless) ring-type wire terminals. Allow a few inches of extra wire (service loops) for ease of servicing.

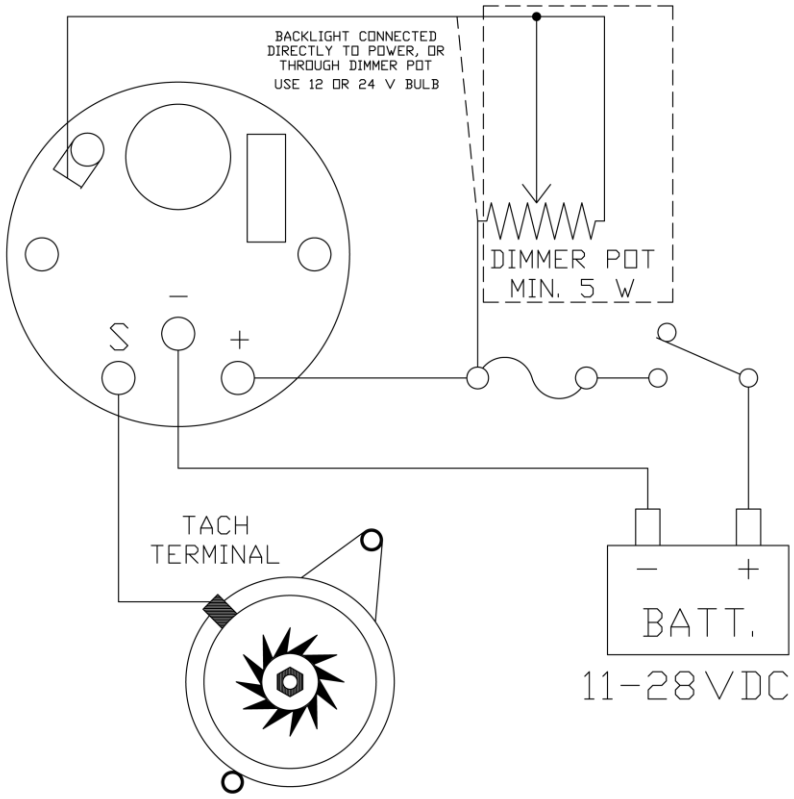
Typical Wiring Diagrams – Hookup for Magnetic Pickup



Typical Wiring Diagrams – Hookup for Ignition



Typical Wiring Diagrams - Hookup for Alternator



Connecting to Power (All Models)

> **IMPORTANT**: The operating voltage range of these units is 11-28VDC only. Always ensure circuits have a fuse or a circuit breaker to protect wiring. Never connect the unit directly to a battery without a fuse or circuit breaker.

1. Connect a wire from "**+**" to Battery or Power Supply "**+**" through a fuse and the ignition switch.
2. Connect a wire from the "**-**" terminal to the negative voltage source (electrical ground).This is shown in Figure 2 as the 'ground stud' (Figure 2 is found in the section: Case Mounting Instructions under Mounting Requirements in this document).

Installing or Replacing Light Bulbs (All Models)

1. Pull out the black rubber protective cap (Light Assembly Cover) provided at back as shown in Figure 2.
2. Twist the bulb holder about 1/8 turn counter-clockwise and remove the bulb holder and bulb. (See Figure 2.)
3. To replace the bulb, pull the bulb from the socket and replace with a new 12V or 24V bulb as required.

Connecting to Magnetic Sensor (Magnetic Sensor Driven Models)

The magnetic sensor (pickup) usually has two connections (terminals or wires) exiting from it. These connections are not polarized; either connection can be considered positive or negative signals. These two connections must be routed directly to the unit. Do NOT ground one of the connections at the engine. (See Figure 2)

1. Connect one of the wires in the twisted pair (from magnetic sensor) to the "S" terminal.
2. Connect the other wire in the twisted pair (from the magnetic sensor) to the negative (**-**) terminal (also noted in Figure 2 as the 'ground stud').

Connecting to Alternator (Alternator Driven Models)

Connect a wire from the "S" terminal to AC phase terminal (sometimes marked "STA" or "R" on the alternator.

Connecting to Ignition Coil (Ignition Driven Models)

Connect wire from the "S" terminal to the negative (**-**) side of the ignition coil or to the terminal marked "TACH" on solid state ignition systems (See Figure 2 – found in this document under the section Case Mounting Instructions, Mounting Requirements).

Calibration Instructions

Magnetic Sensor Driven Models

These models have been designed to function with flywheels having 50 to 304 teeth. Any number in this range can be set using the dip switches provided on the back (see Figure 3 - following). For more details, also refer to Table 1 (In the section: Dip Switch Setting Charts, Magnetic Sensor Driven Models).

If the number of teeth on the flywheel is known, set the calibration by using a pin to adjust the dip switches (see Figure 3, following).

> **IMPORTANT**: DO NOT use a pencil or pen of any type to adjust dip switches. If the pencil breaks while setting the dip positions, graphite can cause a short internally. Leaking ink can do the same.

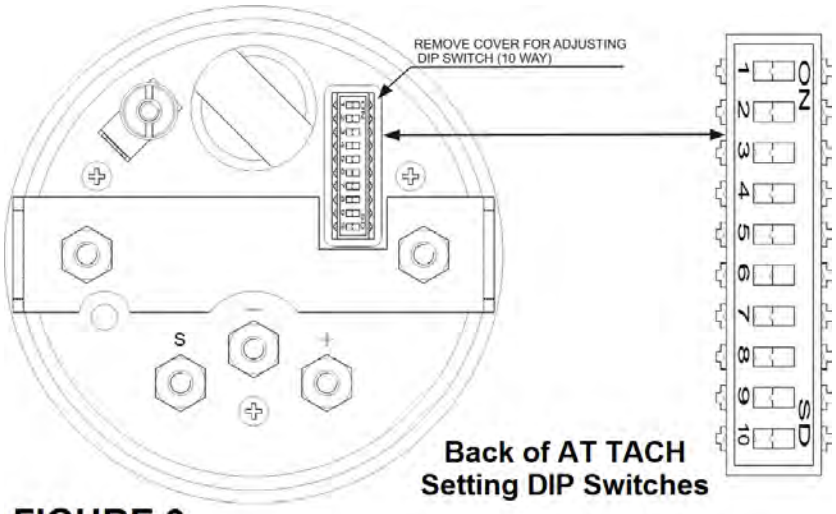


FIGURE 3

Formula for setting dip switches:

- Dip switch setting = binary of decimal equivalent.
- Decimal equivalent = number of flywheel teeth - 49.

> **NOTE:** Dip switches D1 to D8 will be used for setting calibration.
>
> Do not change settings on Dip Switches D9 and D10.
>
> For more details refer to Table 1 - Dip Switch Setting for each model type.
>
> **NOTE**: Make sure the engine has a properly functioning and certified governor before attempting this procedure.

If the number of teeth on the flywheel is not known, set up a calibrated shop tach to monitor the engine's true RPM. Start the engine, and after an appropriate warm-up period increase to normal running RPM as read on the shop tach. If the dip switch was not set previously, set it now to the position that causes the Murphy tach to read closest to the true RPM.

Alternator Driven Models

The alternator-driven tachometer-series models will operate from 3 to 100 pulses per engine revolution. Most applications will be between 3 and 40 pulses per revolution. Obtain the number of pulses per engine revolution:

1. Determine the number of poles on your alternator. Look for the designation/type in the manufacturer's manual.

2. The Alternator Tachometer Chart (Figure 4 – in the section: Pulley Ratios Chart and Alternator Tachometer Chart) lists common alternators and their minimum and maximum pulley ratios. Determine pulley ratio with the following formula:

$$\text{PULLEY RATIO} = \frac{\text{CRANK SHAFT PULLEY DIAMETER}}{\text{ALTERNATOR PULLEY DIAMETER}}$$

3. CHECK that Pulley Ratio falls within the range shown on the Pulley Ratio Chart (Figure 4) for a particular alternator. If ratio falls in the shaded area, the tachometer can be calibrated for the application.

4. To determine the pulses per engine revolution:

$$\frac{\text{NUMBER OF POLES}}{2} \times \text{PULLEY RATIO} = \text{PULSES PER ENGINE REVOLUTION}$$

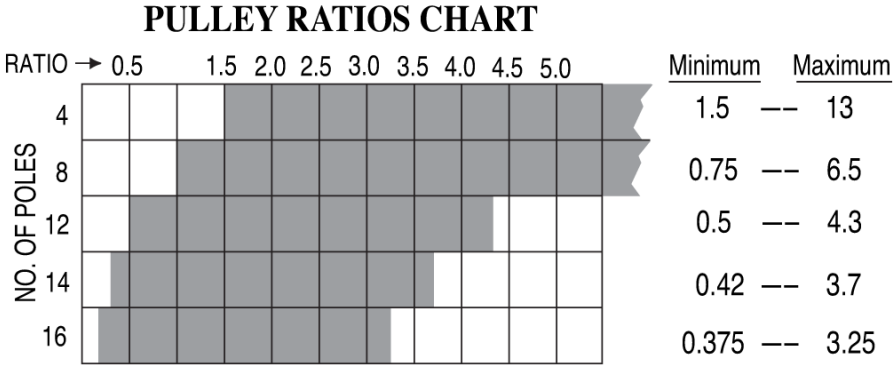
5. If the Pulses per engine revolution is determined, then set the calibration "through selector/dip switches" (See Fig. 3 in the section: Calibration Instructions, Magnetic Sensor Driven Models).

6. Formula for setting Dip switches:

Decimal equivalent = No. of Pulses will be used for setting calibration
Dip switch setting = Binary of decimal equivalent

IMPORTANT
Dip switches D1 to D8 will be used for setting of calibration.
Do not change or disturb settings on Dip Switches D9 and D10.
For more details, see Table 2.

Pulley Ratios Chart and Alternator Tachometer Chart



ALTERNATOR TACHOMETER CHART

Manufacturer	Designation/Type	Poles	Minimum pulley-ratio	Maximum* pulley-ratio
Prestolite	All	8	0.75	6.5
Load Handler	88A, 8LHA, 89C, 8LHC	16	0.375	3.25
Load Handler	All 5 inch models	12	0.5	4.3
Leece Neville	All	12	0.5	4.3
Bosch	G and K Series	12	0.5	4.3
C.E. Neihoff	All	12	0.5	4.3
Delco Remy	30DN	4	1.5	13
Delco Remy	15SI, 21SI, 40DN, 40SI	12	0.5	4.3
Delco Remy	10DN, 10SI, 12SI	14	0.42	3.7
Delco Remy	20DN, 25SI, 27SI	16	0.375	3.25
Delco Remy	29SI, 30SI	16	0.375	3.25
Hitachi	LT125, LT130, LT133	8	0.75	6.5
Hitachi	LT150	12	0.5	4.3
Lucas	All	12	0.5	4.3
Mando	All	12	0.5	4.3
Motorcraft	All	12	0.5	4.3
Nippondenso	All	12	0.5	4.3
Powerline	Series 23	14	0.42	3.7
Powerline	Series 24, 25, 26	12	0.5	4.3
Valeo	All	12	0.5	4.3

Figure 4

NOTE: ***** Although the tach may be calibrated for higher input frequencies in some cases, as shown on the Pulley Ratios Chart, pulley ratios in excess of 5.0 are <u>not</u> recommended nor are they normally used.

Ignition Driven Models

The ignition coil-driven tach series models will operate from 1 to 5 pulses per engine revolution. To obtain the number of pulses per engine revolution:

The ATI and ATHI series models have been designed to function from the ignition signal on 2 through 10-cylinder, 4-cycle engines. Set the calibration using the Dip switches. For more details, see the following formula and information in Table 3 (in the section: DIP Switch Setting Charts, Ignition Driven Models).

Work the following formulas for your Ignition Coil system:

Formula for Setting Dip Switches:

Dip switch setting = Binary of decimal equivalent.

Decimal equivalent = Number of Pulses per engine revolution.

$$\text{Number of Pulses per engine revolution} = \frac{\text{Number of engine cylinders}}{2}$$

For Dip switch settings, please refer Table 3 (in the following section) for ignition speed signals.

> **IMPORTANT**: DO NOT use a pencil or pen of any type to adjust dip switches. If the pencil breaks while setting the dip positions, graphite can cause a short internally. Leaking ink can do the same.

Dip Switch Setting Charts

Table 1 - Magnetic Sensor Driven Models

> **NOTE**
> In the following table, “1” means ON and “0" means OFF.

No. of Flywheel teeth	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
50	01	1	0	0	0	0	0	0	0
51	02	0	1	0	0	0	0	0	0
52	03	1	1	0	0	0	0	0	0
53	04	0	0	1	0	0	0	0	0
54	05	1	0	1	0	0	0	0	0
55	06	0	1	1	0	0	0	0	0
56	07	1	1	1	0	0	0	0	0
57	08	0	0	0	1	0	0	0	0
58	09	1	0	0	1	0	0	0	0
59	10	0	1	0	1	0	0	0	0
60	11	1	1	0	1	0	0	0	0
61	12	0	0	1	1	0	0	0	0
62	13	1	0	1	1	0	0	0	0
63	14	0	1	1	1	0	0	0	0
64	15	1	1	1	1	0	0	0	0
65	16	0	0	0	0	1	0	0	0
66	17	1	0	0	0	1	0	0	0
67	18	0	1	0	0	1	0	0	0
68	19	1	1	0	0	1	0	0	0
69	20	0	0	1	0	1	0	0	0
70	21	1	0	1	0	1	0	0	0
71	22	0	1	1	0	1	0	0	0
72	23	1	1	1	0	1	0	0	0
73	24	0	0	0	1	1	0	0	0
74	25	1	0	0	1	1	0	0	0
75	26	0	1	0	1	1	0	0	0
76	27	1	1	0	1	1	0	0	0
77	28	0	0	1	1	1	0	0	0
78	29	1	0	1	1	1	0	0	0
79	30	0	1	1	1	1	0	0	0
80	31	1	1	1	1	1	0	0	0

No. of Flywheel teeth	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
81	32	0	0	0	0	0	1	0	0
82	33	1	0	0	0	0	1	0	0
83	34	0	1	0	0	0	1	0	0
84	35	1	1	0	0	0	1	0	0
85	36	0	0	1	0	0	1	0	0
86	37	1	0	1	0	0	1	0	0
87	38	0	1	1	0	0	1	0	0
88	39	1	1	1	0	0	1	0	0
89	40	0	0	0	1	0	1	0	0
90	41	1	0	0	1	0	1	0	0
91	42	0	1	0	1	0	1	0	0
92	43	1	1	0	1	0	1	0	0
93	44	0	0	1	1	0	1	0	0
94	45	1	0	1	1	0	1	0	0
95	46	0	1	1	1	0	1	0	0
96	47	1	1	1	1	0	1	0	0
97	48	0	0	0	0	1	1	0	0
98	49	1	0	0	0	1	1	0	0
99	50	0	1	0	0	1	1	0	0
100	51	1	1	0	0	1	1	0	0
101	52	0	0	1	0	1	1	0	0
102	53	1	0	1	0	1	1	0	0
103	54	0	1	1	0	1	1	0	0
104	55	1	1	1	0	1	1	0	0
105	56	0	0	0	1	1	1	0	0
106	57	1	0	0	1	1	1	0	0
107	58	0	1	0	1	1	1	0	0
108	59	1	1	0	1	1	1	0	0
109	60	0	0	1	1	1	1	0	0
110	61	1	0	1	1	1	1	0	0
111	62	0	1	1	1	1	1	0	0

No. of Flywheel teeth	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
112	63	1	1	1	1	1	1	0	0
113	64	0	0	0	0	0	0	1	0
114	65	1	0	0	0	0	0	1	0
115	66	0	1	0	0	0	0	1	0
116	67	1	1	0	0	0	0	1	0
117	68	0	0	1	0	0	0	1	0
118	69	1	0	1	0	0	0	1	0
119	70	0	1	1	0	0	0	1	0
120	71	1	1	1	0	0	0	1	0
121	72	0	0	0	1	0	0	1	0
122	73	1	0	0	1	0	0	1	0
123	74	0	1	0	1	0	0	1	0
124	75	1	1	0	1	0	0	1	0
125	76	0	0	1	1	0	0	1	0
126	77	1	0	1	1	0	0	1	0
127	78	0	1	1	1	0	0	1	0
128	79	1	1	1	1	0	0	1	0
129	80	0	0	0	0	1	0	1	0
130	81	1	0	0	0	1	0	1	0
131	82	0	1	0	0	1	0	1	0
132	83	1	1	0	0	1	0	1	0
133	84	0	0	1	0	1	0	1	0
134	85	1	0	1	0	1	0	1	0
135	86	0	1	1	0	1	0	1	0
136	87	1	1	1		1	0	1	0
137	88	0	0	0	1	1	0	1	0
138	89	1	0	0	1	1	0	1	0
139	90	0	1	0	1	1	0	1	0
140	91	1	1	0	1	1	0	1	0
141	92	0	0	1	1	1	0	1	0
142	93	1	0	1	1	1	0	1	0
143	94	0	1	1	1	1	0	1	0
144	95	1	1	1	1	1	0	1	0
145	96	0	0	0	0	0	1	1	0
146	97	1	0	0	0	0	1	1	0
147	98	0	1	0	0	0	1	1	0
148	99	1	1	0	0	0	1	1	0
149	100	0	0	1	0	0	1	1	0
150	101	1	0	1	0	0	1	1	0
151	102	0	1	1	0	0	1	1	0
152	103	1	1	1	0	0	1	1	0
153	104	0	0	0	1	0	1	1	0
154	105	1	0	0	1	0	1	1	0
155	106	0	1	0	1	0	1	1	0
156	107	1	1	0	1	0	1	1	0
157	108	0	0	1	1	0	1	1	0
158	109	1	0	1	1	0	1	1	0
159	110	0	1	1	1	0	1	1	0
160	111	1	1	1	1	0	1	1	0

No. of Flywheel teeth	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
161	112	0	0	0	0	1	1	1	0
162	113	1	0	0	0	1	1	1	0
163	114	0	1	0	0	1	1	1	0
164	115	1	1	0	0	1	1	1	0
165	116	0	0	1	0	1	1	1	0
166	117	1	0	1	0	1	1	1	0
167	118	0	1	1	0	1	1	1	0
168	119	1	1	1	0	1	1	1	0
169	120	0	0	0	1	1	1	1	0
170	121	1	0	0	1	1	1	1	0
171	122	0	1	0	1	1	1	1	0
172	123	1	1	0	1	1	1	1	0
173	124	0	0	1	1	1	1	1	0
174	125	1	0	1	1	1	1	1	0
175	126	0	1	1	1	1	1	1	0
176	127	1	1	1	1	1	1	1	0
177	128	0	0	0	0	0	0	0	1
178	129	1	0	0	0	0	0	0	1
179	130	0	1	0	0	0	0	0	1
180	131	1	1	0	0	0	0	0	1
181	132	0	0	1	0	0	0	0	1
182	133	1	0	1	0	0	0	0	1
183	134	0	1	1	0	0	0	0	1
184	135	1	1	1	0	0	0	0	1
185	136	0	0	0	1	0	0	0	1
186	137	1	0	0	1	0	0	0	1
187	138	0	1	0	1	0	0	0	1
188	139	1	1	0	1	0	0	0	1
189	140	0	0	1	1	0	0	0	1
190	141	1	0	1	1	0	0	0	1
191	142	0	1	1	1	0	0	0	1
192	143	1	1	1	1	0	0	0	1
193	144	0	0	0	0	1	0	0	1
194	145	1	0	0	0	1	0	0	1
195	146	0	1	0	0	1	0	0	1
196	147	1	1	0	0	1	0	0	1
197	148	0	0	1	0	1	0	0	1
198	149	1	0	1	0	1	0	0	1
199	150	0	1	1	0	1	0	0	1
200	151	1	1	1	0	1	0	0	1
201	152	0	0	0	1	1	0	0	1
202	153	1	0	0	1	1	0	0	1
203	154	0	1	0	1	1	0	0	1
204	155	1	1	0	1	1	0	0	1
205	156	0	0	1	1	1	0	0	1
206	157	1	0	1	1	1	0	0	1
207	158	0	1	1	1	1	0	0	1
208	159	1	1	1	1	1	0	0	1
209	160	0	0	0	0	0	1	0	1

No. of Flywheel teeth	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
210	161	1	0	0	0	0	1	0	1
211	162	0	1	0	0	0	1	0	1
212	163	1	1	0	0	0	1	0	1
213	164	0	0	1	0	0	1	0	1
214	165	1	0	1	0	0	1	0	1
215	166	0	1	1	0	0	1	0	1
216	167	1	1	1	0	0	1	0	1
217	168	0	0	0	1	0	1	0	1
218	169	1	0	0	1	0	1	0	1
219	170	0	1	0	1	0	1	0	1
220	171	1	1	0	1	0	1	0	1
221	172	0	0	1	1	0	1	0	1
222	173	1	0	1	1	0	1	0	1
223	174	0	1	1	1	0	1	0	1
224	175	1	1	1	1	0	1	0	1
225	176	0	0	0	0	1	1	0	1
226	177	1	0	0	0	1	1	0	1
227	178	0	1	0	0	1	1	0	1
228	179	1	1	0	0	1	1	0	1
229	180	0	0	1	0	1	1	0	1
230	181	1	0	1	0	1	1	0	1
231	182	0	1	1	0	1	1	0	1
232	183	1	1	1	0	1	1	0	1
233	184	0	0	0	1	1	1	0	1
234	185	1	0	0	1	1	1	0	1
235	186	0	1	0	1	1	1	0	1
236	187	1	1	0	1	1	1	0	1
237	188	0	0	1	1	1	1	0	1
238	189	1	0	1	1	1	1	0	1
239	190	0	1	1	1	1	1	0	1
240	191	1	1	1	1	1	1	0	1
241	192	0	0	0	0	0	0	1	1
242	193	1	0	0	0	0	0	1	1
243	194	0	1	0	0	0	0	1	1
244	195	1	1	0	0	0	0	1	1
245	196	0	0	1	0	0	0	1	1
246	197	1	0	1	0	0	0	1	1
247	198	0	1	1	0	0	0	1	1
248	199	1	1	1	0	0	0	1	1
249	200	0	0	0	1	0	0	1	1
250	201	1	0	0	1	0	0	1	1
251	202	0	1	0	1	0	0	1	1
252	203	1	1	0	1	0	0	1	1
253	204	0	0	1	1	0	0	1	1
254	205	1	0	1	1	0	0	1	1
255	206	0	1	1	1	0	0	1	1
256	207	1	1	1	1	0	0	1	1
257	208	0	0	0	0	1	0	1	1
258	209	1	0	0	0	1	0	1	1

No. of Flywheel teeth	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
259	210	0	1	0	0	1	0	1	1
260	211	1	1	0	0	1	0	1	1
261	212	0	0	1	0	1	0	1	1
262	213	1	0	1	0	1	0	1	1
263	214	0	1	1	0	1	0	1	1
264	215	1	1	1	0	1	0	1	1
265	216	0	0	0	1	1	0	1	1
266	217	1	0	0	1	1	0	1	1
267	218	0	1	0	1	1	0	1	1
268	219	1	1	0	1	1	0	1	1
269	220	0	0	1	1	1	0	1	1
270	221	1	0	1	1	1	0	1	1
271	222	0	1	1	1	1	0	1	1
272	223	1	1	1	1	1	0	1	1
273	224	0	0	0	0	0	1	1	1
274	225	1	0	0	0	0	1	1	1
275	226	0	1	0	0	0	1	1	1
276	227	1	1	0	0	0	1	1	1
277	228	0	0	1	0	0	1	1	1
278	229	1	0	1	0	0	1	1	1
279	230	0	1	1	0	0	1	1	1
280	231	1	1	1	0	0	1	1	1
281	232	0	0	0	1	0	1	1	1
282	233	1	0	0	1	0	1	1	1
283	234	0	1	0	1	0	1	1	1
284	235	1	1	0	1	0	1	1	1
285	236	0	0	1	1	0	1	1	1
286	237	1	0	1	1	0	1	1	1
287	238	0	1	1	1	0	1	1	1
288	239	1	1	1	1	0	1	1	1
289	240	0	0	0	0	1	1	1	1
290	241	1	0	0	0	1	1	1	1
291	242	0	1	0	0	1	1	1	1
292	243	1	1	0	0	1	1	1	1
293	244	0	0	1	0	1	1	1	1
294	245	1	0	1	0	1	1	1	1
295	246	0	1	1	0	1	1	1	1
296	247	1	1	1	0	1	1	1	1
297	248	0	0	0	1	1	1	1	1
298	249	1	0	0	1	1	1	1	1
299	250	0	1	0	1	1	1	1	1
300	251	1	1	0	1	1	1	1	1
301	252	0	0	1	1	1	1	1	1
302	253	1	0	1	1	1	1	1	1
303	254	0	1	1	1	1	1	1	1
304	255	1	1	1	1	1	1	1	1

Table 2 - Alternator Driven Models

NOTE: In the following table, “1” means ON and “0" means OFF.

No. of Pulses/ Rev.	Decimal equivalent	Dip Switch Position							
		D1	D2	D3	D4	D5	D6	D7	D8
03	03	1	1	0	0	0	0	0	0
04	04	0	0	1	0	0	0	0	0
05	05	1	0	1	0	0	0	0	0
06	06	0	1	1	0	0	0	0	0
07	07	1	1	1	0	0	0	0	0
08	08	0	0	0	1	0	0	0	0
09	09	1	0	0	1	0	0	0	0
10	10	0	1	0	1	0	0	0	0
11	11	1	1	0	1	0	0	0	0
12	12	0	0	1	1	0	0	0	0
13	13	1	0	1	1	0	0	0	0
14	14	0	1	1	1	0	0	0	0
15	15	1	1	1	1	0	0	0	0
16	16	0	0	0	0	1	0	0	0
17	17	1	0	0	0	1	0	0	0
18	18	0	1	0	0	1	0	0	0
19	19	1	1	0	0	1	0	0	0
20	20	0	0	1	0	1	0	0	0
21	21	1	0	1	0	1	0	0	0
22	22	0	1	1	0	1	0	0	0
23	23	1	1	1	0	1	0	0	0
24	24	0	0	0	1	1	0	0	0
25	25	1	0	0	1	1	0	0	0
26	26	0	1	0	1	1	0	0	0
27	27	1	1	0	1	1	0	0	0
28	28	0	0	1	1	1	0	0	0
29	29	1	0	1	1	1	0	0	0
30	30	0	1	1	1	1	0	0	0
31	31	1	1	1	1	1	0	0	0
32	32	0	0	0	0	0	1	0	0
33	33	1	0	0	0	0	1	0	0
34	34	0	1	0	0	0	1	0	0
35	35	1	1	0	0	0	1	0	0
36	36	0	0	1	0	0	1	0	0
37	37	1	0	1	0	0	1	0	0
38	38	0	1	1	0	0	1	0	0
39	39	1	1	1	0	0	1	0	0
40	40	0	0	0	1	0	1	0	0

NOTE: Switch combinations up to 100 pulses per revolution are not shown as the range of 3 – 40 pulses per revolution fits most applications.

Table 3 - Ignition Driven Models

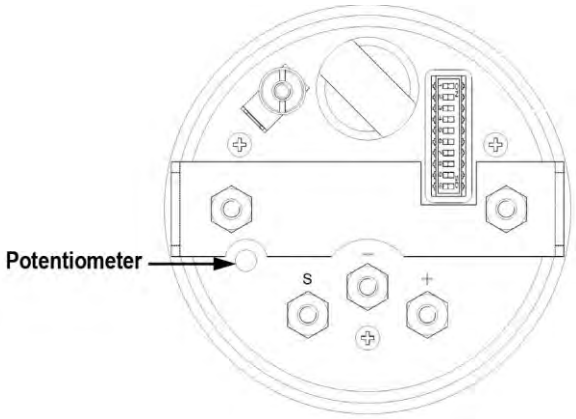
4-Cycle Engines	No. of Pulses per Engine Revolution	Decimal Equivalent	Binary of Decimal Equivalent Dip Switch Position		
			D1	D2	D3
2 cylinder	1	1	1	0	0
4 cylinder	2	2	0	1	0
6 cylinder	3	3	1	1	0
8 cylinder	4	4	0	0	1
10 cylinder	5	5	1	0	1

NOTE: Dip switches D4 through D8 are not used and should be set to OFF.

Potentiometer Fine Adjustment Calibration

You can adjust calibration on all models through the fine adjust potentiometer (pot) located on the back side of the housing.

> **NOTE:** This option is for fine tuning and not for coarse tuning.



The following steps will guide you through the fine adjustment process.

1. Use a duly calibrated optical tach or master tach to determine actual engine RPM.
2. Determine DIP switch settings by calculating and using the table to set the DIP switches provided on the back side of the gauge accordingly. Refer to the preceding calibration instructions.
3. Remove the QC passed sticker to access the fine adjustment hole.
4. Use small flat screw driver (watch maker No. 4) for fine tuning. Make sure the screw driver sits properly in potentiometer slot without touching other parts of the PCB.
5. Rotate the potentiometer such that the reading of the tach matches the actual RPM noted by the master tach. Turning the pot in clockwise direction will increase RPM, while turning the pot in counter-clockwise direction will decrease the RPM.

   IMPORTANT! The fine adjustment potentiometer can only be turned ¾ of a turn. Be gentle and do not force it.

6. The maximum range for increasing and decreasing the RPM through fine adjustment pot is approximately 400 RPM.
7. If unable to match the reading with the master tach using the method above, then recheck the calculations or change the next level DIP switch setting and repeat the calibration procedure.
8. Once the pointer is adjusted to the desired position, it is recommended to cover the fine adjustment hole to protect it from water entry and other atmospheric effects.

Specifications

Magnetic Sensor Driven Models

- **Power Input:** 11-28VDC (70mA – 120mA except lamp load)
- **Backlight:** 3.4W T-10 wedge base bulb
- **RPM Input Signal Voltage:** 1.5Vrms minimum
- **Accuracy:** Tachometer: +2% full scale
  Hourmeter: +0.01% hours, +1 count
- **Temperature Range:** -40°C to +82°C (no permanent damage shall occur)
- **Dial (Face Plate):** 270° sweep with white numerals (over black background)
- **Bezel:** 304 stainless steel for bright and IS 513 E.E.E. CRCA steel for black
- **Scale:** 0-4000RPM
- **Case Material:** Plastic
- **Hourmeter Range:** 99999.9 hours in 0.1 increments.

Alternator Driven and Ignition Driven Models

- **Power Input**: 11-28VDC (70mA-120mA except lamp load)
- **Backlight**: 3.4W T-10 wedge base bulb
- **RPM Input Signal Voltage**: V low: 0.5V max, V high: 8.0V min.
- **Accuracy**: Tachometer: +2% full scale
  Hourmeter: +0.01% hours, +1 count
- **Temperature Range:** -40°C to +82°C (no permanent damage shall occur)
- **Dial (Face Plate):** 270° sweep with white numerals (over black background)
- **Bezel:** 304 stainless steel for bright and IS 513 E.E.E. CRCA steel for black
- **Scale:** 0-4000RPM
- **Case Material:** Plastic
- **Hourmeter Range:** 99999.9 hours in 0.1 increments.

THIS PAGE INTENTIONALY LEFT BLANK.

FW MURPHY
5311 South 122nd East Avenue
Tulsa, Oklahoma 74146 USA
Phone: +1 918 317 4100 Fax: +1 918 317 4266
E-mail: sales@fwmurphy.com
Website: www.fwmurphy.com

ECONTROLS, INC.
5757 Farinon Drive
San Antonio, Texas 78249 USA
Phone: +1 210 495 9772 Fax: +1 210 495 9791
E-mail: info@econtrols.com
Website: www.econtrols.com

FWM INDUSTRIAL PANEL DIVISION
5311 South 122nd East Avenue
Tulsa, Oklahoma 74146 USA
Phone: +1 918 317 4100 Fax: +1 918 317 4124
E-mail: ipdsales@fwmurphy.com
Website: www.fwmurphy.com

FRANK W. MURPHY, LTD.
Church Road, Laverstock
Salisbury, SP1 1QZ, UK
Phone: +44 1722 410055 Fax: +44 1722 410088
E-mail: sales@fwmurphy.co.uk
Website: www.fwmurphy.co.uk

FW MURPHY INSTRUMENTS (HANGZHOU) CO., LTD.
77 23rd Street
Hangzhou Economic & Technological Development Area
Hangzhou, Zhejiang, 310018, China
Phone: +86 571 8788 6060 Fax: +86 571 8684 8878
E-mail: apsales@fwmurphy.com
Website: www.fwmurphy.com/company_ch

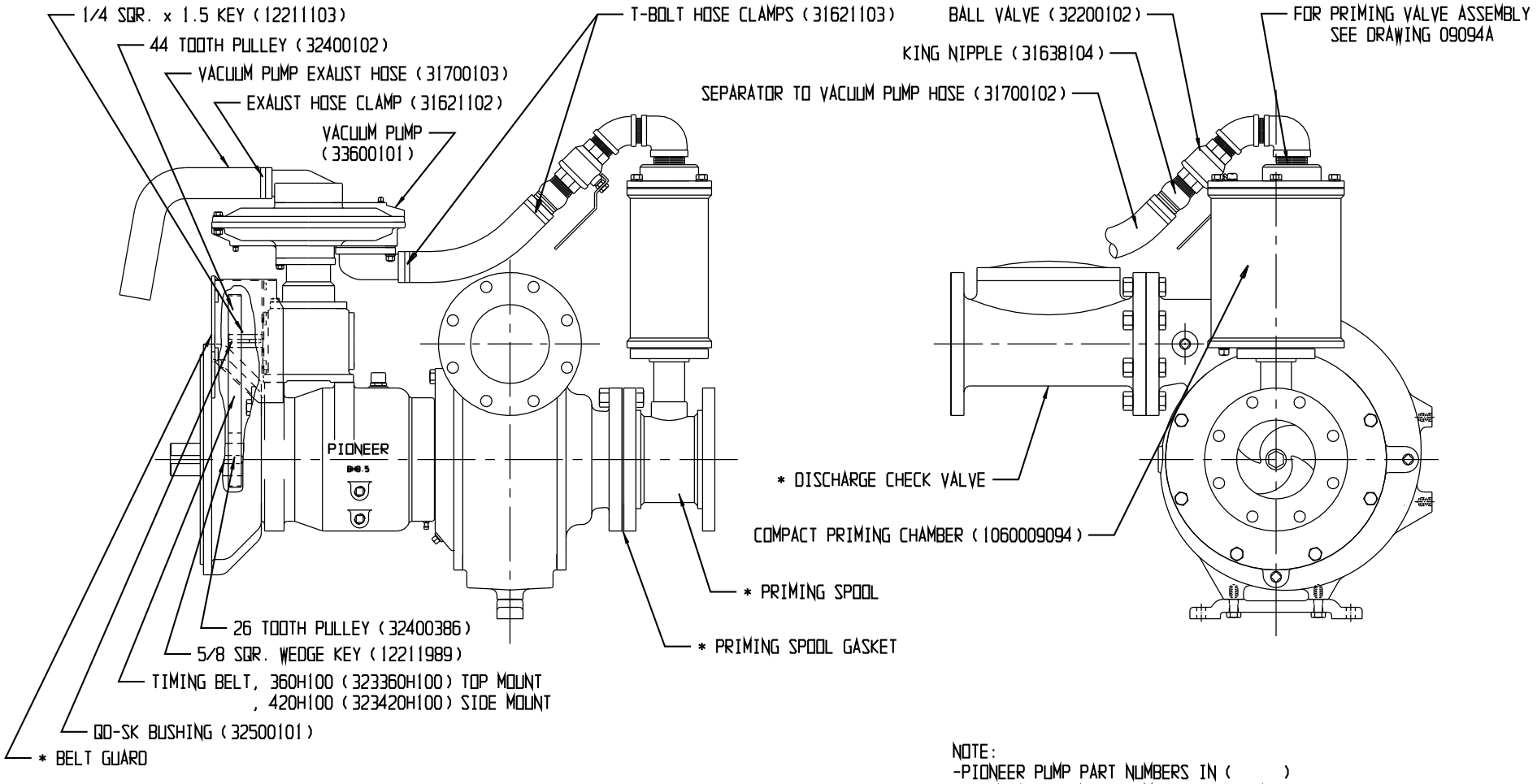
FW MURPHY (LATIN AMERICA & CARIBBEAN)
Apdo. Postal 2-06, Admon "Lomas"
Cord. Arakán 606-16, Lomas 4° Secc.
78211 San Luis Potosí, S.L.P. - México
Phone: +1 918 317 2500
E-mail: lasales@fwmurphy.com
Website: www.fwmurphy.com

FW MURPHY (INDIA)
230, Regus, Connaught Place Centre
Bund Garden Road, Pune 411001
Maharashtra State, India
Phone: +91 915 813 7633
E-mail: indiasales@fwmurphy.com
Website: www.fwmurphy.com

COMPUTRONIC CONTROLS
41 - 46 Railway Terrace
Nechells, Birmingham, B7 5NG, UK
Phone: +44 1722 410055
Fax: +44 1722 410088
E-mail: sales@computroniccontrols.com
Web site: www.computroniccontrols.com

ISO 9001 REGISTERED FIRM | INTERNATIONAL ACCREDITATION BOARD
Certificate No. GB2000671 | Registration No. 0044/1

2012-05-04



NOTE:
-PIONEER PUMP PART NUMBERS IN ( )
-* CONTACT PIONEER PUMP FOR DIFERENT SIZES.
-SHIMS, AS REQUIRED FOR TENSIONING VACUUM PUMP BELT (NOT SHOWN)
0.03" (30300101, 0.06" (30300102), 0.12" (30300103)

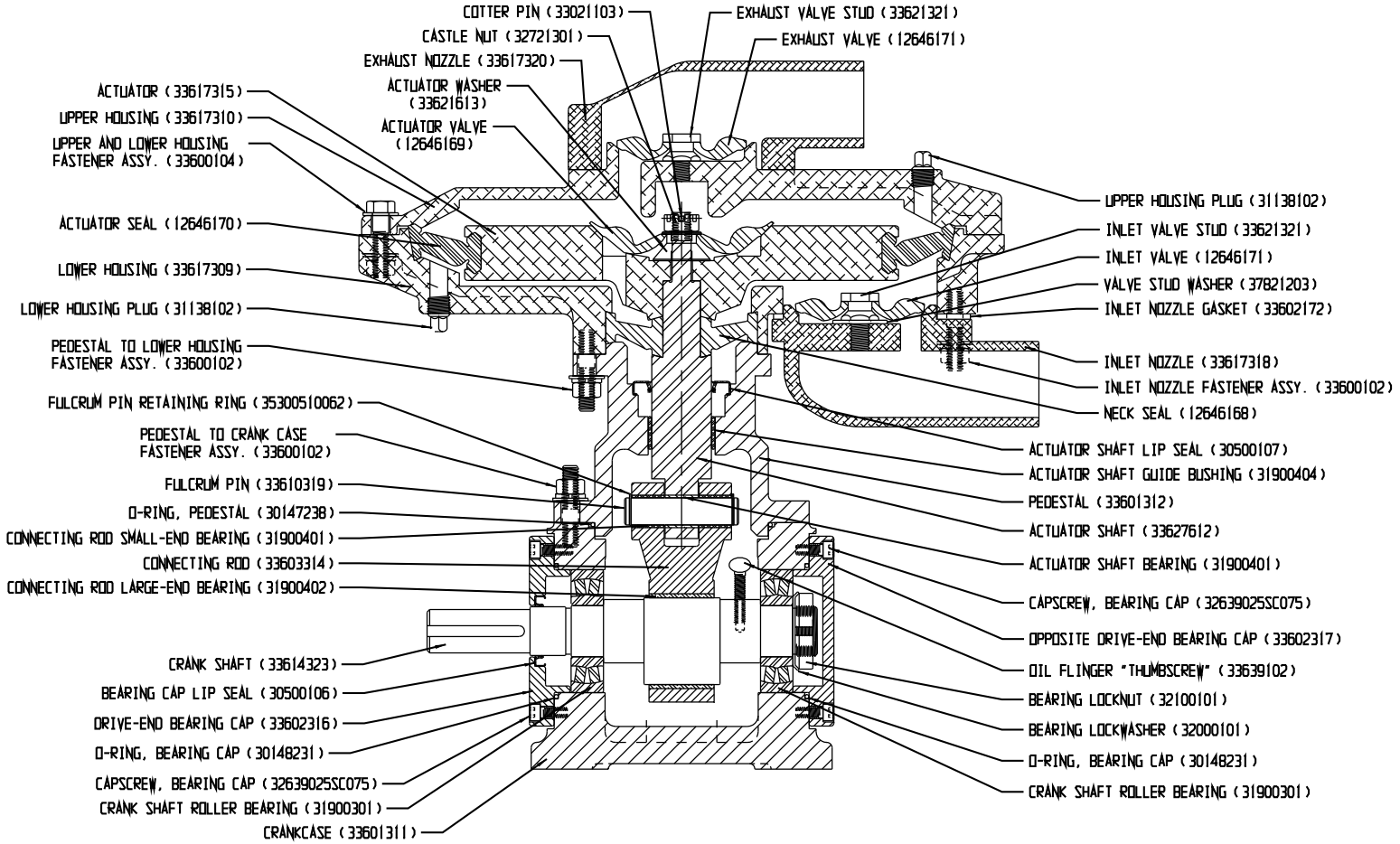
PIONEERPUMP
PERFORMANCE THROUGH INNOVATION™

VAC-ASSIST COMPONENTS (COMPACT CHAMBER)

DWG NO. 10509A
REVISION: 001
DRAWN BY: MG
DATE: 02/17/2012

NOT SHOWN ON CURRENT MODEL:
-CRANKCASE VENT ASSEMBLY (33611103)
-OIL LEVEL SIGHT GLASS (31339102)
-OIL FILL PLUG (33611103)
-OIL DRAIN ASSEMBLY (33600107)
-EXHAUST NOZZLE FASTENER ASSEMBLY (33600105)

NOTE:
- PIONEER PUMP PART NUMBERS IN ( )
- WHEN REPLACING CONNECTING ROD AND ACTUATOR SHAFT BEARING 31900401 THE BEARINGS WILL NEED TO BE REAMED TO FIT THE CONNECTING ROD AFTER THEY ARE INSTALLED



PIONEERPUMP
PERFORMANCE THROUGH INNOVATION™

MODEL: VACUUM PUMP

REFERENCE: COMPLETE ASSEMBLY 33600101

DWG NO. A638A
REVISION: 006
DRAWN BY: JAW
DATE: 01/29/2015

CAUTION **CAUTION** **CAUTION**

GASOLINE IS INVOLVED AND VAPORS WILL SETTLE IN LOW AREAS. WORK IN A WELL VENTILATED SPACE AWAY FROM SPARKS OR OPEN FLAME SUCH AS A PILOT LIGHT. HAVE A CLASS 'B' FIRE EXTINGUISHER CLOSE BY.

TO ELIMINATE THE CHANCE OF FIRE OR PERSONAL INJURY, THE FUEL SYSTEM PRESSURE MUST BE RELIEVED BEFORE SERVICING ANY FUEL SYSTEM COMPONENT.

INSTALLATION INSTRUCTIONS FOR UNIVERSAL ELECTRIC FUEL PUMP

NOTE:

-Before replacing any electric fuel pump diagnose the cause of failure.
-Dirt is the major cause of pump failure, so the tank must be cleaned out or dirt may cause the replacement pump to fail as well.
-Exercise care so that no dirt falls into the tank during disassembly or reassembly.

-For safety reasons, it is recommended an Oil Pressure Safety Switch be installed. This will prevent engine damage and reduce the chance of fire in the case that the engine stops without the ignition switch in the "off" position.

-Installation of the replacement pump may require some of the mounting or electrical components be reused. Do not discard any parts.
-To prevent fuel pump failure, installation of a high quality fuel filter on the inlet side of the pump, is required.

A. FUEL PUMP INSTALLATION

1. Disconnect the negative battery cable.

2. Mount the fuel pump close to the existing fuel lines and tank, but away from any exhaust system component. Place the pump and bracket assembly as near to the bottom of the fuel tank as possible, but never more than 24 inches above the top of the tank.

3. Remove a section of fuel line where the pump is to be mounted. (A tube cutter is recommended when cutting fuel lines. Flush the fuel line to prevent metal chips from entering the fuel system.)

4. If pump has rubber hose fittings proceed to next step. If using a pump with threaded inlet/outlet fittings, assemble the (supplied) fuel fittings to the fuel pump (See Fig. A). (This pump is equipped with dry-seal fuel fittings. Do not use Teflon tape or pipe sealant on pipe fittings, or pump breakage will occur.)

5. Install mounting bracket onto vehicle's chassis/frame with self-tapping screw(s).

6. Install the fuel pump on the mounting bracket with the outlet towards the engine. Place ground (-) wire from pump under mounting screw or bolt.

7. Connect the fuel lines to the fuel pump, using supplied rubber fuel line and clamps provided. (To prevent fuel pump failure, installation of a high quality fuel filter on the inlet side of the pump, is required.) (See Fig. A.)

8. Using #14 or larger (lower gauge #) gauge wire, follow the wiring diagram (See Fig. A & B) and connect the pump to the vehicle's electrical system. If the vehicle has a pre-existing oil pressure safety switch which operates either a warning light or gauge, it is recommended that a T-adapter be installed into the engine block and both the O.E. and the Oil Pressure Safety Switch be used (See Fig. C). A 10-amp fuse should be installed between the pressure safety switch and the electric pump. (Route wires away from heat and road hazards, and anchor securely to prevent vibration and chafing. Full battery voltage must be available to the pump when the ignition switch is "on". Pump ground must be the same as the battery ground.)

9. If this pump is being used to replace a defective in tank pump, and it is not going to be removed, make sure the defective pump does not restrict the fuel supply.

10. If this pump is being used to replace a defective mechanical pump, the fuel lines should bypass the mechanical pump. Fuel pushed through a defective mechanical pump can cause severe engine damage. If mechanical pump is not removed from the engine, the mechanical pump inlet should be plugged.

WARNING **WARNING** **WARNING**

NOT FOR USE IN AIRCRAFT OR OTHER NON-AUTOMOTIVE USE. THE USE OF A PUMP FOR OTHER THAN THE APPLICATIONS LISTED WILL VOID THE WARRANTY AND COULD DO SEVERE ENGINE DAMAGE.

Fig. A

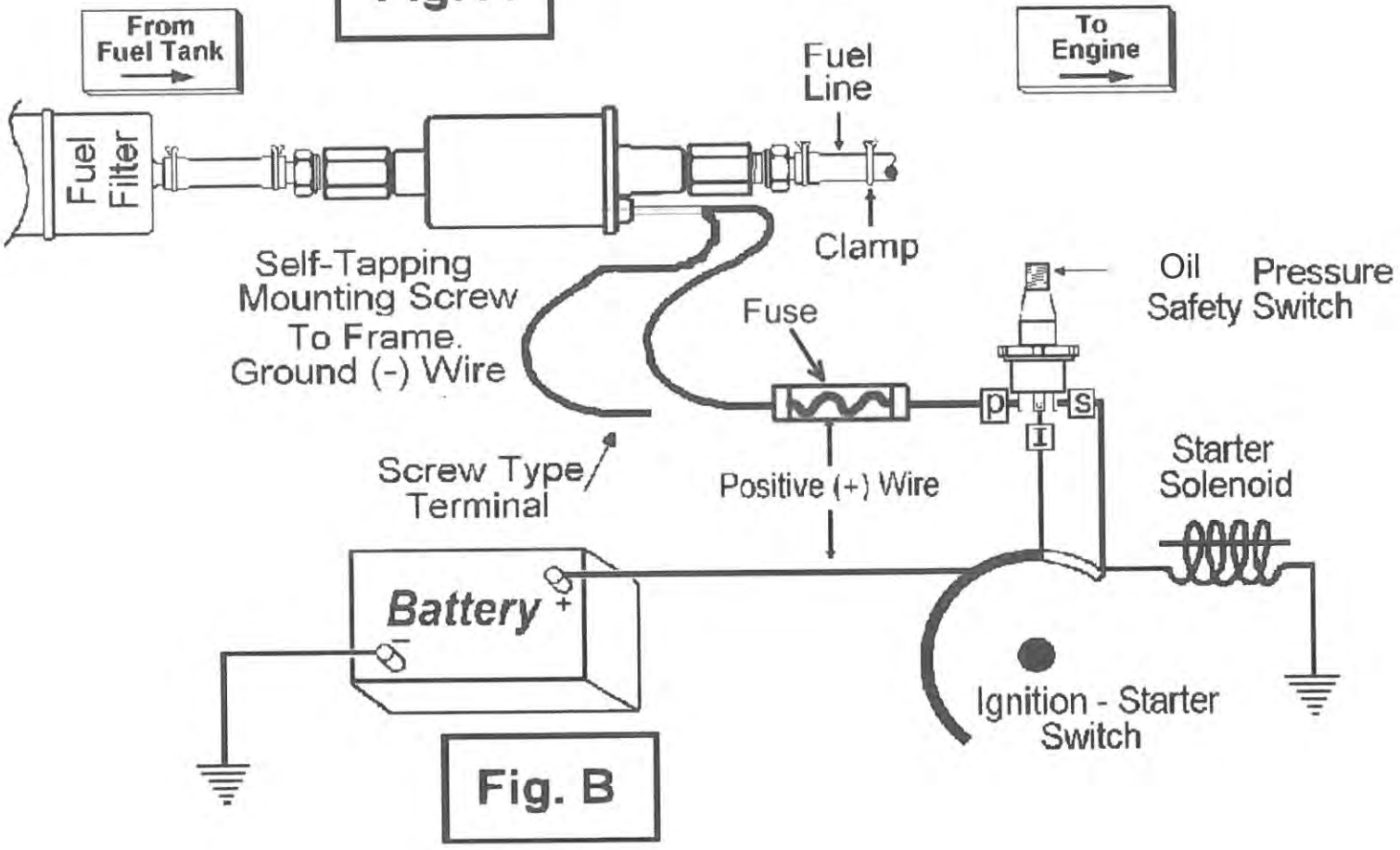
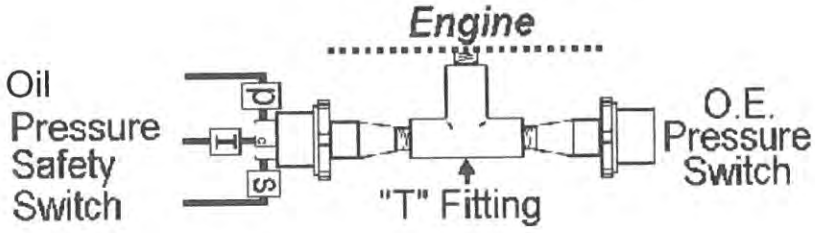

From Fuel Tank
To Engine
Fuel Line
Fuel Filter
Clamp
Self-Tapping Mounting Screw To Frame. Ground (-) Wire
Fuse
Oil Pressure Safety Switch
p
s
I
Screw Type Terminal
Positive (+) Wire
Starter Solenoid
Battery
+
-
Ignition - Starter Switch

Fig. B


Engine
Oil Pressure Safety Switch
p
I
s
"T" Fitting
O.E. Pressure Switch

600 Series

Spin-on Fuel Filter/Water Separators

Instruction Part Number 22249 Rev B

600 Series fuel filter/water separators are specifically designed to handle today's tough fuel filtration problems and can handle flow rates up to 120 GPH (454 LPH), depending on the model used.

Filter replacement intervals depend on fuel type, fuel quality, the application, and operating conditions. All filters eventually clog with contaminants; tracking a fuel filter's restriction saves money and avoids problems.

Model 690R1230 shown.

Contact Information:

Parker Hannifin Corporation
Racor Division
P.O. Box 3208
3400 Finch Road
Modesto, CA 95353

phone 800 344 3286
209 521 7860
fax 209 529 3278
racor@parker.com

www.parker.com/racor

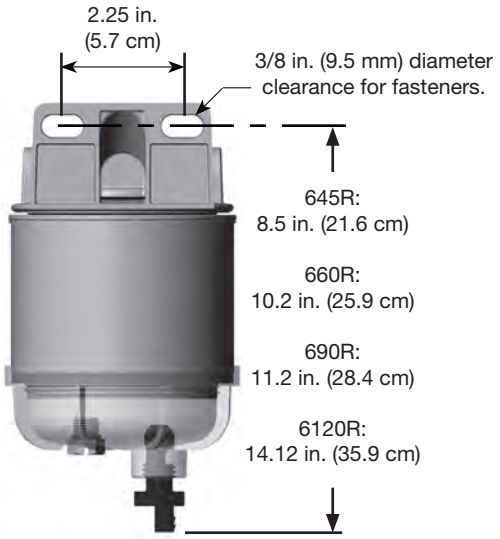
Product Features:

- **Proprietary, high-capacity, water-repelling Aquabloc® filters available in 2, 10, and 30 micron**
- **7-port die-cast aluminum head (four inlets, three outlets) and a unitized mounting bracket for installation convenience**
- **Reusable contaminant collection bowl with self-venting drain**
- **Optional 12 or 24 volt DC, 200 watt, in-bowl fuel heater, water detection kit -** *Danger! Not for use with gasoline applications.*
- **Optional water detection probes/kits also available**

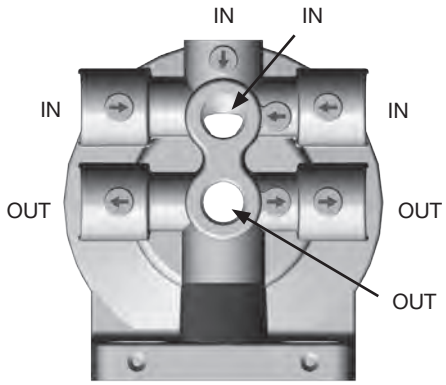
Parker | Racor

ENGINEERING YOUR SUCCESS.

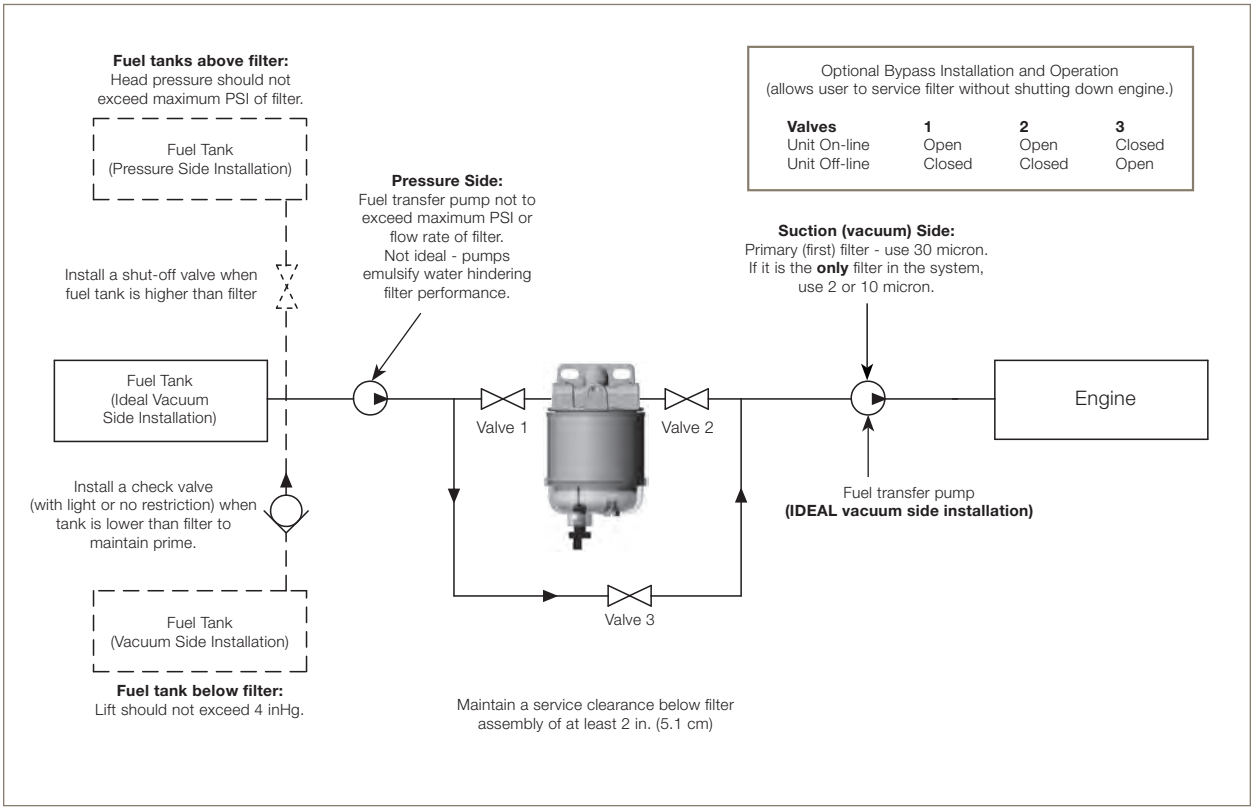
Mounting



Note: When installing mounting bolts (mounting head to frame/engine), limit impact wrench to 30 ft-lbs.



Installation Diagram



Installation Guidelines

READ ALL INSTRUCTIONS FIRST BEFORE BEGINNING INSTALLATION.

For new installations, refer to Mounting and Installation Diagram on previous page and install as follows:

1. Engine should be off and cool to touch. Ignition switch should be in the OFF position.
2. Apply thread sealant to NPT fittings (do not use thread tapes as particles may break off and contribute to clogging filter).
3. Thread fittings into appropriate fuel ports and tighten snugly. Plug unused ports (if any) with port plugs and tighten snugly.

   Important Note: Do not use impact wrenches when installing fittings into the mounting head.

4. Mount filter vertically in a protected area and away from heat sources. Maintain at least 2.0˝ (5.1 cm) of clearance below filter for draining water and servicing filter.
5. Attach fuel lines to filter (3/8˝ or larger is recommended). Avoid tight bends and rubbing areas when routing hoses.
6. Follow “Priming” instructions on this page.
7. Connect water probe and heater wires (if equipped).
8. Verify all other connections are tight and secure.
9. Start engine, inspect installation and correct any leaks with the engine off.

Service

Filter replacement frequency is determined by contamination level in fuels. Fuel flow to engine becomes restricted as filter gradually plugs with contaminants, resulting in noticeable power loss and/or hard starting. As a guideline, change filter every 500 hours, 10,000 miles, every other oil change, annually, or at first indication of power loss, whichever occurs first. Always carry extra replacement filters as one tankful of excessively dirty fuel can quickly plug a filter.

1. Engine should be off and cool to touch. Ignition switch should be in the OFF position.
2. Close all fuel valves, if applicable, to make sure excess fuel does not spill during servicing.
3. Disconnect water probe and heater connectors, if equipped.
4. Drain unit of fuel by opening the drain at the bottom of the filter bowl.
5. Remove bowl and filter. Dispose of filter properly. Bowl is reusable.
6. Lubricate new filter seals with motor oil or clean fuel and install only on new filter.
7. Re-install bowl onto new filter and tighten snugly with Racor bowl wrench (part number RK 22628).
8. To prime, fill filter (with bowl attached) with clean fuel.
9. Spin filter/bowl back onto mounting head. Tighten snugly with Racor bowl wrench (part number RK 22628).
10. Connect water probe and heater connectors, if equipped.
11. Open all fuel valves, if applicable.
12. Verify all other connections are tight and secure.
13. Start engine, inspect installation and correct any leaks with the engine off.

Draining the Collection Bowl

Water is heavier than fuel and will settle to bottom of bowl and appear different in color. In high humidity environments, check bowl frequently (daily if a poor fuel source is suspected). 600 Series bowls are equipped with a water sensor port that will accept a water probe (sold separately) and will alert operator of a high water condition in the filter.

1. Engine should be off and cool to touch. Ignition switch should be in the OFF position.
2. Drain water from filter by opening self-venting drain. Close as soon as all water has evacuated.

CAUTION! If drain is open too long, the entire filter may drain completely of water and fuel.

3. Follow Priming instructions below.

Priming

1. Always consult engine manufacturer’s priming instructions for priming the engine.
2. Remove filter and bowl from mounting head if not already off. Fill filter (with bowl attached) with clean fuel, lubricate filter gasket with motor oil or clean fuel and spin filter/bowl back onto mounting head. Tighten snugly with Racor bowl wrench (part number RK 22628).
3. Verify all other connections are tight.

Trouble Shooting

If filter fails to hold prime, first check drain valve, fittings, head, filter, and bowl are properly tightened. Next, check fuel line connections and verify they are free of pinches or unnecessary bends and check to see if fuel tank strainer (or pick-up tube) is clogged. If problems persist and filter is new, call Racor Technical Support at 800-344-3286, 8 AM to 5 PM, Pacific Time.

Installing the In-bowl Heater (if equipped)

CAUTION! Do not use electric heater in gasoline applications. Do not operate heater if no fuel is inside bowl. Ensure the filter is primed with fuel prior to applying power to the heater.

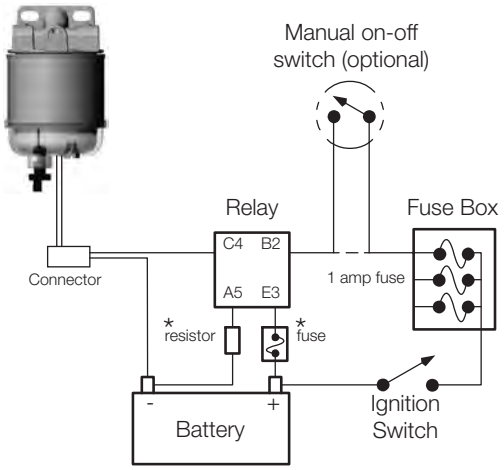
The in-bowl heater is a cold weather starting aid with an internal automatic thermostat that turns the heater on if fuel temperature drops below 45°F (7°C). Heat is supplied just below the filter to melt wax crystals and allow fuel to efficiently pass through. The heater will automatically turn off at about 75°F (24°C). The 200 watt heater is available in 12 or 24 vdc (volts, direct current). The heater is operated by turning on the ignition switch for a minimum of 5 minutes prior to starting the engine.

Customer Supplied Items

1. Because of the heater power demand, 20 amps for the 12 vdc and 10 amps for the 24 vdc, an additional relay is recommended for the safest method of installation. Racor offers two relay kits, available from your dealer, RK 11861 for the 12 vdc systems or RK 11862 for the 24 vdc systems. These kits include an in-line fuse holder (and fuse) and the RK 11862 kit also includes a resistor. Use the 25 amp fuse with the 12 vdc and the 15 amp fuse (and resistor) with the 24 vdc systems. See page 11 for more details.
2. Use an on-off toggle switch to control power to heater relay. This allows operator to cut power to heater relay in warmer climates.
3. All wires should be 14 AWG (American Wire Gauge), minimum.

Installation

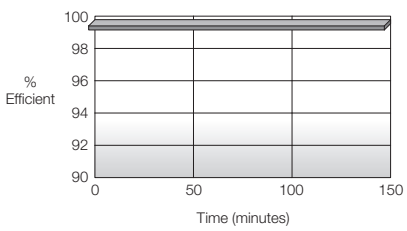
1. Either heater wire may be used for Hot (+) or Ground (-).
2. Wire/terminal connections should be soldered and crimped.
3. Run wires in protected locations. Avoid hot surfaces and places that could pinch or rub on the wires.



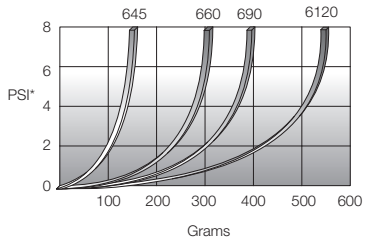
* Use 15 amp fuse and resistor with 24 vdc systems.

Performance Information

Test results are from controlled laboratory testing. Field results may vary.



SAE J1839 Water Separation



SAE J905 SOFTC-2A Contaminant Capacity, 10 micron Aquabloc® media

*PSI x 2.036 = inHg. (PSI x 6.895 = kPa)

Specifications

	645R	660R	690R	6120R
Max. Flow Rate	45 GPH (170 LPH)	60 GPH (227 LPH)	90 GPH (341 LPH)	120 GPH (454 LPH)
Fuel Port Size	3/8"-18 NPTF (SAE J476)	3/8"-18 NPTF (SAE J476)	3/8"-18 NPTF (SAE J476)	3/8"-18 NPTF (SAE J476)
Total Number of Ports: **(total inlets)** **(total outlets)**	7 4 3	7 4 3	7 4 3	7 4 3
Min. Service Clearance	2.0 in. (5.1 cm)	2.0 in. (5.1 cm)	2.0 in. (5.1 cm)	2.0 in. (5.1 cm)
Center Threads	1"-14	1"-14	1"-14	1"-14
Height	8.5 in. (21.6 cm)	10.2 in. (25.9 cm)	11.2 in. (28.4 cm)	14.1 in. (35.8 cm)
Width	4.5 in. (11.4 cm)	4.5 in. (11.4 cm)	4.5 in. (11.4 cm)	4.5 in. (11.4 cm)
Depth	4.5 in. (11.4 cm)	4.5 in. (11.4 cm)	4.5 in. (11.4 cm)	4.5 in. (11.4 cm)
Weight (dry)	2.4 lb (1.09 kg)	2.6 lb (1.18 kg)	2.7 lb (1.22 kg)	3.9 lb (1.8 kg)
Clean Pressure Drop	0.01 PSI (0.001 bar)	0.05 PSI (0.003 bar)	0.29 PSI (0.02 bar)	2.65 PSI (0.18 bar)
Max. Working Pressure[1]	30 PSI (2.07 bar)	30 PSI (2.07 bar)	30 PSI (2.07 bar)	15 PSI (1.03 bar)
Available Options:[2] **(water sensor)** **(heater)**[3]	 Yes Yes	 Yes Yes	 Yes Yes	 Yes Yes
Bowl Capacity **(water)** **(with heater)**	 4.0 oz. (118 ml) 3.5 oz. (104 ml)	 4.0 oz. (118 ml) 3.5 oz. (104 ml)	 4.0 oz. (118 ml) 3.5 oz. (104 ml)	 2.8 oz. (82 ml) 2.4 oz. (70 ml)
Water Removal Efficiency	99%			
Ambient Temp. Range	-40° to +255°F (-40° to +121°C)			
Max. Fuel Temp.	190°F (88°C)			

1 Pressure installations are applicable up to maximum PSI shown. Vacuum installations are recommended.
2 Do not use with gasoline applications.
3 Maximum power requirements for in-bowl heater option: 12 vdc (200 watt) = 16.6 amps, 24 vdc (200 watt) = 8.3 amps. See section on heater relay kits, if needed.

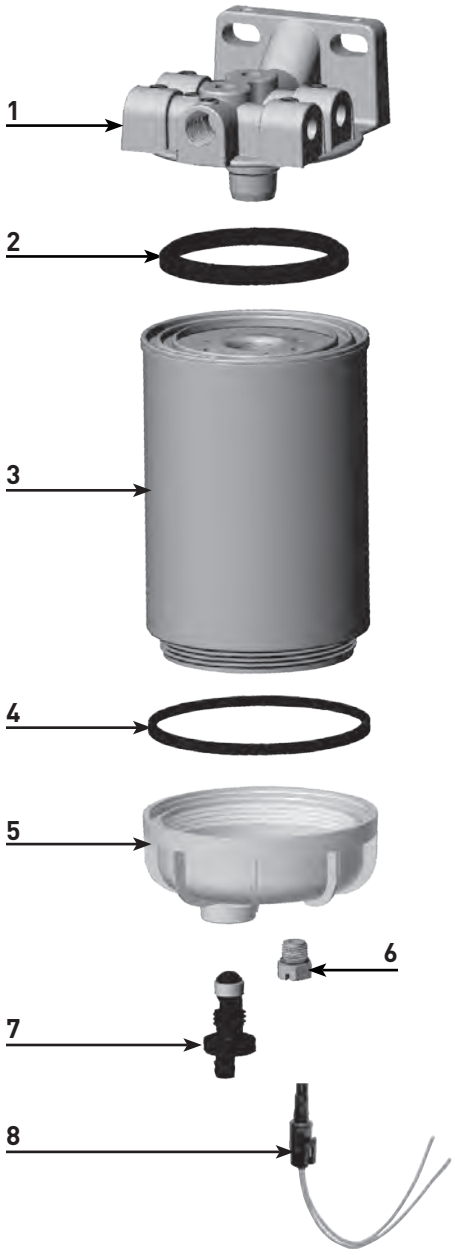
645R, 660R, and 690R Replacement Parts

Part Number	Description	
1. RK 22098	Mounting Head Kit (with 3/8”-18 NPTF fuel ports)	
2. RK22998	Filter Gasket Kit	
3. Replacement Filters		
645R	R45S or R47S	2 micron
	R45T	10 micron
	R45P	30 micron
660R	R60S	2 micron
	R60T	10 micron
	R60P	30 micron
690R	R90S	2 micron
	R90T	10 micron
	R90P	30 micron
4. RK 22333	Bowl Gasket Kit	
5. Replacement Bowl Kits		
RK 21113-13-11	Clear Bowl Kit	
RK 22616-01[1]	Heated Bowl Kit (Clear bowl with 12 vdc heater)	
RK 22616-02[1]	Heated Bowl Kit (Clear bowl with 24 vdc heater)	
6. RK 20126	Bowl Plug Kit (1/2”-20 SAE)	
7. RK 30476	Self-Venting Drain Kit	
8. RK 30964	Water Probe/Sensor Kit	

Additional Parts (not shown)

RK 22323[1]	Heater Connector Kit
01SP-6S	Metal Port Plug (3/8” NPTF)

[1] In-bowl heater may require a Heater Relay Kit.
Maximum power requirements: 12 vdc = 16.6 amps, 24 vdc = 8.3 amps.
Note: Do not use heater in gasoline applications.



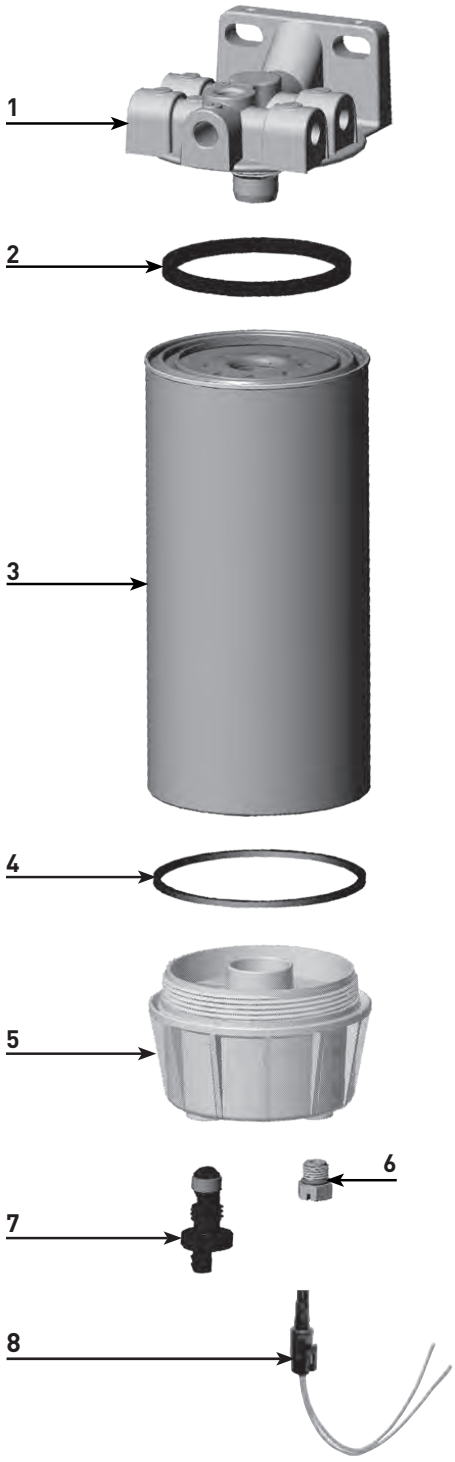
6120R
Replacement Parts

Part Number	Description	
1. RK 22098	Mounting Head Kit (with 3/8”-18 NPTF fuel ports)	
2. RK22998	Filter Gasket Kit	
3. Replacement Filters	R120S	2 micron
	R120T	10 micron
	R120P	30 micron
4. RK 30965	Bowl Gasket Kit	
5. Replacement Bowl Kits		
RK 30063	Clear Bowl Kit	
RK 30900[1]	Heated Bowl Kit (Clear bowl with 12 vdc heater)	
RK 30925[1]	Heated Bowl Kit (Clear bowl with 24 vdc heater)	
6. RK 20126	Plug Kit (1/2”-20 SAE)	
7. RK 30476	Self-Venting Drain Kit	
8. RK 30964	Water Probe/Sensor Kit	

Additional Parts (not shown)

RK 30876[1]	Heater Connector Kit
01SP-6S	Metal Port Plug (3/8” NPTF)

[1] In-bowl heater may require a Heater Relay Kit.
Maximum power requirements: 12 vdc = 16.6 amps, 24 vdc = 8.3 amps.
Note: Do not use heater in gasoline applications.



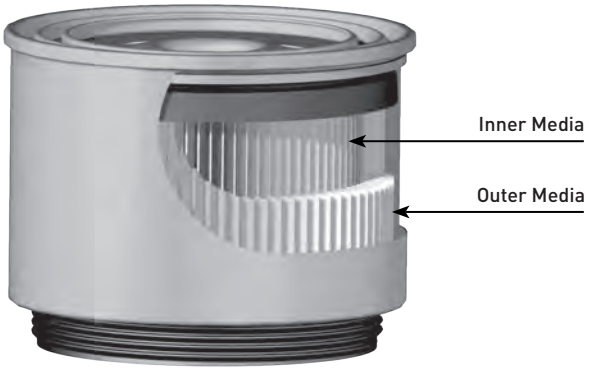
Replacement Filters

Model Number	2 micron (Final Filtration)	10 micron (Secondary Filtration)	30 micron (Primary Filtration)
645R	R45S or R47S	R45T	R45P
660R	R60S	R60T	R60P
690R	R90S	R90T	R90P
6120R	R120S	R120T	R120P

Optional Dual Layer Media Filter

Dual-layer media offers enhanced dirt-holding capacity, extended filter life, and ensures a more complete removal of all size contaminants. The R47S filter replaces the R45S and provides removal efficiencies of 99.98% (nominal) on 2 micron particles, still much greater than the 50-90% efficiency of most single-stage filters.

R47S



Remote Vacuum Gauges

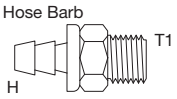
Vacuum gauges are available to monitor filter condition and as the filter slowly becomes clogged with contaminates the restriction (resistance to flow) increases. The fuel pump tries to draw fuel (suction) but because of restriction, less fuel is delivered to engine and instead more air is pulled from it (fuel de-gassing). Results can cause engine to lose power and eventually stall.

By installing a vacuum gauge in the fuel system on the outlet side of the filter, visual monitoring of filter condition is possible.

Specifications	RK 11233	1606B
Description	Silicone dampened, 0-30 inHg. Instrument panel installation.	Includes gauge and two fittings. Instrument panel installation.
Threads	1/4” NPT back bracket mount.	1/4” NPT back bracket mount.
Dimensions	2.0” W x 1.9” D	2.0” W x 1.9” D
Dial	2 in.	2 in.
Weight	0.4 lb (0.2 kg)	0.4 lb (0.2 kg)

Special Notes: For severe vibration applications, mount gauge on stable, remote location and connect using flexible tubing. Additional gauges available - contact your local distributor.

Fittings

Filter Part Number	Description	Hose (H)/ Thread (T)	T1	Part No.
For all models		3/8” 1/2”	3/8” NPT 3/8” NPT	951-N6-H6 951-N6-H8

Note: The T1 side of the fitting threads into the mounting head ports.

Water Probe Kits

Racor offers a wide selection of water probes, each designed for use with particular models and installation requirements. These probes are available in various configurations to fit every Racor filter/ separator. The water probe is only a component in the water detection system and will not work without a Racor electronic detection module.

RK 30880E has an electronic detection module built-in to its design and has the simplest installation procedure. Wiring instructions are supplied with each water detection module.

Specifications	RK 30964	RK 30880E
Threads	1/2”-20 Threads	1/2”-20 Threads
Description	Includes detachable 2-wire connector. Requires a detection module.	Includes detachable 3-wire connector, built-in detection electronics and under-dash warning light. Probe sends ground signal to light.
Voltage	12 or 24 vdc	12 or 24 vdc
Power Draw: ***(12 volt)*** ***(24 volt)***	N/A	5 Milliamps 10 Milliamps
Maximum Load	N/A	1 Amp
Weight	0.02 lb (0.01 kg)	0.4 lb (0.2 kg)

CAUTION! Never wire a water probe directly to voltage or another brand of detection module.

Water Detection Modules

Racor Water Detection Kits are available for under dash, in-dash and remote mount installation. These units may be used with any Racor fuel filter/water separator and water probe. An electric detection module analyzes electrical resistance at the water probe and determines if water is present. Units reset automatically after removing water (unless specified). All water detection module kits include an RK 21069 water probe.

Under Dash Modules

Specifications	RK 12870	RK 12871
Voltage	12 vdc	24 vdc
Features	Light and Buzzer	Same as RK 12870
Description	Lamp illuminates and buzzer sounds when water is detected. Water must be drained to reset light and stop buzzer.	
Dimensions	1.4" H x 1.25" D x 1.4" W	
Power Draw	1 Milliamp	
Max. Internal Load	30 Milliamps	
Weight	0.2 lb (0.1 kg)	

Note: Additional modules available - contact your Racor distributor.

In-Dash Modules

Specifications	RK 20726
Voltage	12 or 24 vdc
Features	Light and Buzzer
Description	Red DRAIN lamp illuminates continuously and buzzer sounds momentarily when water is detected. Power-up self diagnosis feature and circuit protection included.
Dimensions[1]	2.2" Diameter x 3.2" Depth
Power Draw: *(12 volt)* *(24 volt)*	 3 Milliamps 13 Milliamps
Max. Internal Load	30 Milliamps
Weight	0.4 lb (0.2 kg)

[1] Cut 2.0" diameter hole to mount gauges in instrument panel.

Note: Additional modules available - contact your Racor distributor.

Remote Mount Modules

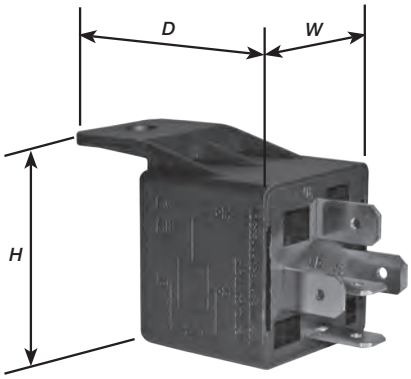
Specifications	RK 14329	RK 14321
Voltage	12 vdc	24 vdc
Features	Sends Hot (+) Signal	Sends Hot (+) Signal
Description	Receives signal from water probe or vacuum switch (not included) then sends a signal to horn or lamp. Must use with relay if power draw is over 1 amp.	Same as RK14329 but sends a 24 vdc hot (+) signal.
Dimensions[1]	0.7" H x 2.5" D x 2.8" W	1.0" H x 1.5" D x 2.0 W
Power Draw:	14 Milliamps	10 Milliamps
Max. Internal Load	30 Milliamps	30 Milliamps
Weight	0.3 lb (0.1 kg)	0.4 lb (0.2 kg)

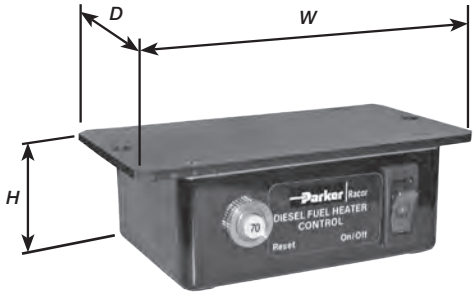
Note: Additional modules available - contact your Racor distributor.

Electrical Heater Relay Kits

CAUTION! Do not use electric heater in gasoline applications. Do not operate heater if no fuel is inside bowl. Ensure the filter is primed with fuel prior to applying power to the heater.

The following relay kits may be necessary when installing Racor Heater Kits due to power demand. Standard OE fuses, wiring and alternators may be unable to carry the load without overheating or shorting, creating a serious condition. Wire/terminal connections should be soldered and crimped.





Specifications	RK 11861	RK 11862	RK 19490-12	RK 19490-24
Description	Heater Relay Kit, Includes fuse and holder.	Heater Relay Kit, Includes fuse and holder.	Heavy-Duty Relay Kit	Heavy-Duty Relay Kit
Voltage	12 vdc	24 vdc	12 vdc	24 vdc
Detection Module	Remote Mount	Remote Mount	Under Dash	Under Dash
Maximum Watts	300	360	600	900
Maximum Amps	25	15	50	37
Dimensions	1.3” H x 1.6” D x 1.1” W	1.3” H x 1.6” D x 1.1” W	1.7” H x 2.9” D x 5.1” W	1.7” H x 2.9” D x 5.1” W
Weight	0.3 lb (0.1 kg)	0.3 lb (0.1 kg)	1.6 lb (0.7 kg)	1.6 lb (0.7 kg)

Caution: If you are uncertain if your electrical system can provide the additional power draw, consult your equipment distributor or qualified electrician.

Limited Warranties Statement

All products manufactured or distributed by Racor are subject to the following, and only the following, LIMITED EXPRESS WARRANTIES, and no others: For a period of one (1) year from and after the date of purchase of a new Racor product, Racor warrants and guarantees only to the original purchaser-user that such a product shall be free from defects of materials and workmanship in the manufacturing process. The warranty period for pumps and motors is specifically limited to ninety (90) days from date of purchase. A product claimed to be defective must be returned to the place of purchase. Racor, at its sole option, shall replace the defective product with a comparable new product or repair the defective product. This express warranty shall be inapplicable to any product not properly installed and properly used by the purchaser-user or to any product damaged or impaired by external forces.

THIS IS THE EXTENT OF WARRANTIES AVAILABLE ON THIS PRODUCT. RACOR SHALL HAVE NO LIABILITY WHATSOEVER FOR CONSEQUENTIAL DAMAGES FLOWING FROM THE USE OF ANY DEFECTIVE PRODUCT OR BY REASON OF THE FAILURE OF ANY PRODUCT. RACOR SPECIFICALLY DISAVOWS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED INCLUDING, WITHOUT LIMITATION, ALL WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE (EXCEPT FOR THOSE WHICH APPLY TO PRODUCT OR PART THEREOF THAT IS USED OR BOUGHT FOR USE PRIMARILY FOR PERSONAL, FAMILY, OR HOUSEHOLD PURPOSES), WARRANTIES OF DESCRIPTION, WARRANTIES OF MERCHANTABILITY, TRADE USAGE OR WARRANTIES OR TRADE USAGE.

Warning

Failure or improper selection or improper use of the products and/or systems described herein or related items can cause death, personal injury and property damage. This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the applications are met. The products described herein, including with limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

The following statement is required pursuant to proposition 65, applicable in the State of California: 'This product may contain a chemical known to the State of California to cause cancer or reproductive toxicity'.

March 2012

Parker Racor

ENGINEERING YOUR SUCCESS.

Kubota

INSTALLATION MANUAL

Block Heater P/N: 70000-73274

for

SVL75 Compact Track Loaders

WARNING

To avoid serious injury:

- **Before you start the installation procedure, insure that the Engine is turned OFF, has cooled down, the key is removed from the ignition, and POSITIVE Battery terminal is disconnected.**

[A]. Over View:

These instructions apply to the V3307DI-T engine used in the SVL75 Compact Track Loader.

Installation time: 30 minutes.

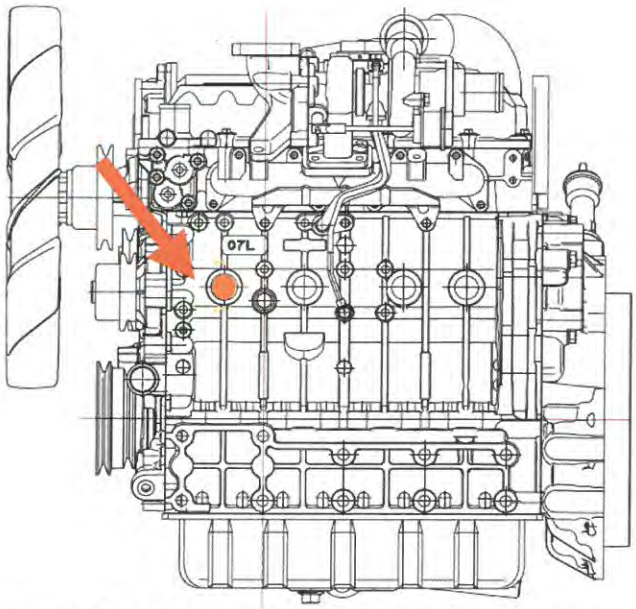
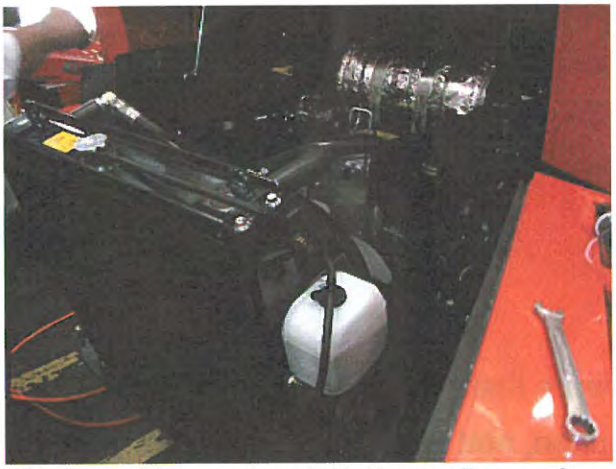
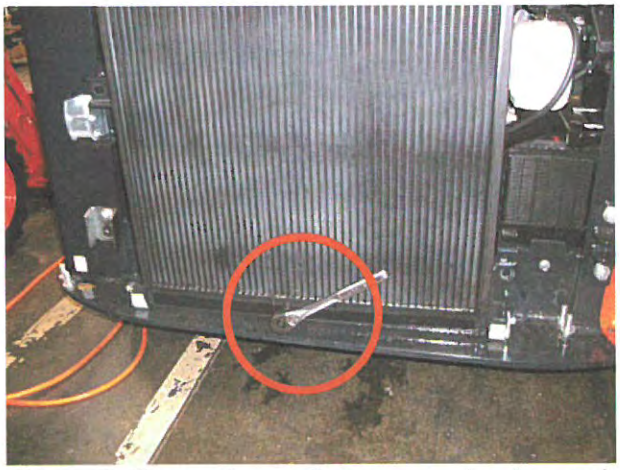


Fig.1. Block heater location, right side view.

[B]. INSTALLATION:



Step.1. Slide out and tilt the radiator after removing the (4) 19mm mounting bolts. Secure using the radiator in place.



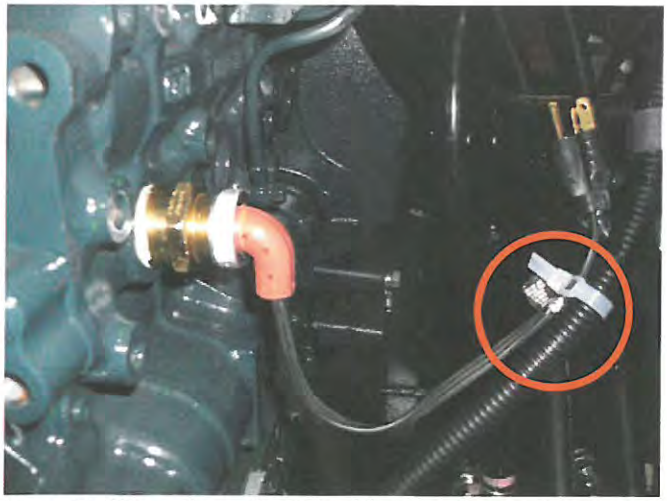
Step.2. Open the radiator cap slowly, and then loosen the coolant drain plug using a 12mm socket wrench.

Step.3. Locate the plug on the right side of the engine.

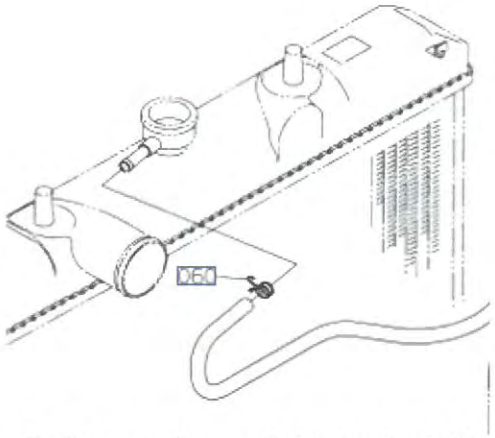
Step.4. Remove the plug using a 17mm socket Alan wrench. Note: Avoid damage to fan.

[B]. INSTALLATION: continued...

Step.5. Apply thread seal tape to the block heater, then screw block heater into engine block.



Step.6. Plug the electrical lead wire to the block heater. Zip tie (not included) lead wire to the nearby wire harness avoiding moving parts and hot engine parts



Step.7. Secure the radiator by installing radiator bolts. Tighten the coolant drain plug. Replace coolant in radiator as per WSM, and check the level in the overflow tank.

Step.8. Check for leaks if necessary. Install battery Terminal. Start engine (CAUTION: KEEP CLEAR FROM MOVING PARTS) and run for 5 minutes. Turn OFF the engine, check once again for leaks and coolant level.

Notes