Interceptor™ Sampling Systems IOM

Instruction, Operation & Maintenance Manual

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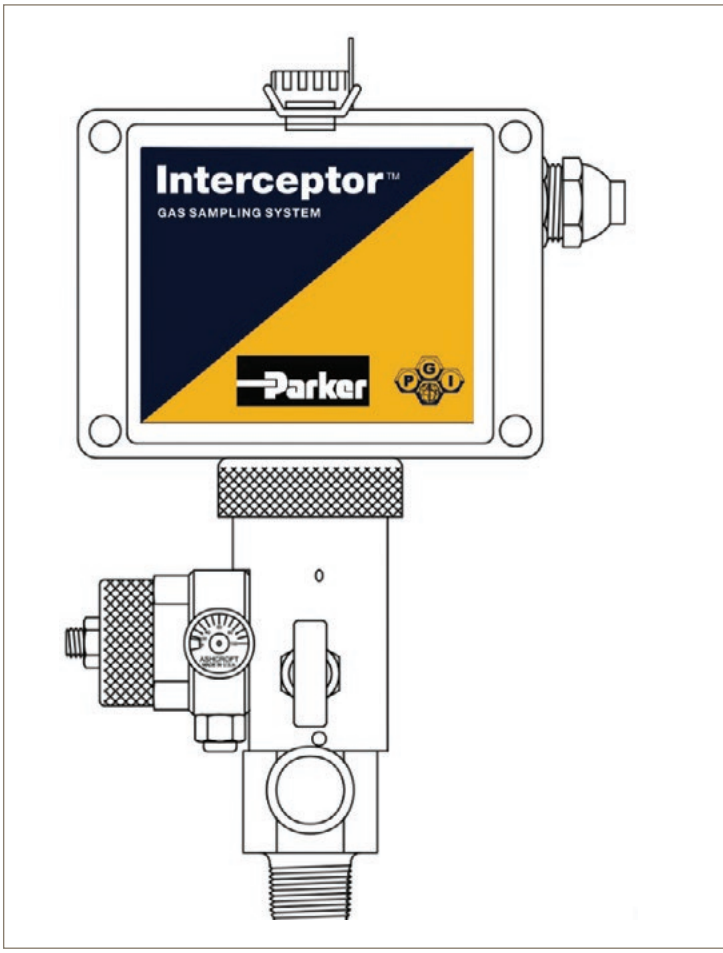

⚠ WARNING – USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS 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 or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

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I. General Information

1.0 Nameplate Location

For system configurations A and B, see Figure 41 and Figure 42. For all other system configurations, see Figure 43.

2.0 Shipping Damage Inspection

Upon receipt of the Interceptor™ Sampler System, please inspect all items to be certain that no damage occurred during transit. Should there be damage, please contact your product representative or the factory immediately.

Note: Returns will not be accepted without an Authorization to Return (ATR) number issued by the factory.

3.0 Introduction

Prior to installation of your new Interceptor™, please take a few minutes to familiarize yourself with the orientation and location of the major components that comprise this state of the art Gas Sampler.

1) Make sure that all options ordered are included and the pipeline probe to be used is included.

Note: Steps 2 – 5 are performed only if the optional G6000 control card is present.

2) Plug in the battery pack and turn the controller on.
3) Program the controller to operate in the mode in which it will be installed in the field. (See Section III, paragraphs 2.4 and 2.9)
4) Perform the Test Sample as indicated in Section II, paragraph 2.2A.
5) Check the voltage of the battery pack to ensure that all systems are go. (See Section III, paragraph 2.3.)

For sample collection, constant pressure or spun end sample cylinders are available from your local Parker PGI distributor.

For questions about your new Interceptor™ or assistance at any time, please contact your local distributor or Parker PGI at 713-466-0056 or 800-231-0233.

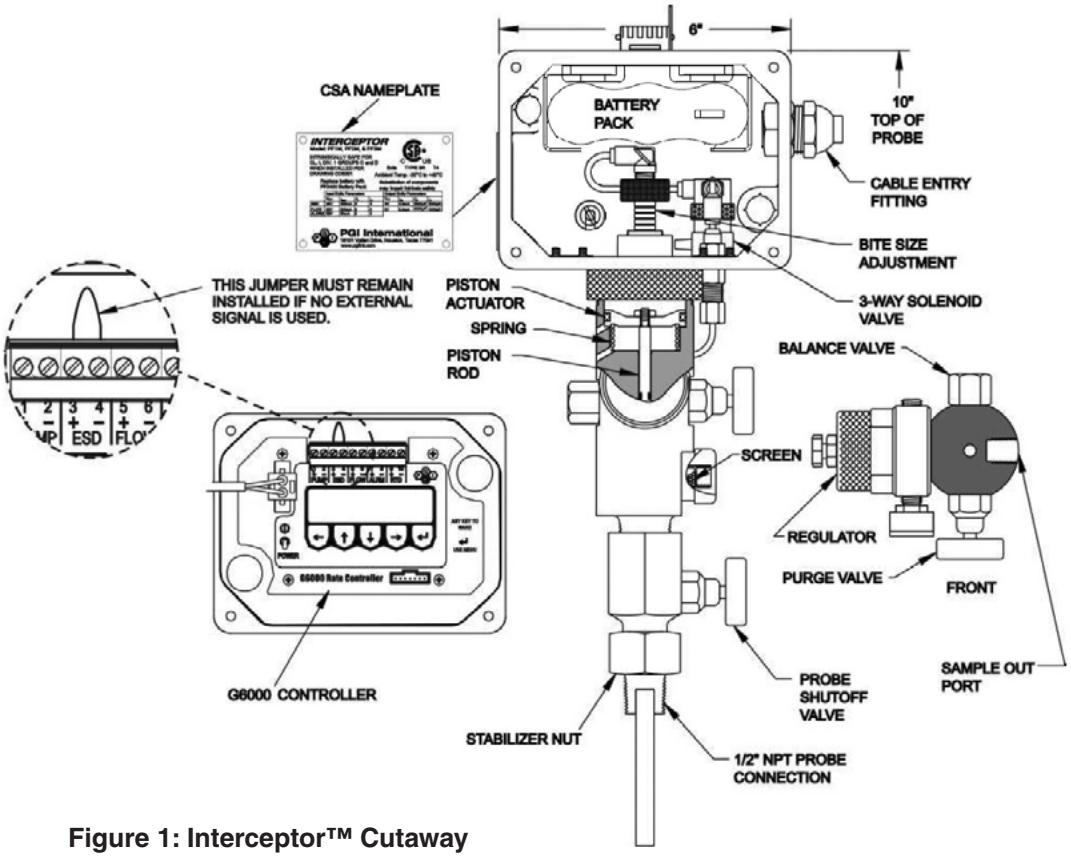

Figure 1: Interceptor™ Cutaway

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4.0 Theory of Operation

The Interceptor™ gas sampler is a positive displacement piston pump which is powered by a low pressure, gas operated, spring return piston actuator. In high pressure applications, gas directly from the pipeline is regulated by an integral regulator to provide this low pressure gas source. Sampling is accomplished when a 3-way, low power, 6, 12 or 24 VDC solenoid valve is energized, which allows the low pressure gas to perform a downward pumping stroke. After a one second (1 second) "hold in", the solenoid valve is de-energized and the actuator spring returns the piston to begin the next pumping cycle.

At the completion of each sampling stroke, the sample is discharged into the sample bottle through an integral balance valve (high pressure applications) or an adjustable spring check valve (low pressure applications). This valve protects the sample bottle from loss of pressure if the pipeline pressure should fluctuate up or down. An integral purge valve is provided for purging the entire system of old gas after a sample bottle change-out.

The sample bite size (or sample volume) can be manipulated from .1 cc to 0.5 cc by adjusting the calibrated mechanical adjustment screw. Making adjustments here will vary the length of the pump stroke to obtain the desired sample volume. All pipeline gas enters the pump through a 40 micron filter, which protects all pump seals and moving components from abrasive damage and premature failure due to entrained solid particles. The chemical integrity of the gas sample is unaffected by this filtering process.

Continuous collection of composite gas samples can be accomplished at fixed intervals (time-based), as well as true proportional to flow, when gas flows are fluctuating. The G6000 Controller will take a 1-5 VDC or 4-20ma signal from a differential pressure transmitter and take samples at a rate proportional to flow. The Controller also has the capability to take the square root of a linear input signal, if required, and has time-based capabilities to allow sampling to continue if the primary signal device is temporarily out of service. Electrical power to the system is provided by an alkaline battery pack. If no control card is present, sampling will be controlled by a flow computer which will be connected directly to the system solenoid.

There are three (3) specific pump styles available, in combination with four (4) different mounting methods. Each pump style incorporates features that are unique to the particular service for which it was designed.

For Example:

Pump Style PF1 — From -10" Hg. vacuum to 90 psig, is designed specifically for low pressure gas gathering systems.
Note: See low pressure pump set options to specify low pressure range.

Pump Style PF2 — From 90 psig to 1480 psig, is designed for systems where pipeline gas is "wet and dirty", and a separate clean instrument air or gas source is available to the solenoid valve.

Z3 SS pump option increases max. inlet to 2200 psi.

Pump Style PF3 — From 90 psig to 1480 psig, is designed for general gas pipeline applications.

Z2 SS pump option increases max. inlet to 2200 psi.

All Interceptor™ Gas Samplers are CSA approved as intrinsically safe for use in Class I, Division 1, Groups C and D hazardous locations.

All Interceptor™ gas samplers have a maximum temperature rating of 200°F.

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5.0 G6000 Sample Rate Controller

5.1 Features

- Flow input can be configured for pulses, voltage (1 to 5 volts), or current (4 to 20 milliamps)
- Flow input set for pulses offers three (3) 'voltage trigger' levels for maximum noise immunity
- An adjustable sample pump actuation duration (1 to 9 seconds)
- External RTD sensor, for monitoring heated sample enclosures
- Configurable alarm output, displaying:
  - o Low battery
  - o Power switch is off
  - o Emergency Shut-Down (ESD) detected
  - o Low or high RTD temperature
  - o Sample count
- Sample count limit can be setup to disable the pump or activate the alarm after a fixed number of samples have been taken
- ESD input allows for remote disabling on 'no-flow', 'sample vessel full', or some other event (factory configuration = Disabled)
- Offline configurations simplify installation and controller replacements
- Software configuration tool accurately determines preset between samples and bite size to fill the sample vessel over the sample period with the desired number of samples
- System configuration values can be saved in the controller for later edits

5.2 G6000 Overview

The G6000 sample rate controller (optional feature) manages and monitors the sampling process. Its main function is to control the sample rate. When it is time to take a sample, the G6000 controller will activate the sample pump by providing power on the pump output, energizing the pump solenoid. When the solenoid opens, gas pressure supplied by the sample probe actuates the sample pump for one cycle.

The sample rate can be proportional to time (time-based) or proportional to the flow rate (flow-based). Time-based samples occur at fixed time intervals, every 30 minutes for example. When sampling proportional to a flow rate, the frequency or interval between samples varies as the flow rate varies. If the flow rate increases, the sample rate increases. The flow signal can be pulses, 1-5 volts or 4-20 milliamps. When the flow input is a voltage or current, the G6000 controller can be set to take the square root of the input to convert a differential pressure into a linear flow value.

A preset counter is used to count down to the next sample. When the preset counts down to zero a sample is taken and the preset counter is re-loaded in preparation for the next sample. In time-based mode, the preset is the time until the next sample. In most flow-based applications the preset value is left at "1". This means that each time the flow computer sends a signal a sample will be taken.

An ESD (emergency shut-down) input can be used to disable the sampler, if necessary. ESD can be used with any dry contact switch or a sample vessel 'full switch'.

An alarm output can be used for remote notification of a malfunction or an event such as a low battery, ESD, or maximum number of samples taken. Other alarm events are available and each can be enabled or disabled at setup.

If the G6000 controller is used with a heated enclosure, the enclosure temperature can be monitored using an RTD temperature sensor. Alarm levels for low and high temperature can be set to trigger an alarm, an event, or both.

A two-line LCD display and a sealed membrane keypad provide a simple user interface for quick setup, monitoring, and diagnostics. Configuration settings are saved in nonvolatile memory and are recalled at 'power on' — even if the battery is temporarily disconnected. A 'date and time clock' stamps events such as a low battery or ESD detected.

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5.3 G6000 Menus

The G6000 menu system allows configuration parameters to be adjusted using the 5 keypad buttons. If the display is off and the G6000 is in the low power/sleep mode, press any key to wake the display. If no keys are pressed for 3 minutes, the G6000 will automatically switch to run and go back to the low power/sleep mode. When any key is pressed, the 3-minute timer is restarted.

Configuration settings are saved to nonvolatile memory and will be recalled even if the battery is disconnected.

The LEFT arrow key is used to select the menu item directly to the left of the currently selected item. In Run Mode, the LEFT arrow will move to the previous data value to be displayed on the bottom line of the display.

The UP arrow key is used to select the menu item directly above the currently selected item. When entering a value, the digit where the cursor is will increment each time the UP arrow is pressed. In Run Mode, the UP arrow will move to the previous data value to be displayed on the bottom line of the display.

The DOWN arrow key is used to select the menu item directly below the currently selected item. When entering a value, the digit where the cursor is will decrease each time the DOWN arrow is pressed. In Run Mode, the DOWN arrow will move to the next data value to be displayed on the bottom line of the display.

The RIGHT arrow key is used to select the menu item directly to the right of the currently selected item. In Run Mode, the RIGHT arrow will move to the next data value to be displayed on the bottom line of the display.

The ENTER key is used to enter or save configuration settings, and select menu choices. In Run Mode, pressing the ENTER key will bring up the G6000 main menu.

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6.0 Part Number Construction

The following chart represents how to construct an Interceptor™ model number.

Base Model Number

Base Model Number					Options (see next page)					
	Pump	System	Mount							
PF	X	X	X	–	X	X	X	X	X	X

Pump Style

Code	Regulator	Outlet Control	Inlet Pressure
1	No	Spring Check	50 to 90 PSI (see S2 options for under 50 PSI)
2	No	Balance Valve	90 to 1480 PSI hazardous locations (requires alternative source to operate solenoid)
3	Yes	Balance Valve	90 to 1480 PSI (see Z2 option for 1480 to 2200 PSI)

Mounting Methods

Code	Description
B	Direct mount (includes PR65 SS dual flow 3/4" MNPT x 3/4" FNPT stabilized probe)
D	Direct mount (includes PR16 SS single flow 1/2" MNPT x 3/4" FNPT stabilized probe; 3/4" MNPT process connection – see N3 option)
L	Direct mount (no probe; 3/4" MNPT pump connection)
P	Pipe mount (no probe; 3/8" FNPT connection; includes SS pipe mounting bracket) valid w/ C, D, & M configurations only

System Configuration

Code	Controller	Solenoid	Electronics Enclosure	Bite Size Adjustment	Power
A	None	12 VDC	None	.1, .2, .3, .4, or .5cc selectable	Customer Supplied
B	None	6 VDC	None	.1, .2, .3, .4, or .5cc selectable	Customer Supplied
C	None	12 VDC	On top of pump	Adjustable from 0 to .5cc	Customer Supplied
D	None	6 VDC	On top of pump	Adjustable from 0 to .5cc	Customer Supplied
*K	None	12 VDC	None	Adjustable from 0 to .5cc	Customer Supplied
*L	None	6 VDC	None	Adjustable from 0 to .5cc	Customer Supplied
M	G6000	6 VDC	On top of pump	Adjustable from 0 to .5cc	PF-2500 (14 amp hour Battery)
*P	G6000	6 VDC	On top of heated enclosure	Adjustable from 0 to .5cc	PF-2500 (14 amp hour Battery)
R	None	24 VDC	On top of pump	Adjustable from 0 to .5cc	Customer Supplied
S	None	24 VDC	None	.1, .2, .3, .4, or .5cc selectable	Customer Supplied
*T	None	24 VDC	None	Adjustable from 0 to .5cc	Customer Supplied

*For heated enclosures only
System configuration codes M and P replace all previous electronic controller options (E, F, G, H and J)

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Options List

Note: The first letter of an option is written only once.
For example, option M1 & M5 is written as M15.

Options	
Pressure Gauge Options	
G	316 SS 0-2000 PSI liquid-filled pressure gauge (previously Z9 option)
G1	316 SS 0-1000 PSI liquid-filled pressure gauge
G2	316 SS 0-100 PSI liquid-filled pressure gauge
G3	316 SS 0-30 PSI liquid-filled pressure gauge
G6	316 SS 0-600 PSI liquid-filled pressure gauge
Moisture/Liquid Protection Options	
LS	Liquid shut-off assembly
MF	Membrane filter assembly
Vessel Rack Options	
M1	16" fiberglass channel direct mount vessel rack (includes aluminum bracket)
M2	16" fiberglass channel direct mount vessel rack (includes SS bracket)
M5	29" pipe mount horizontal vessel rack (includes CS mounting bracket)
M6	16" pipe mount horizontal vessel rack (includes CS mounting bracket)
M7	Mounting bracket and hardware for spun end cylinder (for direct mount only) [See G options for gauge]
M8	316 SS mounting bracket for pipe mounted vessel rack (adder to M5 or M6 option)
Probe Options	
N3	3/4" MNPT on Sample Probe (1/2" standard) ***Valid with "D" mounting method only***
N4	1" MNPT on Sample Probe (1/2" standard)

Solenoid and Low-Pressure Pump Set Options	
S1	25' cable for system configurations A or B only (replaces standard 10' cable)
S2	Low pressure solenoid, 24 VDC, 12 VDC or 6 VDC, 50 PSI max. pipeline pressure (15 to 50 PSI factory-set spring check)
	S2P1 low pressure solenoid, 5 to 15 PSI factory-set cpring check (.5 cc min. bite) ***PF1 only***
	S2P2 low pressure solenoid, vacuum to 5 PSI factory-set spring check (.5 cc min. bite) ***PF1 only****
S3	Replace 10' of Belden® wire with 25' of Belden® wire
S4	Replace 10' of Belden® wire with 15' of Belden® wire
S5	Solenoid pipe-away vent to bulkhead fitting
Miscellaneous Options	
X2	Kel-F® purge valve seat (acetal resin standard)
X4	Tefzel® purge valve seat (acetal resin standard)
Pump Options	
ZA	PF3 low temperature O-rings (-40°F)
Z1	SS tubing and fittings to solenoid (for system configurations A, B, K, or L only)
Z2	316 SS pump and regulator for PF3 – rated to 2200 PSI maximum inlet pressure**
Z3	316 SS pump for PF1 and PF2 – rating changes to 2200 PSI maximum inlet pressure for the PF2 only**
Z4	"E" nickel / 316 SS fittings to solenoid for H_2S / CO_2 service ***Valid only when electronics enclosure is used***
Z5	CO_2 service O-rings
Z7	Install (1) V-556SDV-H8 into hot loop port on Interceptor
Z8	316 SS tee with 316 SS 0-2000 PSI liquid-filled pressure gauge at outlet port

*May require a minimum of 30 PSI alternative source to operate solenoid.
**140°F max. temperature to meet NACE MR0175/ISO 15156

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7.0 Service/Conversion Kits and Accessories

Controller Cards	
SM-G6000-I	Controller card only (replaces G2500 through G4000 cards)
Battery Pack	
SPF-2500	14 amp hour battery pack (system configurations M and P)
SK-PF-22	Battery bracket
Solenoid and Solenoid Kits	
SPF-5030	12 VDC solenoid and 10' cable assembly (system configuration A) [Add S1 for 25' cable]
SPF-5039	6 VDC solenoid and 10' cable assembly (system configuration B) [Add S1 for 25' cable]
SPF-5061	24 VDC solenoid and 10' cable assembly (system configuration S) [Add S1 for 25' cable]
SS-C80-555	12 VDC solenoid (system configuration C)
SS-C80-556	6 VDC solenoid (system configurations D, L, M, or P – old system configurations E, F, G, or H)
SS-C80-559	24 VDC solenoid (system configurations R, S, or T)
SS-C80-528	6 VDC low pressure solenoid (50 PSI max. pipeline pressure)
SS-C80-519	12 VDC low pressure solenoid (50 PSI max. pipeline pressure)
SPF-Z1	SS tubing and fitting to solenoid [Z1 system option] (system configurations A or B only)
Bite Size Selector Buttons	
SPF-5036	Bite size selector button kit (includes .1, .2, .3, .4 and .5 cc selectors)
Pump Service Kits – Complete Rebuild Pump Kit	
SK-PF-01	PF1 Series – FKM soft goods standard, includes pump rod assembly and check spring
SK-PF-02	PF2 Series – FKM soft goods standard, includes pump rod assembly
SK-PF-03	PF3 Series – FKM soft goods standard, includes pump rod assembly
SK-PF-ZA	PF2 low temperature O-ring service kit
SK-PF-16-5	CO_2 service PF3 mini rebuild kit
P9-061	Super Lube® synthetic grease
PF3/PF2 Conversion from High Pressure to Low Pressure	
SK-PF-04	Spring check housing conversion kit (high to low pressure) – below 50 PSI, requires S2 solenoid option
Balance Valve Kit	
SK-PF-07	PF2 or PF3 replacement balance valve
SK-PF-07-5	CO_2 service PF3 balance valve assembly
SK-PF-07-Z2	PF2 or PF3 replacement balance valve – 316 SS
Spring Check Rebuild Kit	
SK-PF-08	Outlet spring check kit (PF1 only)

Regulator Kits	
SK-PF-09	Regulator kit, FKM soft goods (PF3 only)
SK-PF-R	Pressure gauge / adjustable regulator kit
SK-PF-RS	Pressure gauge / regulator kit in 316 SS material
Pump Service Kit (Upper Body only)	
SK-PF-10	Upper pump body, FKM soft goods kit with pump rod assembly (PF1 and PF2 only)
SK-PF-11	Upper pump body, FKM soft goods kit with pump rod assembly (PF3 only)
Pump Service Kit (Lower Body only)	
SK-PF-12	Lower pump body, FKM soft goods kit (PF1, PF2 and PF3)
Inlet Strainer	
SK-PF-13	Inlet strainer service kit (40 micron only)
Purge and Probe Block Valve Parts	
SK-PF-14	Tefzel® purge valve seat and FKM O-ring seal
SK-PF-17	Acetal resin purge valve seat and FKM O-ring seal
SK-PF-18	Kel-F® purge valve seat and FKM O-ring seal
SK-PF-19	Complete bonnet assembly replacement (includes acetal resin seat and seal)
Vessel Racks and Spun end Brackets	
SPF-M1	16" fiberglass channel direct mount vessel rack (includes aluminum bracket)
SPF-M2	16" fiberglass channel direct mount vessel rack (includes SS bracket)
SM-5	29" pipe mount horizontal vessel rack (includes CS mounting bracket)
SM-6	16" pipe mount horizontal vessel rack (includes CS mounting bracket)
SPF-M7	Aluminum mounting bracket and hardware for spun end cylinder (see SPF-G for gauge)
SM-8	316 SS mounting bracket for pipe mounted vessel rack (adder to M5 or M6 option)
Pump Pressure Gauge	
SPF-G	316 SS 0-2000 PSI liquid-filled pressure gauge (previously Z9 option)
SPF-G1	316 SS 0-1000 PSI liquid-filled pressure gauge
SPF-G2	316 SS 0-100 PSI liquid-filled pressure gauge
SPF-G3	316 SS 0-30 PSI liquid-filled pressure gauge
SPF-G6	316 SS 0-600 PSI liquid-filled pressure gauge
SPF-Z8	316 SS tee with 316 SS 0-2000 PSI liquid-filled pressure gauge at outlet port

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II. Installation Instructions

1.0 Mechanical Installation

1.1 Mounting Methods

A. Pipe Mount — Mounting Code P

(Refer to Figure 2)

This mounting method requires a 2" vertical pipe rigidly mounted and located as close to the sample probe as possible. A stainless steel pipe mounting bracket is attached to the sampler enclosure. A 3/8" NPT inlet Ⓐ is provided at the sampler for attaching to a single flow probe. For “hot loop” or dual flow probes, a 1/4" NPT connection Ⓑ is provided to accommodate return flow back to the probe or to any location on the pipeline which is at a lower pressure. Parker PGI dual flow probe models PR20-N3 or PR25 may be used when connecting to a 3/4 NPT pipeline coupling.

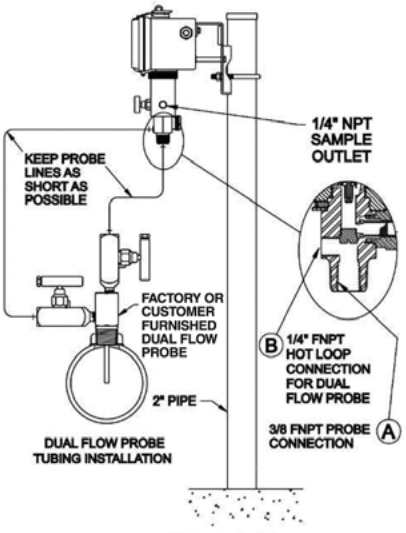

Figure 2: Mounting Code P

B. Direct Mount — Mounting Code D

(Refer to Figure 3)

This mounting method is provided with a model PR16, 316 SS single flow probe with a 1/2" NPT threaded connection and a stabilizer nut. All probes are furnished standard with a 3/8" OD x 8" long probe square cut on the end. The probe length should be field modified to place the end of the probe within the center one-third of the pipeline. The direct mount sampler is also equipped with a 1/4" NPT connection for a hot loop return line to any location on the pipeline which is at a lower pressure. The stabilizer nut provides rigidity to the 1/2" NPT probe connection.

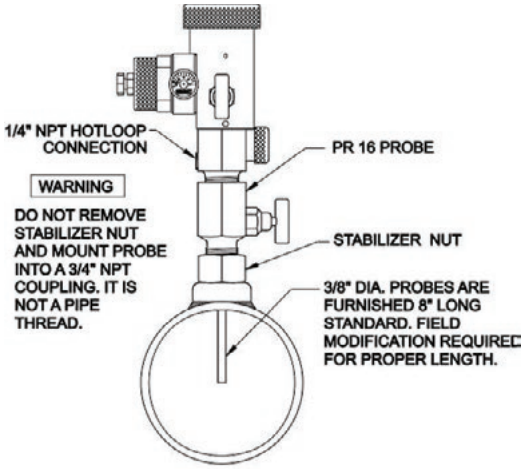

Figure 3: Mounting Code D

C. Direct Mount Less Probe — Mounting Code L

(Refer to Figure 4)

This mounting method is furnished without a probe and is intended for connection to any existing pipeline probe with a 3/4" NPT inlet connection. For dual flow probes, the 1/4" NPT “hot loop” connection provided can be utilized.

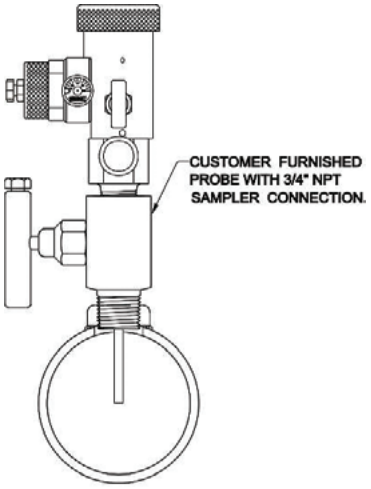

Figure 4: Mounting Code L

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D. Direct Mount/Dual Flow — Mounting Code B
(Refer to Figure 5)

This mounting method is provided with a model PR65 (not pictured), 316 SS dual flow probe with a 3/4" NPT threaded connection. All probes are furnished standard with a 3/8" OD x 8" long probe square cut on the end. The probe length should be field modified to place the end of the probe within the center one-third of the pipeline. The sampler is equipped with a 1/4" NPT connection for a hot loop return line back to the dual flow probe.

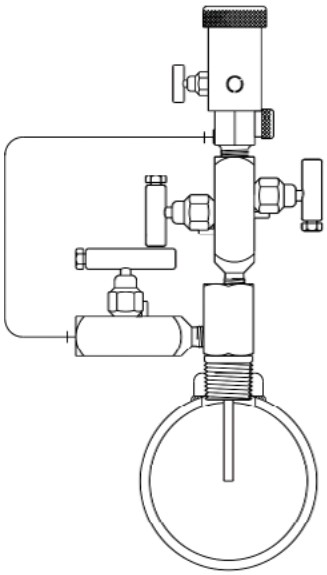

Figure 5: Tubing Installation Example

1.2 High Capacity Regulator Drain (Refer to Figure 6)

All model PF3 pump style samplers are equipped with an integral single stage regulator. The primary side of the regulator will operate from 90 psig to 1480 psig, while the secondary side has a fixed nominal output of 60-70 psig.* A 1/8" NPT threaded connection is provided on the bottom of the regulator and may be connected to a drip pot for continuous draining. The drip pot will require periodic draining.

* PF3 pumps with Z2 option operate from 90 psig to 2200 psig on the primary side. At inlet pressures under 1480 psig, the secondary side has a fixed nominal output of 60-70 psig. At inlet pressures between 1480 to 2200 psig, the secondary side must have a nominal output of 85-95 psig.

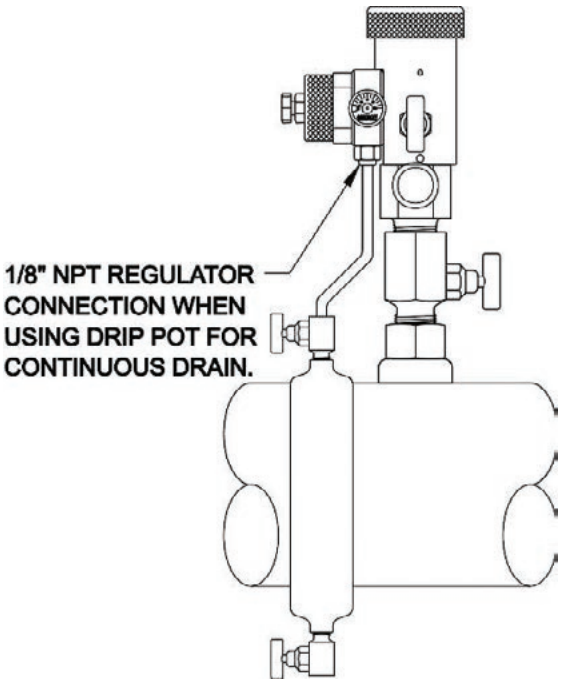

Figure 6: High Capacity Regulator Drain

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2.0 Electrical Installation

2.1 System Configuration Codes A, B, C, D, R, and S (Refer to Figure 7)

This system is used when a flow computer or other device supplies power to the solenoid, for at least one (1) second when a sample is to be taken.

- **Codes A and C** are equipped with a 12 VDC double diode protected intrinsically safe 3-way N.C. solenoid valve and a weatherproof connection at the solenoid terminals. The solenoid connection leads are polarity sensitive and are marked (+), (-), for proper connection.
- **Codes B and D** are is identical to Codes A and C but use a 6 VDC solenoid.
- **Codes R and S** are identical to Codes A and C but use a 24 VDC solenoid.

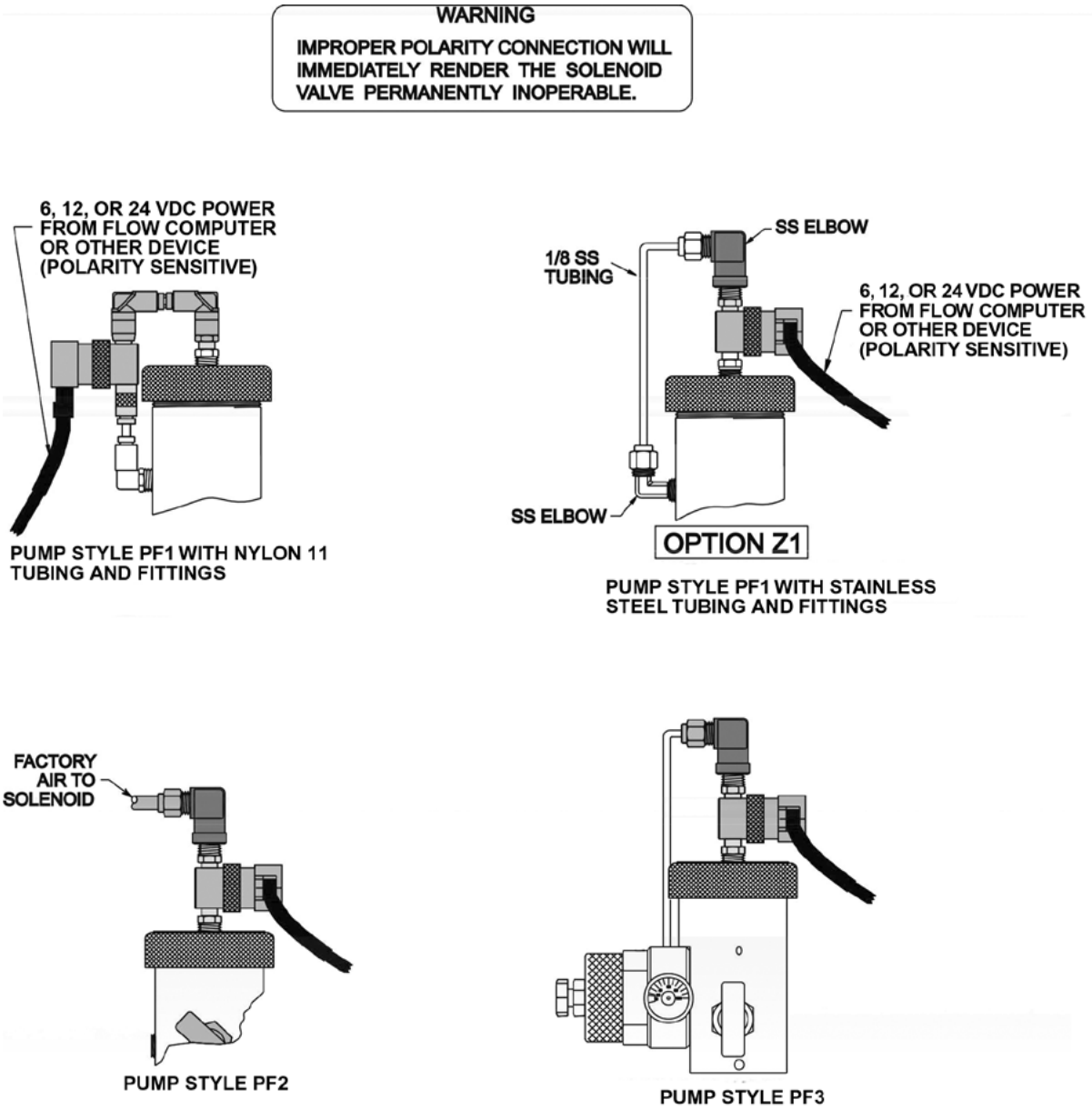

Figure 7: System Configurations

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2.2 Field Connections to the G6000 Controller

Field connections to the G6000 controller are made at the pluggable connectors located above the G6000 display. All of the negative (-) connections are internally connected together to form a common ground. Each input pair has its own two-pin terminal block, allowing each function to be independently disconnected to help isolate sections when troubleshooting.

In order to maintain intrinsic safety ratings, always consider entity parameters for an associated apparatus when installing the system in a hazardous location and when making field connections to the G6000. See the CSA nameplate, which is mounted outside the NEMA 3R enclosure. Relocating the battery and/or solenoid outside of the NEMA 3R enclosure will impair the intrinsic safety of the unit.

A. PUMP Terminals 1 and 2 (refer to Figure 8)

The PUMP output on terminals 1 and 2 provide power to the pump solenoid to actuate the sample pump. Only the ECO-3, 6-volt DC solenoid is approved for use with the G6000 controller.

Important: Observe polarity when connecting the solenoid to the controller. Connect the red lead to terminal 1 (+) and the black lead to terminal 2 (-).

Testing the Pump – Test Sample

The pump solenoid can be tested or actuated by the G6000 controller. From the G6000 main menu select:

Test ↵ Pump ↵ Test Sample ↵

The solenoid will be actuated for the same duration that will be used while in Run mode. After the test sample, the sample counter will be incremented and the G6000 will return to the test menu.

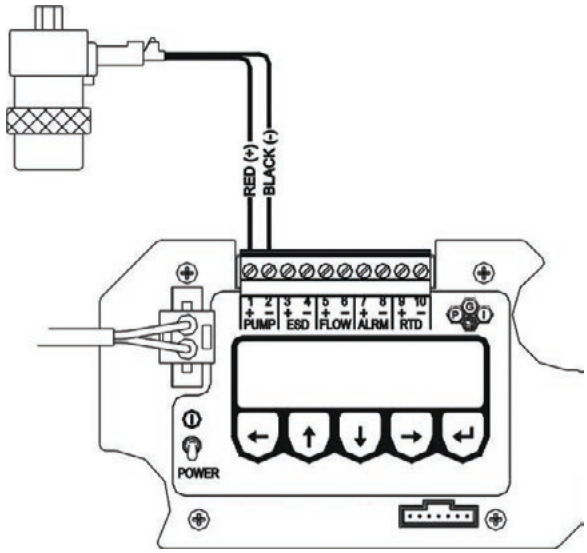

Figure 8: Pump Terminals

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B. ESD Terminals 3 and 4 (refer to Figure 9)

The emergency shut-down (ESD) input is used to disable the sampler when a signal is received from an external device. For example, the ESD Input may be used to pause or stop sampling when an “open circuit signal” is received, indicating such incidents as ‘Sample Bottle 80% Full’ or ‘No/ Low Flow’. When the circuit between terminals 3 and 4 is opened, the G6000 will enter the ESD mode and stop taking samples until the ESD input returns to a low level, electrically connecting terminals 3 and 4 back together.

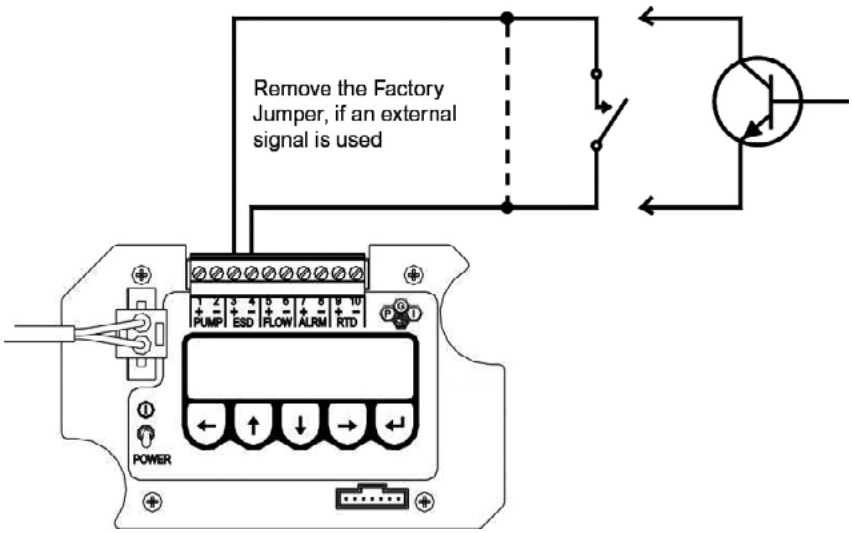

Figure 9: ESD Terminals

The G6000 provides power for a switch, a relay dry contact, or an open collector for a short time when the Input is polled. No external power is required to use the ESD input. However, the ESD input may also be controlled by a voltage source, where voltages below 0.5 volts enable the controller and voltages above 2 volts disable sampling. Maximum ESD Input voltage is 30 volts.

The G6000 controller can be set for a latched ESD. When a latched ESD is detected, the controller will stop taking samples until the operator clears the latched ESD condition.

A latched ESD can be reset using the G6000 keypad. To clear a latched ESD from the G6000 main menu, select:

Reset ↵ ESD ↵ Run ↵

The standard ESD configuration is “disabled” from the factory. To enable ESD Input, remove the jumper across terminals 3 and 4.

If the ESD Input is not used, the jumper must remain installed, connecting ESD terminals 3 and 4 together.

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C. FLOW Terminals 5 and 6 (refer to Figure 10)

The G6000 controller can take samples proportional to a flow rate provided by an external flow meter or flow computer. The flow can be provided as a 1 to 5 volt signal, a 4 to 20 milliamps signal, or pulses. When connecting a 4 to 20 milliamps signal to the FLOW Inputs, a 250 ohm resistor connected across FLOW terminals 5 and 6 is required to convert the input to 1 to 5 volts.

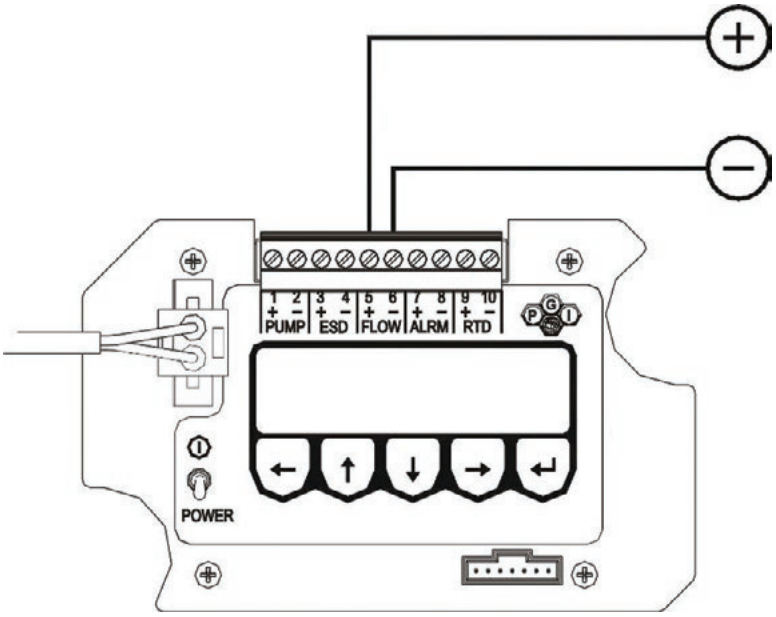

Figure 10: Flow Terminals

Flow-based sampling is set during the sample rate setup. See the section on Controller Configuration for details.

Displaying Measured Flow

When the G6000 controller is set for flow-based sampling, the current flow value can be displayed while in Run mode. With the preset count on the top line of the display, press one of the arrow keys to change the value displayed on the bottom line. Use the DOWN or RIGHT arrow to sequence forward through the available values, and the UP or LEFT arrow to step back through the available values. Press the DOWN arrow key until the Percent Flow value appears on the bottom line of the G6000 display. Pressing the DOWN arrow again will display the measured voltage, current, or pulse count per second (PPS), depending on which mode is set.

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D. ALARM Terminals 7 and 8 (refer to Figure 11)

The G6000 Alarm Out can be used to remotely monitor the status of the sampler system. This open collector output will be ON (or electrically shorted) when not in Alarm (healthy). If an alarm condition is detected, alarm terminal 7 (ALRM +) will be allowed to float to a high logic level. The user must supply power to the alarm circuit through a pull-up resistor. Maximum current through the alarm circuit is 30 milliamps and open circuit voltage should not exceed 30 volts.

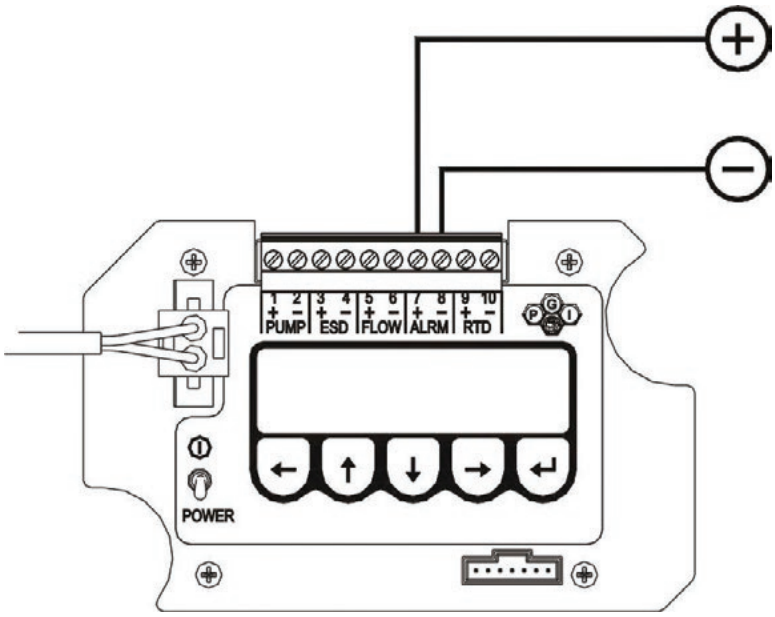

Figure 11: Alarm Terminals

To enable or disable alarms using the G6000 keypad, select

Setup ↵ Alarm ↵ Low Battery (Enable / Disable) ↵
ESD Alarm (Enable / Disable) ↵
High Sample Count (Enable / Disable) ↵
Low RTD Temperature (Enable / Disable) ↵
Set Alarm Level (if enabled) ↵
High RTD Temperature (Enable / Disable) ↵
Set Alarm Level (if enabled) ↵
Power Switch Off (Enable / Disable) ↵

Testing the Alarm Output

The alarm output can be tested using the G6000 keypad. From the main menu enter

Test ↵ Alarm ↵ Healthy (closes alarm output)
Alarmed (opens alarm output)
Cancel (restore alarm state and return to test menu) ↵

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E. RTD Terminals 9 and 10

If the G6000 is installed with a heated sampling system, the temperature of the system can be monitored by an RTD temperature probe. Alarm levels may be set for high or low temperature events. When armed, the G6000 will create a time-stamped log of events listing the temperatures above or below the alarm levels. Additionally, the alarm events can be tied to the alarm output for remote monitoring. The G6000 is designed to work with a 100 ohm platinum RTD sensor with a 0.00385 alpha coefficient. Although only a 2-wire sensor is necessary, 3-wire and 4-wire sensors may also be used. Measurement range is -22°F (-30°C) to +158°F (+70°C) with 1 degree resolution.

Displaying the RTD Temperature

The current RTD temperature can be displayed on the G6000 controller while it is in Run mode. In Run mode with the preset count on the top line of the display, press one of the arrow keys to change the value displayed on the bottom line. The DOWN or RIGHT arrow will sequence forward through the available values, and the UP or LEFT arrow will step back through the available values. Press the arrow key until the RTD temperature appears on the bottom line of the G6000 display.

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3.0 Optional Equipment Installation

3.1 Vessel Racks — Direct Mount (Refer to Figure 12)

Options M1 and M2 are direct mount vessel racks for constant pressure sample cylinders. The PR16 probe stabilizer nut secures the bracket to the top surface of the pipeline threaded coupling and allows for mounting the sample cylinder at any position. By utilizing the 1/4" NPT hot loop probe connection, natural gas can be used as a back pressure charge gas in lieu of nitrogen or helium.

3.2 Pipe Mount (Refer to Figure 12

Options M5 and M6 are used for constant pressure sample cylinders and in conjunction with pipe mounted samplers.

3.3 Spun End Bottle Bracket (Refer to Figure 12)

Option M7 utilizes the same plate mounting bracket as Options M1 and M2. The1/4" NPT hex nipple and tee can be moved in the slot provided to allow a spun end type bottle to be rigidly mounted as close to the pipeline as possible. This minimizes the length of tubing from the discharge side of the pump to the sample bottle.

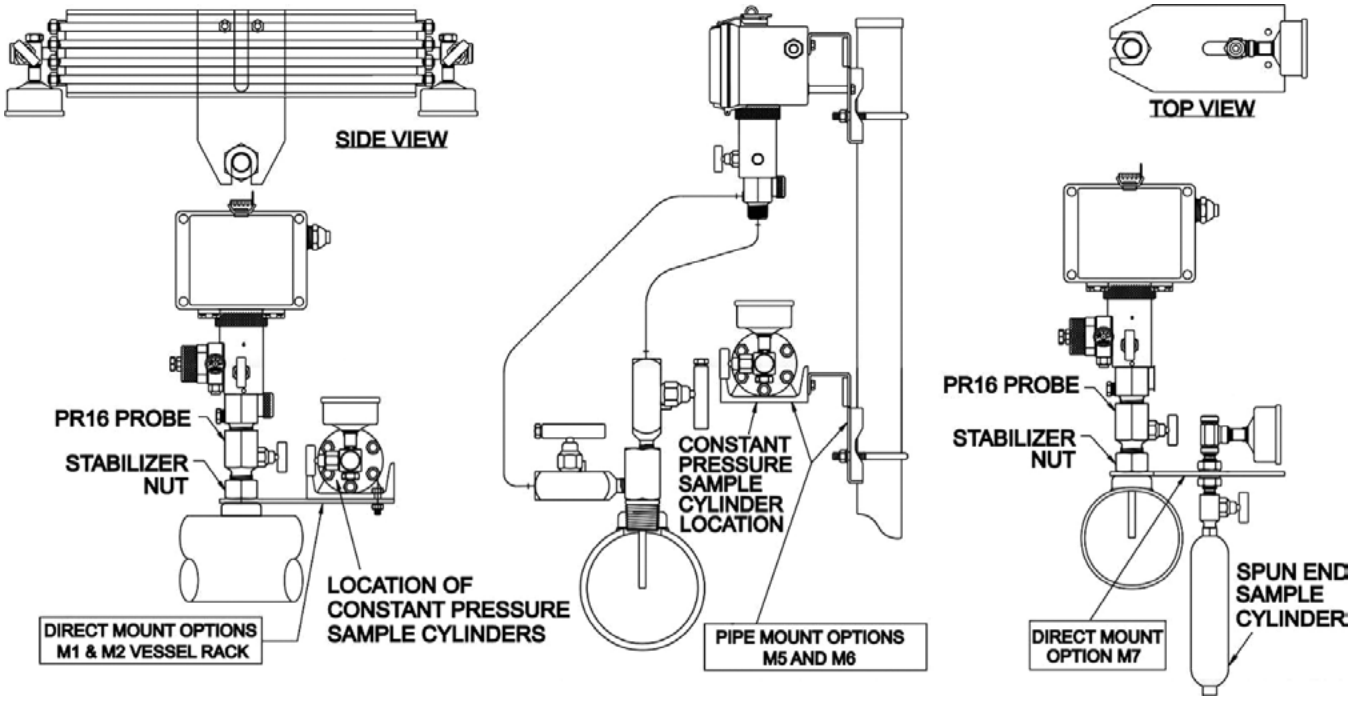

Figure 12: Optional Equipment Installation

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III. Operation Instructions

1.0 Mechanical Operation

1.1 Adjusting Bite Size (refer to Figure 13)

For samplers equipped with the adjustable bite size feature, the following procedure should be followed:

Remove pipeline pressure from sampler before proceeding. While holding the swivel fitting ④ in place, rotate bite adjustment screw ⑤ clockwise to decrease the bite size, or counter-clockwise to increase the bite size.

Note: Each rotation of the bite size adjustment screw ⑤ equals 0.04 cc volume change.

The bite size adjustment screw has calibrated grooves from 0 to 0.5 cc bite sizes in 0.1 cc increments. To select the proper bite size to fill a sample bottle in a 31 day period, refer to the sampling rate chart on page 24. Sampling periods shorter or longer than 31 days may be interpolated from this chart, as well. Refer to paragraphs 1.4 and 1.5 of this section, Bite Size vs. Sample Bottle Pressure, for additional instructions on individual pump styles PF1, PF2, and PF3.

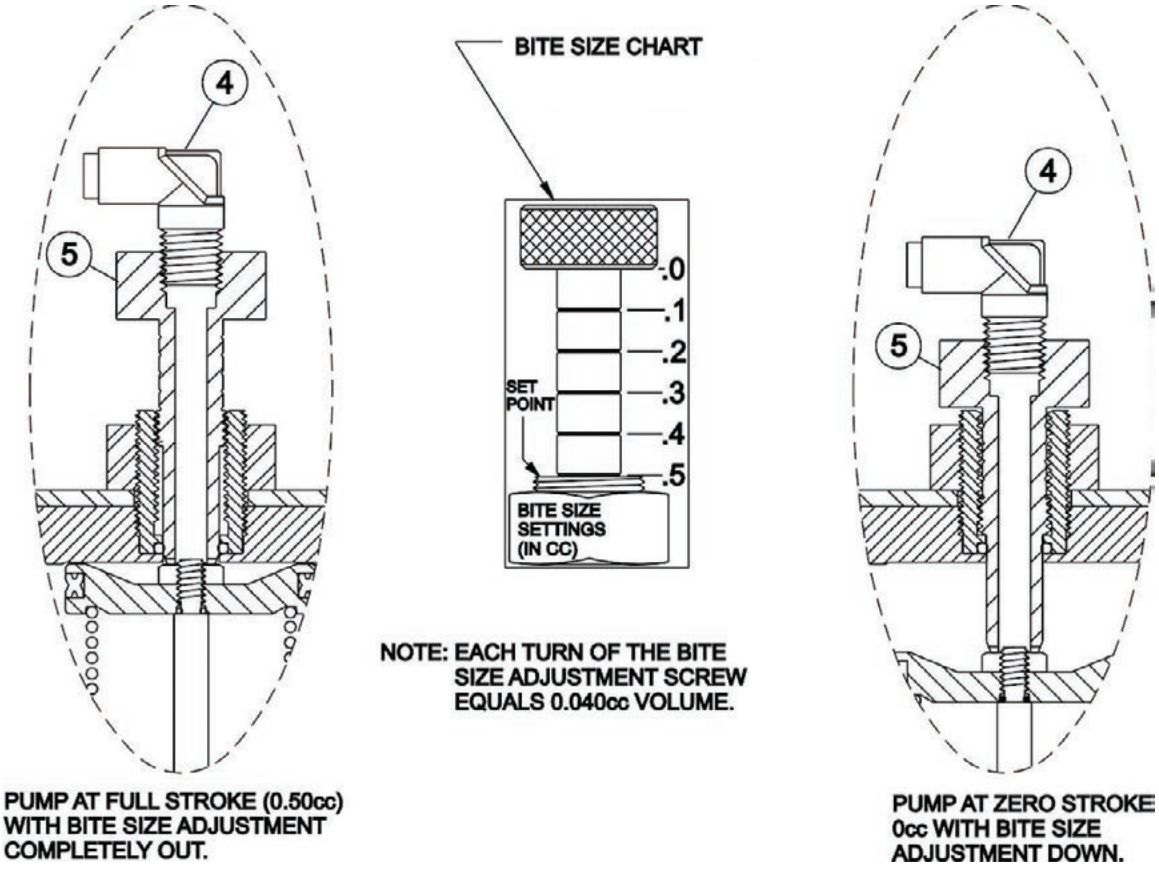

Figure 13: Adjjusting Bite Size

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1.2 Inspecting the Inlet Screen (refer to Figure 14)

Caution: Bleed all pipeline pressure from the Sampler before proceeding.

Remove the inlet screen housing ① by hand. The 40 micron screen ② and the screen spring ③ may now be removed and inspected for debris or particles deposited from the gas stream. It is recommended that the screen ② be inspected and cleaned at the end of each sample period. When reinstalling the 40 micron filter, verify that the orientation is correct. The open end of the filter screen should be facing into the pump.

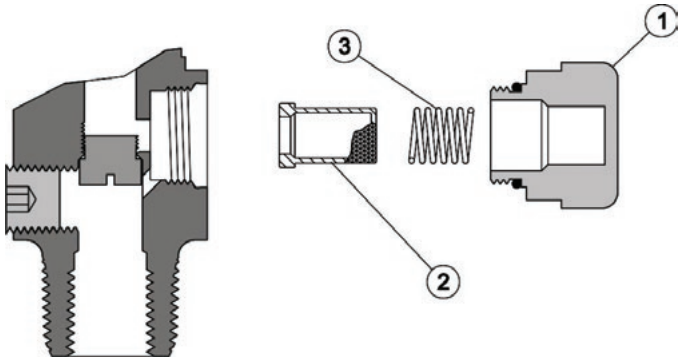

Figure 14: Inspecting the Inlet Screen

1.3 Dumping Regulator Condensate (refer to Figures 15 and 16)

For manual removal of condensate, loosen the regulator end cap ① counter-clockwise (CCW) one-half turn. This will allow condensate to discharge through the drain holes provided under the O-ring seal ② of the end cap. If the regulator is equipped with a continuous drain into a remote condensate bottle (as in Figure 16), open the valve on the bottle to discharge any condensate collected.

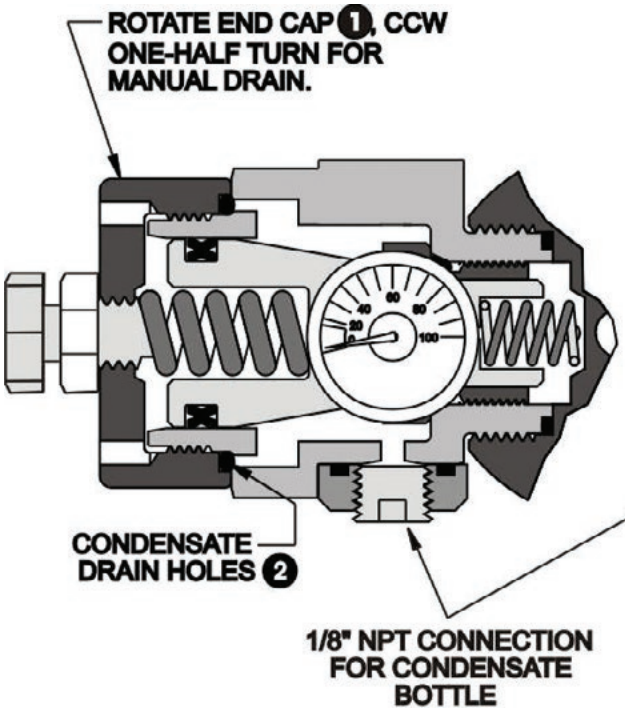

Figure 15: Dumping Regulator Condensate

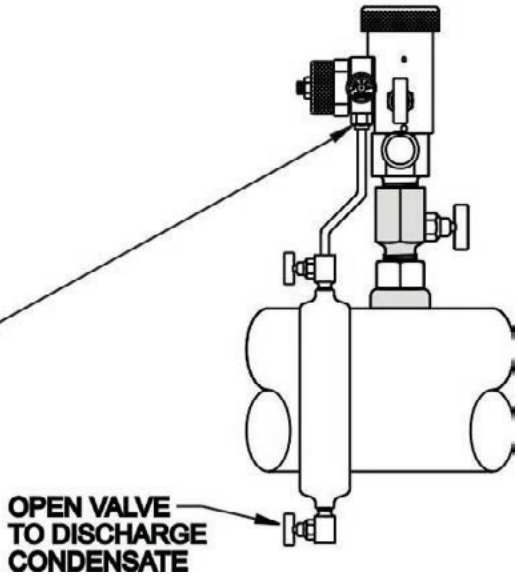

Figure 16: Dumping Regulator Condensate with Continuous Drain

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1.4 Pump Styles — Bite Size vs. Sample Bottle Pressure

A. PF1 Pump Style (refer to Figure 17)

These pump styles have an inlet pressure range from -10" Hg. to 90 psig. Since inlet pressures are low, they are equipped with a manually adjustable check spring at the sample outlet, rather than an automatic balance valve which is utilized in higher pressure range sample pumps. To achieve the maximu sample bottle pressure, the check spring can be set to match a specific inlet pressure range.

If the inlet pressure range is specified when the pumps are purchased, they will be tested and shipped with the factory settings listed below.

For Factory Setting -10" Hg. to 5 psig inlet pressures: 5 psig check spring setting (refer to Curve #1) — Pumps ranging from vacuum to low positive pressures must have 30 psig minimum instrument air to the actuator piston. **A .5 cc bite size is required.**
For Factory Setting 5 psig to 15 psig inlet pressures: 15 psig check spring setting (refer to Curve #2) — The actuator piston will be powered by the actual inlet line pressure of the system. **A .5 cc bite size is required.**
For Factory Setting 15 psig to 50 psig inlet pressures: 50 psig check spring setting with a .5 cc bite size (refer to Curve #3) — For applications where the inlet pressure does not fluctuate appreciably, the check spring setting can be customized to the exact inlet pressure, or slightly higher, and sample bites smaller than .5 cc can be taken. As an example, Curve #3 covers a range of 15 psig to 50 psig, with the check spring settings at 15, 35, and 50 psig instead of using the standard factory setting of 50 psig for all three inlet pressures. This allowed a .04 cc sample bite with inlet pressure to the piston actuator to build sample bottle pressure above line pressure to the values shown on the curve.
For Factory Setting 50 psig to 90 psig inlet pressures: 90 psig check spring setting with a .5 cc bite size (refer to Curve #4) — This curve shows sample bottle pressures attainable with a 90 psig spring check setting, and a bite size as small as .08 cc. Field customizing by setting the spring check to the exact inlet pressure or slightly higher will allow sample bottle pressures to build even higher.

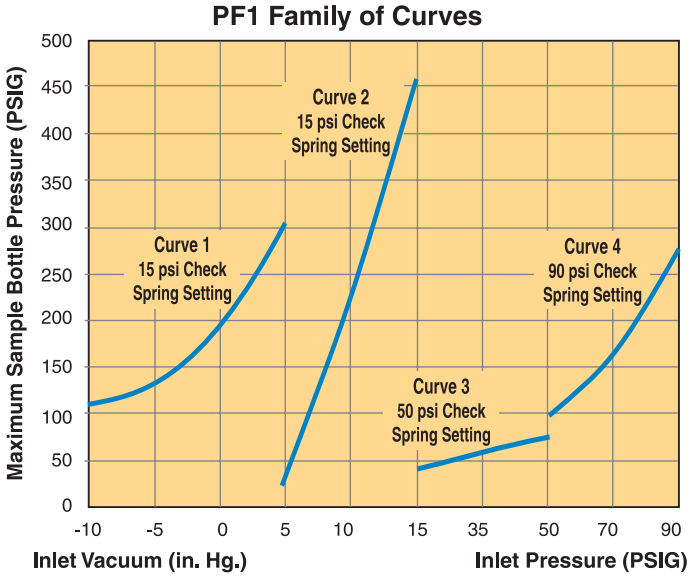

Figure 17: PF1 Family of Curves

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B. Procedure for Field Setting of Spring Check (refer to Figure 18)

Equipment required: 8" adjustable wrench, a small blade type screw driver, 1/4" NPT tubing fitting with a plastic or metal tube, and a cup of water.

a) Remove the spring check end cap ①, from the spring check housing ②.

b) Close the sampler purge valve ⑥.

c) Apply the “maximum inlet pressure expected” to the sampler inlet connection.

d) Connect the 1/4" NPT tubing fitting and the tube to the sample outlet port, and place the end of the tube in a cup of water.

If bubbles do not appear in the cup of water, turn the spring check adjustment screw ③ counter-clockwise until bubbles appear, then follow the procedure below.

If bubbles appear in the cup of water, turn the spring check adjustment screw ③ clockwise to compress the check spring ④ against the spring check poppet ⑤ until the bubbles cease.

Then turn adjustment screw an additional 1/4 turn.

e) Place your thumb over the end of the spring check housing ② to effect a seal and observe the cup of water.

If any bubbles appear, turn the adjustment screw an additional 1/4 turn, place your thumb over the end of the spring check housing ② and observe the cup of water.

f) After all bubbles have ceased, replace the spring check end cap ①, and allow the pump to stroke several times to ensure that bubbles do not appear between pump strokes.

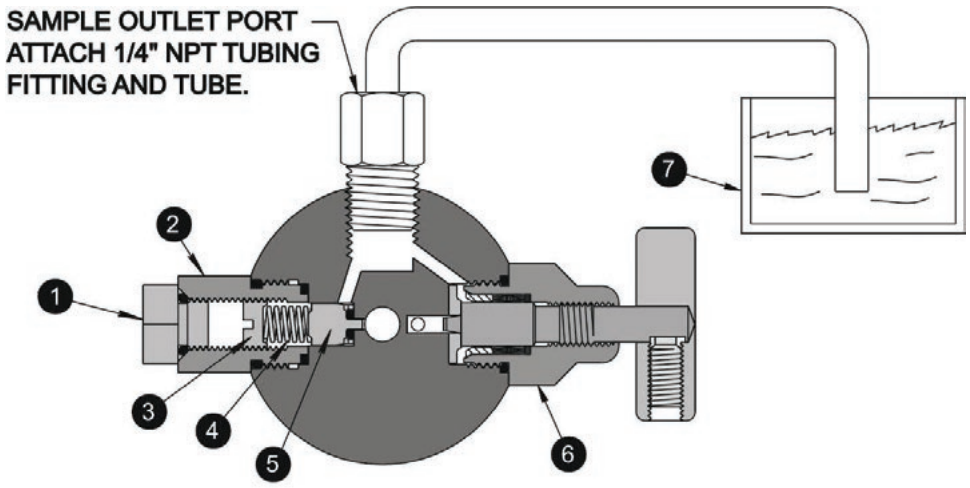

Figure 18: Field Setting of Spring Check

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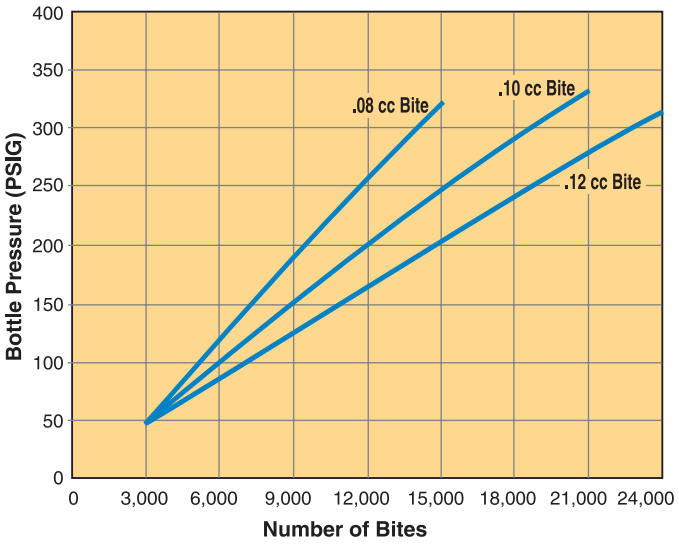
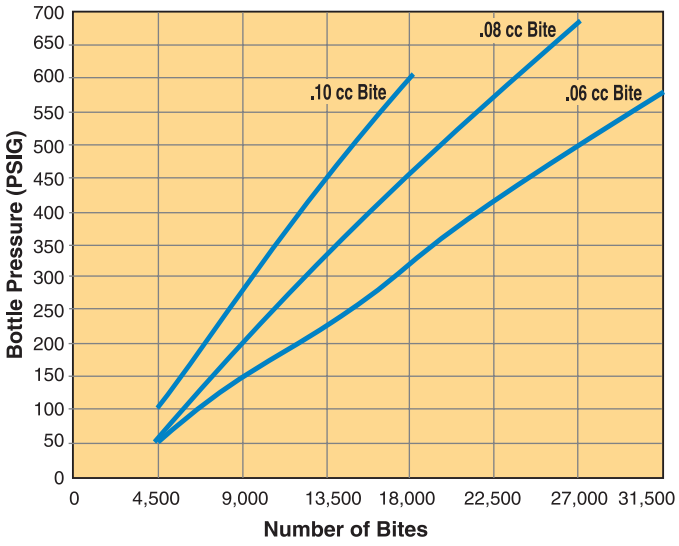
Curve 1
Sample Bottle Pressure vs. Number of Bites
200 psi Line Pressure with 1,000 cc Bottle



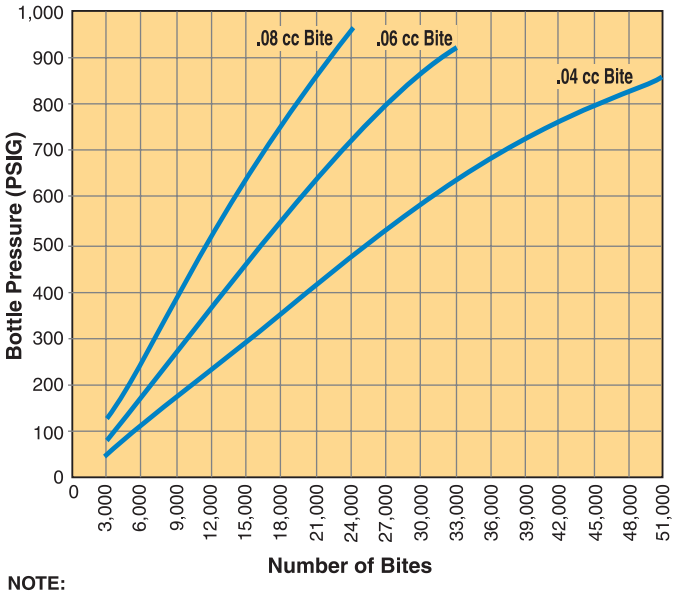
NOTE:
For bite sizes larger than .12 cc, refer to Sampling Rate in Minutes Chart.

Curve 2
Sample Bottle Pressure vs. Number of Bites
400 psi Line Pressure with 1,000 cc Bottle



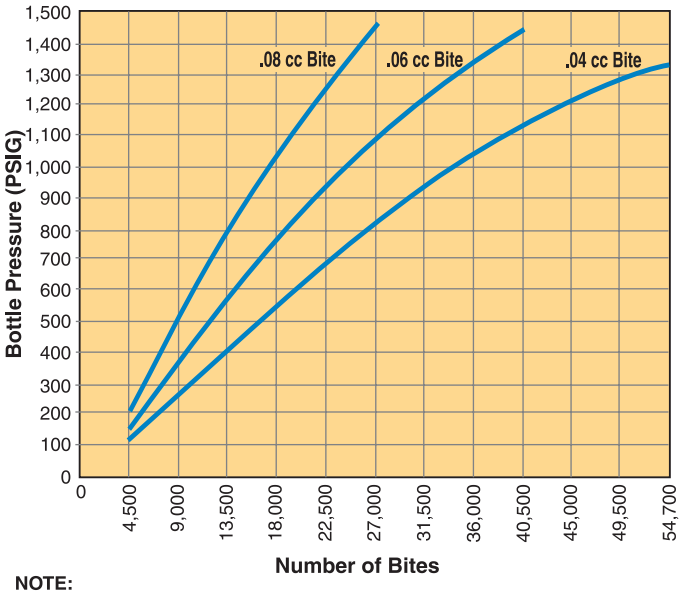
NOTE:
For bite sizes larger than .10 cc, refer to Sampling Rate in Minutes Chart.

Curve 3
Sample Bottle Pressure vs. Number of Bites
600 psi Line Pressure with 1,000 cc Bottle



NOTE:
For bite sizes larger than .08 cc, refer to Sampling Rate in Minutes Chart.

Curve 4
Sample Bottle Pressure vs. Number of Bites
800 psi Line Pressure with 1,000 cc Bottle



NOTE:
For bite sizes larger than .08 cc, refer to Sampling Rate in Minutes Chart.

Figure 19: Sample Bottle Pressure vs. Number of Bites Curves

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C. All PF2 Pump Style System Configurations (refer to Figure 20)

The PF2 pump styles have an inlet pressure range from 90 psig to 1480 psig.* A separate instrument air supply, (50 to 90 psig), is required to power the actuator piston. PF2 pump styles are equipped with a 40 micron inlet filter, which can easily be removed and cleaned, and an integral purge valve for sample bottle purging during change-out. An automatic balance valve compensates for fluctuating line pressures to ensure no bleed-up or bleed-down of the sample bottle will occur if line pressures change.

The sample bite size may be determined by using the fixed bite size nuts (in configurations A, B, and S), or may be adjustable anywhere from .04 cc to .5 cc in all other configurations. In addition, the PF2s can be electronically configured to sample time-based, from pulse inputs, or proportional to flow. Electronic configurations will also display the number of samples taken, the battery condition as a voltage reading, and provide the ability to take a test sample when desired.

* Pumps with Z3 option have inlet pressure range from 90 psig to 2200 psig.

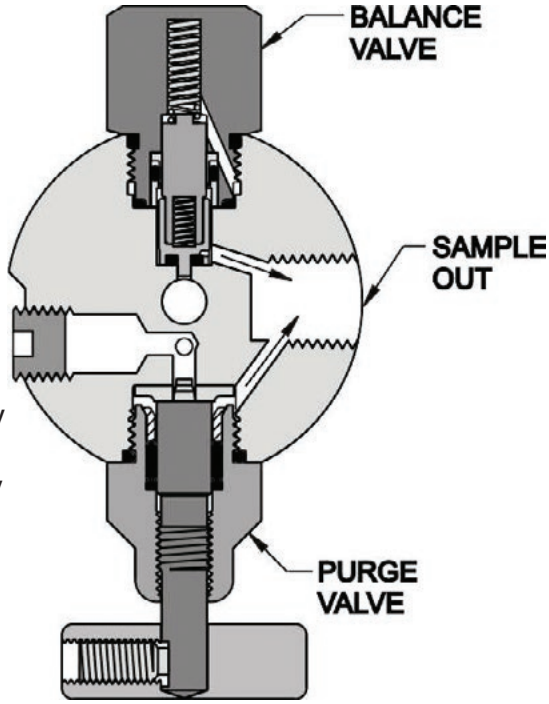

Figure 20: PF2 System Configurations

D. All PF3 Pump Style System Configurations (refer to Figure 21)

The PF3 pump styles have an inlet pressure range from 90 psig to 1480 psig.* An integral regulator automatically regulates pipeline inlet pressure from 50 to 95 psig and provides power to the solenoid actuated piston. Regulator pressure can be adjusted between 50 and 95 psig by loosening the lock nut ① and slowly turning the adjustment screw ② clockwise to increase pressure and counter-clockwise to decrease pressure. Regulated pressure can be read on the gauge ③.

Retighten the lock nut ① when the desired set pressure is indicated. **Note:** When increasing the set pressure, be careful not to pressure over 95 psig, as damage to the solenoid will result.

PF3 pump styles are equipped with a 40 micron inlet filter screen and an integral purge valve, for sample bottle purging during change-out. (See Figures 15 and 24, respectively, for maintenance instructions.) An automatic balance valve compensates for fluctuating line pressures to ensure no bleed-up or bleed-down of the sample bottle will occur if line pressures change. The sample bite size may be determined by using the fixed bite size nuts (in configurations A and B), or may be adjustable anywhere from .04 cc to .5 cc (in configurations A, B, and S). In addition, the PF3s can be

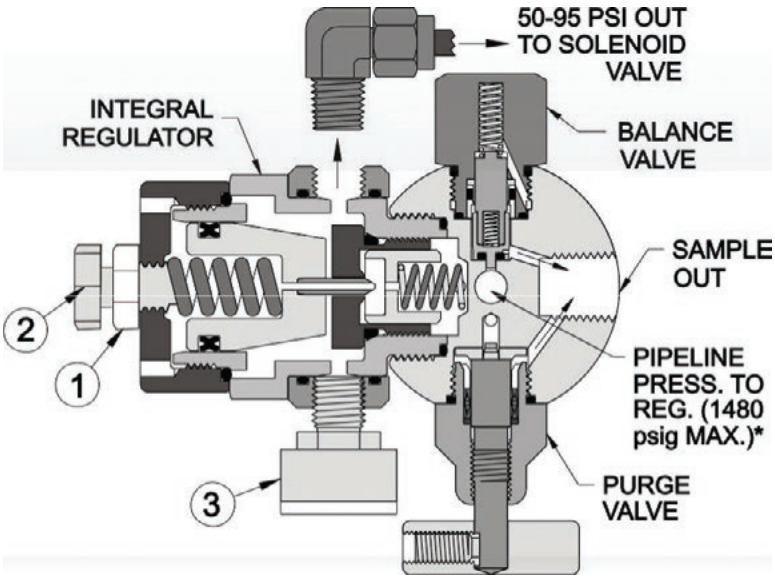

Figure 21: PF2 System Configurations

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electronically configured to sample time-based or proportional to flow. Electronic configurations will also display the number of samples taken, the battery condition as a voltage reading, and provide the ability to take a test sample when desired.

* Pumps with Z2 option have inlet pressure range from 90 psig to 2200 psig.

1.5 Bite Size vs. Sample Bottle Pressure for Pump Styles PF2 and PF3

[Refer to our Sampler Configuration Software]

Time-Based Sampling using the Sampling Rate Chart (refer to Figure 22)

The standard procedure for calculating the time to fill a sample bottle to line pressure for a specific sample period is as follows:

Example: To fill a 1000 cc sample bottle over a 31-day period at .2 cc per bite:

(a) 1000 cc bottle x 1 bite ÷ .2 cc = 5000 total bites

(b) 44,640 (minutes in 31 days) ÷ 5000 total bites = 8 min. 56 sec.
(See Sampling Rate Chart for 1000 cc bottle)

The minimum bite sizes for a specific line pressure range that will fill a sample bottle to line pressure per the above calculated example are shown below.

Line Pressure Range (psig)	Min. Bite Size (cc)
200 – 399	.14
400 – 599	.12
600 – 799	.12
800 – 899	.10
900 – 999	.08
1000 – 1480	(.08 – .04)
1481 – 2200	.04

Figure 22: Sampling Rate Chart

Sample Rate in Minutes for Vessel Indication 31-Day Sampling Period						
Sample Pump Displacement per Stroke	300 cc		500 cc		1000 cc	
(cc)	Min.	Sec.	Min.	Sec.	Min.	Sec.
.100	14	53	8	56	4	28
.200	29	46	17	51	8	56
.300	44	38	26	47	13	24
.400	59	31	35	43	17	51
.500	74	24	44	38	22	19

For sampling applications where it is desired to take samples more frequently with smaller bite sizes than the minimum and still have the sample bottle at line pressure at the end of the sampling period, please refer to the PF1 family of curves in Section III, ¶ 1.4. These curves represent actual tests conducted with nitrogen as a supply source. They can be used to determine the number of bites required to reach a given sample bottle pressure (1000 cc), at less than the minimum bite settings.

Note: When using a 500 cc bottle, divide the number of bites by 2.
When using a 300 cc bottle, divide the number of bites by 3, etc.

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2.0 Electrical Operation

2.1 Power Switch

The power switch is used to disable the G6000 controller while sample bottles are being exchanged or while doing pump repairs. The event clock will continue to keep time even while the power switch is in the OFF or down position, but all other functions will be disabled to conserve power.

When power is switched to the 'ON' or up position, the controller will read the configuration settings from memory and reset the controller to begin sampling. After the 'power on' sequence, the G6000 will default to the Run mode and begin taking samples based on the current settings. The Preset counter and Samples Taken counter will not be reset and will have their previous values. If a new sample bottle is installed, these counters should be reset.

2.2 Resetting Counters

To reset the Preset counter and Samples Taken counter using the G6000 keypad, enter the following selections from the main menu;

Reset ↵ Counters ↵ Run

2.3 Displaying Battery Voltage

With the preset count on the top line of the display, press one of the arrow keys to change the value displayed on the bottom line. Use the DOWN or RIGHT arrow to sequence forward through the available values, and the UP or LEFT arrow to step back through the available values. Press an arrow key until the battery value appears on the bottom line of the G6000 display.

2.4 Time-Based Samples

When the G6000 controller is configured for time-based samples, the controller will wait a predetermined and fixed time between samples. In this mode, the rate controller functions as a countdown timer. When the time counts down to zero, a sample is taken regardless of flow conditions, and the time resets.

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2.5 Configuring for Time-Based Samples

Before the controller can be setup, a preset value, representing the amount of time between samples, must be determined. The preset should be based on the number of samples that need to be taken over the sample period, the size of the sample vessel, and the bite size of each sample.

The following information is required to calculate the bite size and number of counts between samples:

Vc = Volume of the sample cylinder (i.e. 150 cc, 300 cc, 500 cc, 800 cc or 1000 cc)
T = Number of days in the sample period
Vd = Maximum daily flow at 100% flow rate
Va = Average daily flow
Vs = Gas volume between samples
F = Constant = 100 Hz x 60 sec. x 60 min. x 24 hr. = 8,640,000
Bs = Sample bite size in cc
Cs = Counts between samples (counts / sample)

Note: The units of measure for Vd, Va, and Vs must be the same (i.e. mmcf or mcf).

Formulas

1. Calculate bite size **Bs = (Vc x Vs) ÷ (Vd x T)**
2. Calculate counts / sample **Cs = ((Vs x Va) x F)) ÷ Vd^2**

Example:
Vc = 500 cc
T = 31 days
Vs = 2 mmcf
Vd = 115 mmcfd
Va = 90 mmcf
Bs = (500 cc x 2 mmcf) ÷ (115 mmcfd x 31 days) = 0.28 cc
= 1000 ÷ 3565 = 0.28 cc

Note: The Interceptor™ gas sampler has a maximum bite size of 0.5 cc

Cs = ((2 mmcf x 90 mmcfd) x 8,640,000)) ÷ $(115\ mmcfd)^2$ = 117,595 counts / sample
= (180 x 8,640,000) ÷ 13225 = 117,595 counts / sample
= 1,555,200,000 ÷ 13225 = 117,595 counts / sample

The Sampler Tools software can also be used to determine the preset value for a specific configuration.

To setup the G6000 controller for time based sampling using the keypad, enter the following from the main menu: Setup ↵ Rate ↵ Time ↵

(Enter the Preset value in Hours:Minutes:Seconds) ↵

Sample for 1 second (Enter the number of seconds to hold the pump actuator, usually 1 second for the Interceptor™ pumps) ↵

ESD Latched? (Yes / No) ↵

Max Samples (Enter the maximum number of samples in the sample period or enter 999999 to disable this feature) ↵

Stop at Max? (If yes, the sampler will stop when the Max Samples count is equal to the number of samples taken) ↵

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2.6 Flow-Based Samples

The G6000 controller can be configured to automatically adjust the delay between samples to be proportional to a flow rate. This method will produce a sample that is more representative of the product flowing throughout the sample period. Slower flow rates will produce fewer samples and higher flow rates will automatically increase the number of samples taken. The controller can be set to automatically stop taking samples if the flow stops.

The G6000 controller will need flow rate information from an external device. Flow information can be from several possible sources. The most commmon method is voltage pulses from a flow computer that are proportional to the average daily flow rate. Signals of 1-5 volts and 4-20mA are also programmable.

2.7 Analog Flow Rate (1-5V or 4-20mA)

When the flow input is from a current source, a 250 ohm resistor must be connected across the FLOW terminals 5 and 6 on the G6000 controller. The resistor will convert the current into a 1 to 5 volt signal. The G6000 controller scales the 1 to 5 volts to 0 to 100 percent. To scale the pulse rate, the 'percent of flow' is subtracted from the preset at a one second interval. For example, if the flow input voltage is 3 volts, the flow percent will be 50%. At one second intervals, as long as the flow remains at 50%, a count of 50 will be subtracted from the preset. When the preset counts down to zero, a sample is taken and the preset count is reloaded. 25% flow would reduce the preset by 25 counts per second, and so on.

2.8 Square Root Extraction

If the flow signal is provided from a differential pressure transmitter, the G6000 can extract the square root of the flow voltage/current to produce a linear flow value. When square root extraction is enabled, the G6000 will take the square root of the 1 to 5 volt flow signal and then scale it to 0 to 100%. The voltage or current displayed on the bottom line of the G6000, and using the Sampler Tools software, is the actual measured voltage/current before taking the square root.

2.9 Digital Flow Rate (Pulses)

When the G6000 controller is configured for flow pulses, the flow input is reconfigured as a voltage detector with an adjustable trigger level. As the input goes above this trigger level, the controller counts this as a pulse. The flow pulse voltage must then go below the trigger level to reset the detector for the next pulse.

The pulse source can be from a dry contact closure, an open collector, or a voltage source. For dry contact and open collector sources, the G6000 provides a slight pull-up current and an external power source is not needed.

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2.10 Configuring for Flow-Based Samples

Before the controller can be setup, a preset value representing the amount of time between samples must be determined. In addition to the method outlined below, the Sampler Tools software can simplify this process.

To setup the G6000 controller for flow-based sampling using the keypad, enter the following from the main menu:

Setup ↵ Rate ↵ Flow ↵

Pulse (select trigger level) ↵

0.5 V
1.5 V
2.5 V
5.0 V

V ↵

Square Root? (Yes / No) ↵

mA ↵

Square Root? (Yes / No) ↵

Flow Preset

(Enter the Preset value – typically 1 for most flow-based applications) ↵

Sample For 1 second (Enter the number of seconds to hold the pump actuator – usually 1 second for the Interceptor™ pumps) ↵

ESD Latched? (Yes / No) ↵

Max Samples (Enter the maximum number of samples in the sample period or enter 999999 to disable this feature) ↵

Stop at Max? (If yes, the sampler will stop when the Max Samples count is equal to the number of samples taken) ↵

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3.0 Start-Up and Sample Bottle Change Out Procedure – All Pump Styles and Mountings

3.1 Start-Up Procedure (refer to Figure 23)

1. Close the sampler purge valve ①.
2. Open the pipeline probe valve ② (or valves, in the case of a dual flow probe).
3. When using a spun end sample bottle, connect the inlet side of the bottle to the 1/4" NPT sample out connection Ⓐ of the sampler.

Note: GPA recommends that the sample bottle be mounted in the vertical position.

When using a constant pressure sample cylinder, connect the product side of the cylinder to the 1/4" NPT sample out connection Ⓐ of the sampler. The pre-charged side of the sample cylinder must either contain a compressed gas or be connected to a compressed gas source.

Note: When using option Z8, it will be piped to the 1/4" NPT sample out connection Ⓐ and allows a short pumping test to verify that the sampler is building pressure into a gauge prior to commencing sample collection. Option M7 with option Z8 provides the pumping test capability plus a ridged mounting.

Purging the System

Spun End Sample Bottle – Open the sample bottle inlet valve ③. Open the sampler purge valve ① and pressure up the sample bottle and all piping. Use a liquid leak detector (Parker PHinder) on all fittings and threaded connections to check for leaks. Open the sample bottle purge valve ④, allowing new gas to purge the system. Close the sampler purge valve ①. Close the sample bottle purge valve ④ after all gas flow ceases. The system is now ready for a fresh sample to be taken.

Constant Pressure Sample Cylinder – Open the sample cylinder product inlet valve ⑤. Open the sampler purge valve ① and pressure up the product side of the sample cylinder and all piping. Use a liquid leak detector (Parker PHinder) on all fittings and threaded connections to check for leaks.

Note: If the sample cylinder is equipped with a product purge valve ⑥ (located on the face of one or both of the end caps), open the valve and allow fresh gas to purge all piping. If the sample cylinder does not have a product purge valve, loosen the tubing fitting at the sample cylinder inlet valve ⑤ and allow fresh gas to purge all piping. Close the sampler purge valve ①. Close the product purge valve ⑥, or retighten the tubing fitting after all gas flow ceases. The system is now ready for a fresh sample to be taken.

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3.2 Bottle Change-Out Procedure (refer to Figure 23)

1. Close the probe valve ②.
2. Close the sample cylinder inlet valve ③. Remove the tubing fitting at the sample cylinder inlet valve slowly to bleed all pressure in the tubing.
3. Follow the start-up procedure above.

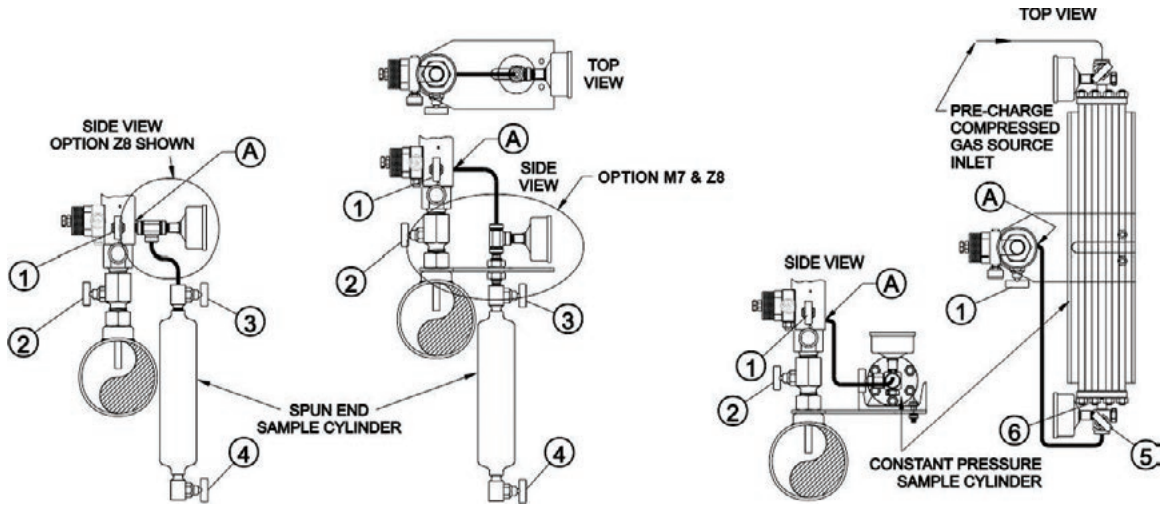

Figure 23: Bottle Change-Out Procedure

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IV. Maintenance Instructions

1.0 General Maintenance

1.1 Purge the System (refer to Figure 24)

Prior to servicing the Interceptor™ , the sample line must be purged in the sequence listed below.

Note: Each of the valves referenced here are equipped with a right-hand thread. Turn clockwise to close and counter-clockwise to open.

1. Close the top cylinder valve ①.
2. Close the probe valve ②.
3. Open the purge valve ③.
4. Open bleed valve ④.

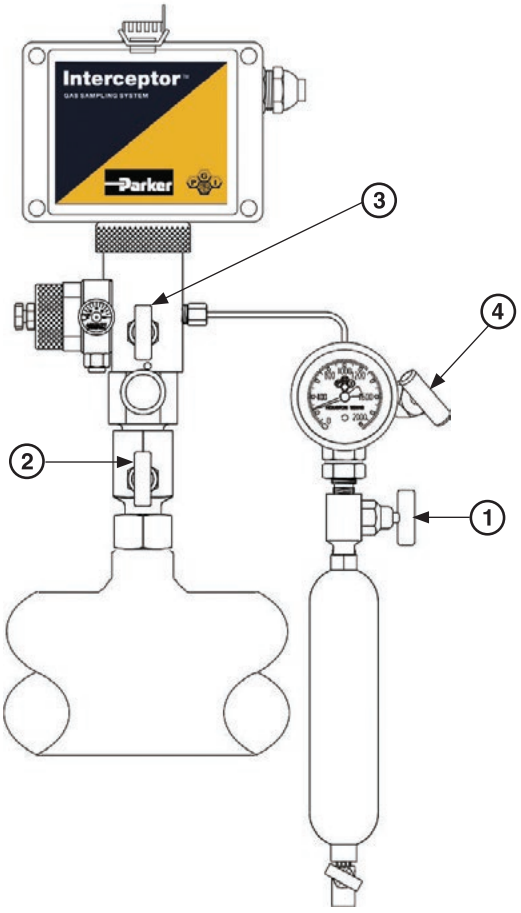

Figure 24: Purging the System

1.2 Replacement of the Purge Valve Seat (refer to Figure 25)

1. Purge the system as shown in step 1.1 and Figure 25.
2. Remove the purge valve bonnet and stem assembly ① (located at ③ in Figure 25), using a 3/4" hex wrench.
3. Remove the seat ② from the seat pocket.
4. Replace the seat ② and the O-ring ③. **Note:** See Figure 20 for seat orientation.
5. Reinstall the purge valve bonnet and stem assembly into the pump body and tighten using the wrench.
6. Close the purge valve prior to returning to service.

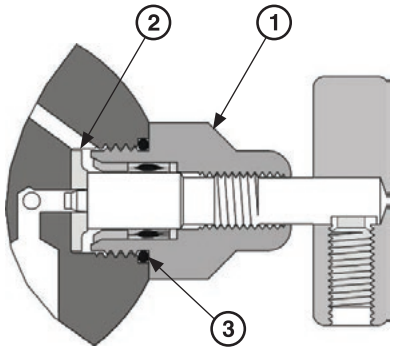

Figure 25: Replacement of the Purge Valve Seat

Service Kit Numbers for Purge Valve Seat	
Kit Number	**Seat Material**
SK-PF-14	Tefzel®
SK-PF-17	Acetal (std.)
SK-PF-18	Kel-F®

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1.3 Inspection/Repair of the Outlet Spring Check (refer to Figure 26)

Seal Kit Number SK-PF-08 (PF1 only)

Note: Lubricate all O-rings with a non-petroleum based synthetic lubricant.

Removal Procedure (refer to Figures 26 & 27)

1. Purge the system as shown in step 1.1 and Figure 24.
2. Locate the spring check and remove the housing ①, using a 3/4" hex wrench.
3. Remove the spring ② and the poppet ③.

WARNING! Eye protection must be worn before removing the poppet ③.

An easy method to remove the poppet, is to place the palm of your hand over the open spring check pocket and ***slowly*** open the pipeline probe valve to allow pressure to the pump. This will dislodge the poppet against the palm of your hand.

4. Inspect the exposed surface of the poppet O-ring ④ using a loupe or a magnifying glass for solid particles, cuts or abrasions on the sealing surface. **Proper inspection can not be done with the un-aided eye.** Replace the O-ring if cuts and abrasions are found.
5. Remove the end cap ⑤ and the end cap O-ring ⑥.

   DO NOT remove the adjustment screw ⑦. (The adjustment screw is preset at the factory and further adjustment should not be required. If an adjustment is necessary, refer to Section III, paragraph 1.4B for adjusting instructions from vacuum to 90 psig service.)
6. Remove O-rings ⑧ and ⑨. Replace the O-rings if cuts or abrasions are found.

   Note: It is possible that simply cleaning the sealing surface would be enough to allow the O-rings to once again seal properly.

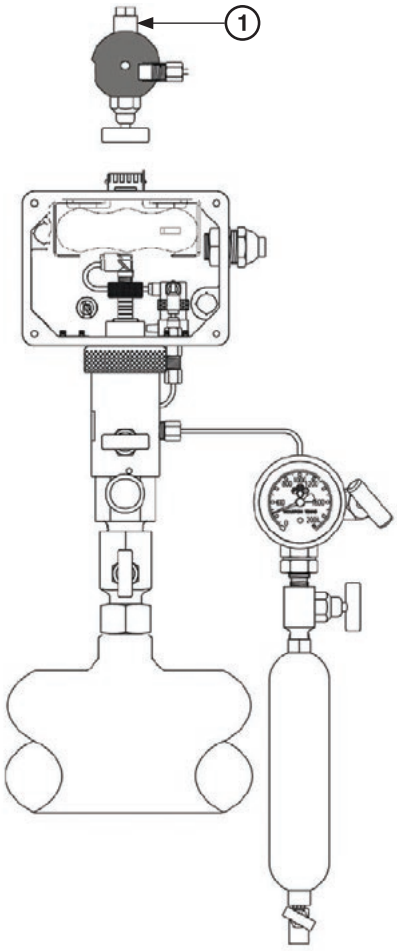

Figure 26: Inspection/Repair of the Outlet Spring Check

Replacement Procedure (refer to Figure 27)

Note: Lubricate all O-rings with a non-petroleum based synthetic lubricant.

1. Use a cotton swab to clean the spring check pocket at Ⓐ to remove old grease and/or debris.
2. With the O-ring ④ installed in the poppet ③ and pointed downward, place the poppet into the spring check pocket.
3. Place O-ring ⑨ into the pump body.
4. Replace O-ring ⑧ on the housing ①.
5. Place the spring ② into the housing and install into the pump body and tighten with a 3/4" hex wrench.
6. Replace the end cap O-ring ⑥ and install the end cap ⑤ into the housing.

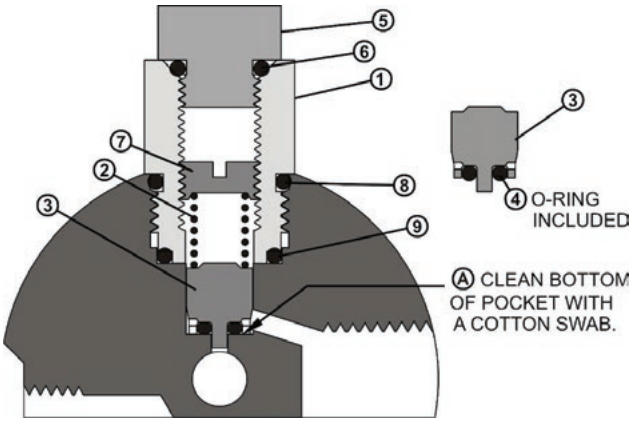

Figure 27: Outlet Spring Replacement

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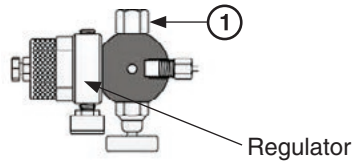
1.4 Replacement of the Balance Valve Assembly (refer to Figure 28)

The balance valve ① is not field-repairable and must be replaced as a complete assembly. Each balance valve is assembled and bench-tested to verify that it functions properly prior to being packaged for shipment.



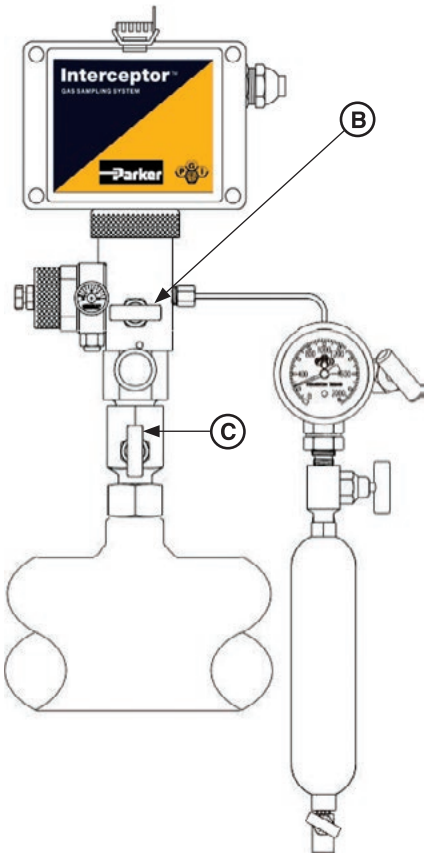


Figure 28: Replacement of Balance Valve Assembly

Removal Procedure (refer to Figure 29)

1. Purge the system as shown in step 1.1 and Figure 24.
2. Remove the balance valve assembly ①, using a 3/4" hex wrench.
3. The poppet and O-ring assembly ② may remain inside the pump body pocket, and should be removed with a cotton swap or other soft object.

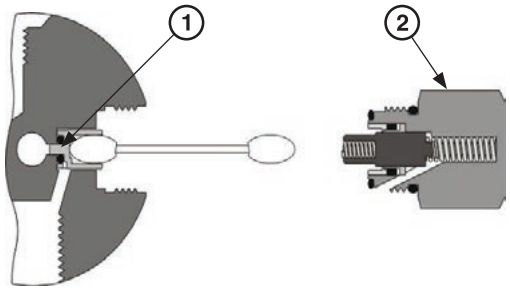


Figure 29: Removal of Balance Valve Assembly

4. Using a loupe or magnifying glass, inspect the poppet O-ring for solid particles, cuts and/or abrasions on the sealing surface. **Proper inspection can not be done with the un-aided eye.** If flaws are found on the poppet and O-ring assembly, replacement will be necessary (Kit Number SK-PF-07). It is possible that simply cleaning the sealing surface would be enough to allow the assembly to once again seal properly.

Replacement Procedure (refer to Figure 30)

1. Use a cotton swab to clean the pump body pocket at Ⓐ.
2. With the poppet and O-ring assembly ② installed over the piston ③ and the piston spring ④, and with O-ring ⑤ in place, carefully install the complete balance valve assembly into the pump body and tighten against the body with the 3/4" hex wrench.
3. Close the purge valve (Ⓑ in Figure 28), then open the Probe Valve (Ⓒ in Figure 28).
4. Take several test samples to verify proper installation of the balance valve.

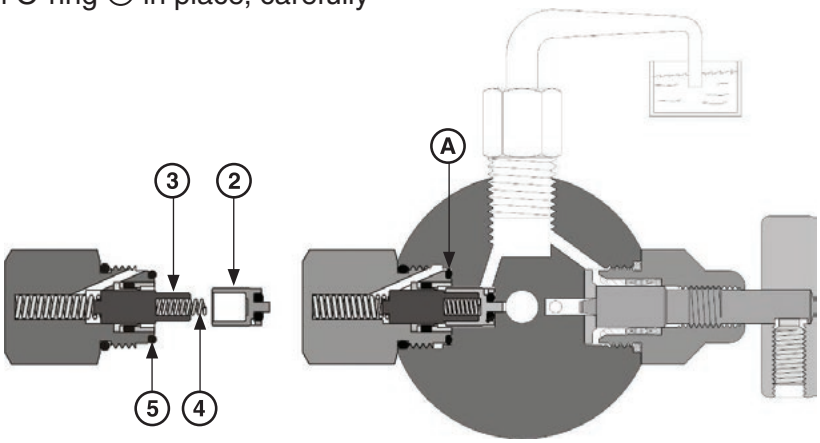


Figure 30: Replacement of Balance Valve Assembly

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1.5 Inspection/Repair of Integral Regulator (refer to Figure 32)

Seal Kit Number SK-PF-09

1. Purge the system as shown in step 1.1 and Figure 24.
2. Locate the regulator and remove the end cap ① by hand.
3. Remove the piston spring ②.
4. To remove the piston ③, insert a small-blade screwdriver into the removal groove Ⓐ and pull outward.
5. Remove the relief nut ④ by turning counter-clockwise with a large-blade screwdriver.
6. Remove the dart ⑤ and dart spring ⑥.
7. To remove the dart seat ⑦, straighten a paperclip and insert one end through the seat removal hole Ⓑ.

Inspection of the Dart Seat

Use a loupe or a magnifying glass to inspect the main seat area (around the conical indentation) and the relief rod seat area (inside the conical indentation). Both areas should exhibit a smooth contact area with the relief nut ④ and the relief rod ⑧. The dart seat should be replaced if any wear or imperfections exist.

Replacement Procedure

Note: Lubricate all O-Rings with a non-petroleum based synthetic lubricant.

1. Replace O-ring ⑨ on the relief nut ④.
2. Assemble the dart ⑤, dart seat ⑦, and dart spring ⑥ into the relief nut as shown at right.
3. Install the relief nut ④ into the regulator body, using a large, flat blade screwdriver.
4. Replace the quad ring ⑩ and install the piston ③ into the regulator body.
5. Install the piston spring ② into the piston ③.
6. Loosen the lock nut ⑪ and remove the adjusting screw ⑫ from the end cap ①.
7. Replace O-ring ⑬ on the end cap and install the end cap to the regulator body hand-tight. Slowly open the probe valve (② in Figure 24).

   Note: When increasing the set pressure, be careful not to over-pressure above 90 psig, as damage to the solenoid will result.
8. Re-install the adjusting screw ⑫ and slowly set to the desired pressure (typically 90 PSI).
9. Tighten the lock nut ⑪ with a wrench after the pressure has been set.

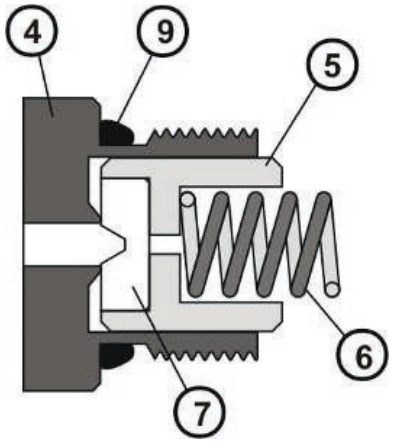

Figure 31: Replacing Integral Regulator

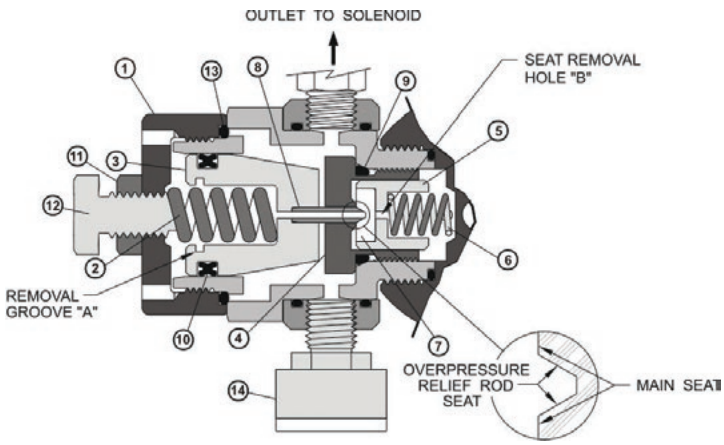

Figure 32: Replacing the Integral Regulator

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1.6 Inspection/Replacement of Inlet Check Valve O-Ring (refer to Figure 33)

Seal Kit Number SK-PF-12

Removal Procedure

1. Purge the system as shown in step 1.1 and Figure 24.
2. Use a 3/32" hex socket wrench to back out the set screw ① until about 1/4" of it is visible outside the pump body ②.
3. By hand, turn the pump body ② counter-clockwise until it is removed from the lower body ③.
4. Remove the inlet diverter plug ④ from the lower body ③ using a flat blade screwdriver.
5. Place a 1/4" nut driver onto the nut at the bottom of the inlet check ⑤ and push upward to expose the O-ring ⑥.
6. Remove the O-ring ⑥ by rolling it over the flange of the inlet check.
7. Remove O-rings ⑦ and ⑧ from the lower body.

Replacement Procedure

Note: Lubricate all O-rings with a non-petroleum based synthetic lubricant.

1. Remove any old grease and debris from all O-ring grooves and sealing surfaces.
2. Lubricate O-ring ⑥ and stretch it over the top flange of the inlet check, while using the 1/4" nutdriver to raise the inlet check.
3. Reinstall the inlet diverter plug ④ and tighten with the flat blade screwdriver.
4. Lubricate and install O-rings ⑦ and ⑧.
5. Reinstall the pump body ② to the lower body ③, hand-tight.
6. Tighten the set screw ① with the 3/32" hex socket wrench.

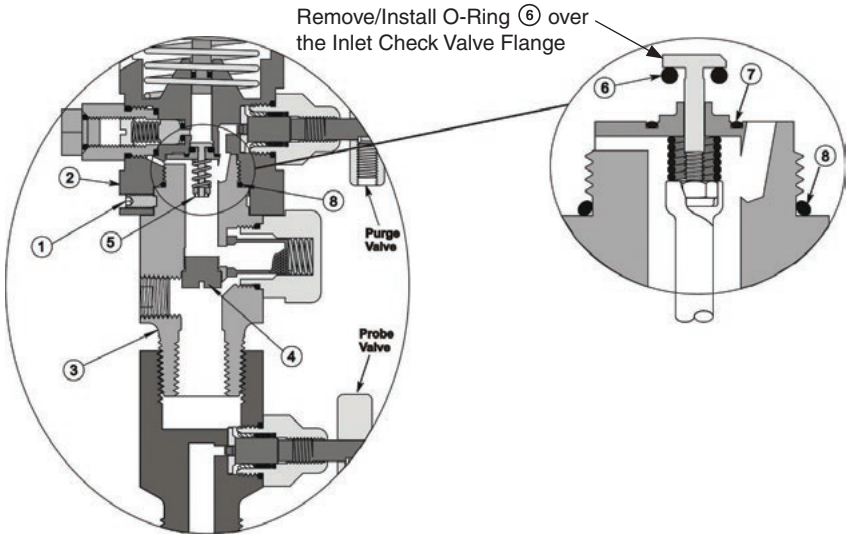

Figure 33: Inlet Check Valve O-Ring Replacement

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1.7 Inspection/Replacement of Inlet Screen (refer to Figure 34)

Inlet Strainer Kit: SK-PF-13

Removal Procedure

1. Purge the system as shown in step 1.1 and Figure 24.
2. Remove the inlet screen housing ① by hand.
3. Remove the 40 micron screen ② and the screen spring ③ and inspect them for debris and particles deposited from the gas stream.
4. Use a non-petroleum based cleaner and blow out the screen with compressed air.
5. When reinstalling the filter screen make sure that the open end of the filter is facing towards the pump body.

It is recommended that the screen be inspected at the end of each sample period.

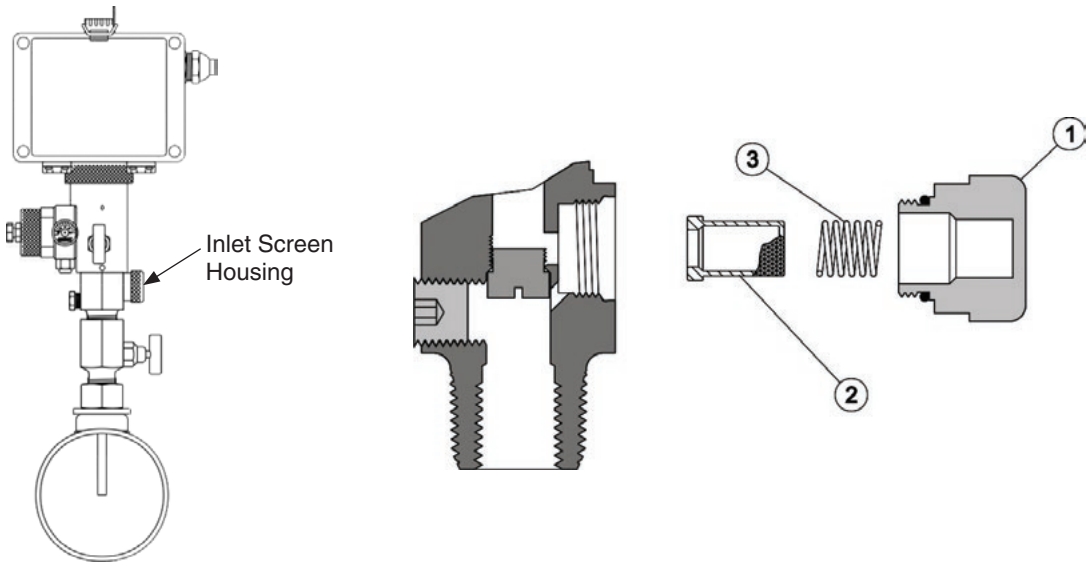

Figure 34: Replacement of Inlet Screen Housing

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1.8 Inspection of Actuator and Pump Rod Seals or Stroke Adjustment Nut

Pump Style	Seal Kit Number
PF1	SK-PF-10 – or – complete rebuild kit SK-PF-01
PF2	SK-PF-10 – or – complete rebuild kit SK-PF-02
PF3	SK-PF-11 – or – complete rebuild kit SK-PF-03

Removal Procedure (Refer to Figure 35)

1. Purge the system as shown in step 1.1 and Figure 24.
2. Disassemble the solenoid valve ① by removing tubing sections ② and ③. To remove the tubing, depress the fitting caps on fittings ④ and ⑤ and gently pull from the tubing.

   For Pumps with the 'Z1' Option:
   Remove Fitting Nuts ⑬ and ⑭ to remove the 1/8" stainless steel tubing, then remove the solenoid.
3. The next two steps require that you create an airtight seal over the piston stroke inspection hole Ⓐ and the moisture drain hole Ⓑ using your thumb. Hold this seal until completing step 5. When the seal is broken, the piston and the pump rod will be pushed upward from the pump body.
4. With the seal in effect, remove the end cap ⑥ by hand, turning counter-clockwise.
5. Now place the palm of your other hand over the top of the piston ⑦ and remove your thumb. The piston and the pump rod ⑧ will now be released from the pump body ⑨.
6. Remove the stroke adjustment nut ⑩ using a 1/2" hex wrench.
7. Unscrew the piston ⑦ from the pump rod ⑧.
8. Remove the quad ring ⑪ from the piston, and the O-ring ⑫ from the end cap ⑥.

Note: The pump rod seal kit includes a new pump rod with the seals installed.

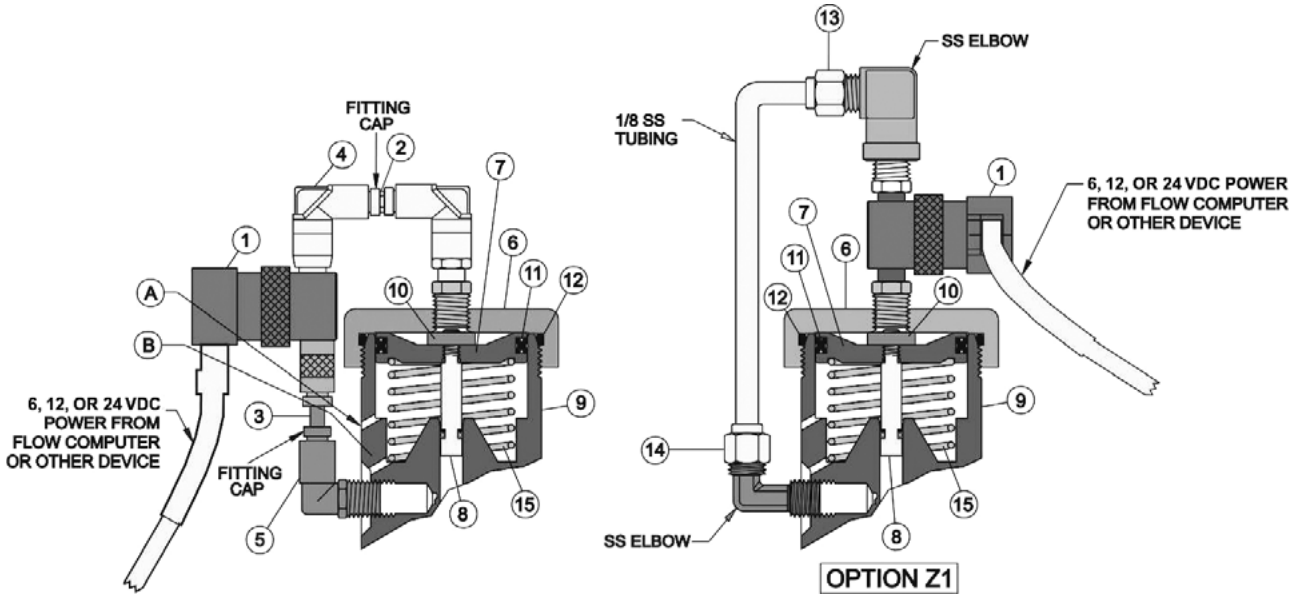

Figure 35: Inspection of Actuator and Pump Rod Seals or Stroke Adjustment Nut

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1.9 Replacement of Actuator and Pump Rod Seals or Stroke Adjustment Nut

Reassembly Procedure (refer to Figure 36)

1. Thread the pump rod ⑧ into the piston ⑦ by hand until it is snug.
2. Install the desired stroke adjustment nut ⑩ and tighten it against the piston with a 1/2" hex wrench.

   Note: All samplers with system configuration A, B, or S are shipped with a .5 cc stroke adjustment nut as standard. Stroke Adjustment Nut Kit # PF-5036 includes four additional bite size nuts: .1 cc, .2 cc, .3 cc, and .4 cc sample sizes (see Figure 35).
3. Place the piston spring ⑮ into the pump body.
4. Place the piston ⑦ and the pump rod assembly on top of the piston spring.
5. Gently press the piston about 1/4" into the actuator bore. As the piston and spring are being pressed into the bore, the pump rod seal and back-up ring will enter the pump body bore. This motion must be done straight down and evenly to ensure that the seals are not damaged.
6. While holding the piston in the bore, place your thumb over the **piston stroke inspection hole** Ⓐ and the **moisture drain hole** Ⓑ, creating an airtight seal. (Holding this seal will effect a vacuum that will hold the piston in the bore while you install the end cap.)
7. Install the end cap ⑥ and tighten, hand-tight, then remove your thumb.
8. Reinstall the solenoid valve ① and the fittings and tubing.

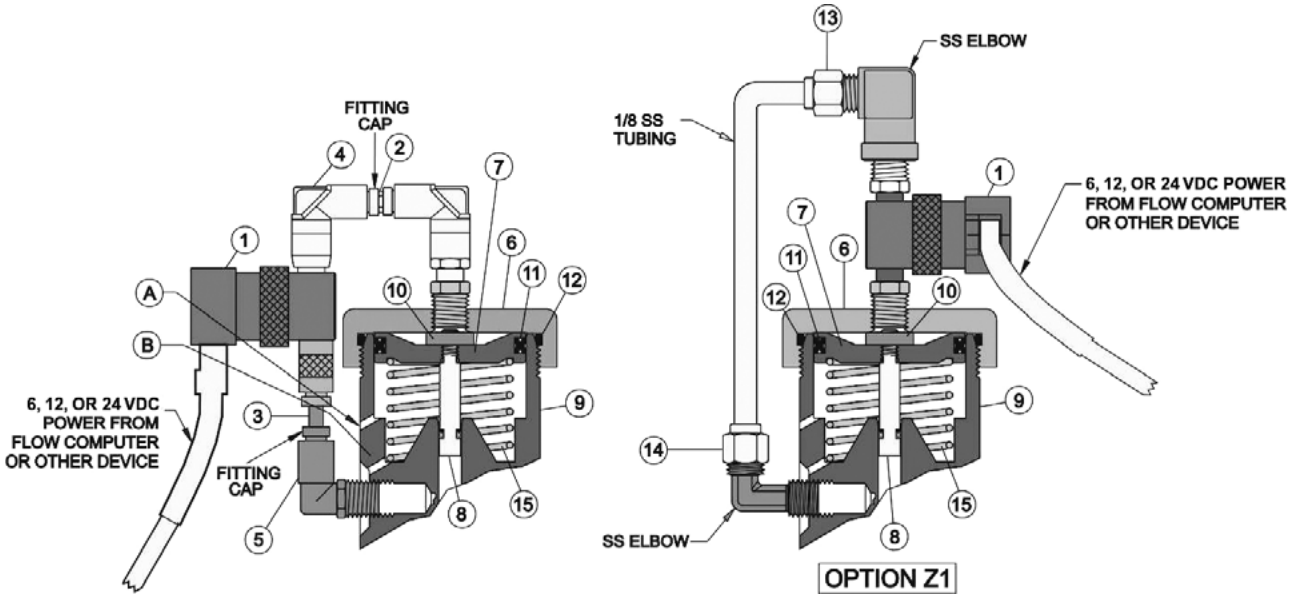

Figure 36: Replacement of Actuator and Pump Rod Seals or Stroke Adjustment Nut

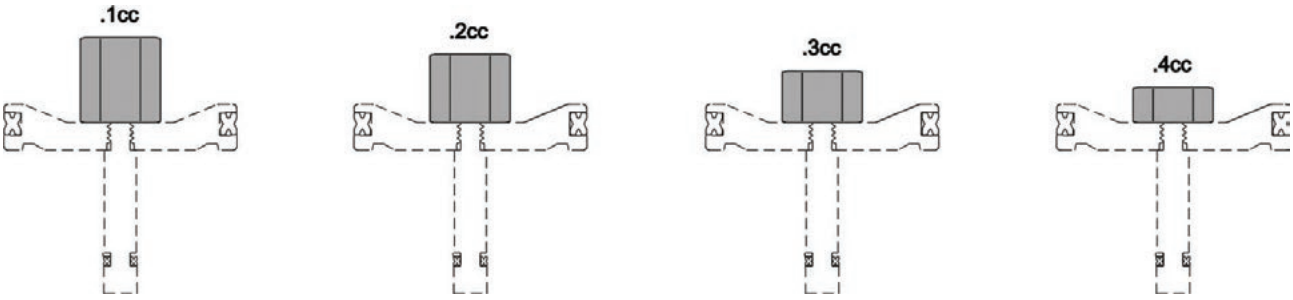

Figure 37: Stroke Adjustment Nuts

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1.10 Inspection of Actuator and Pump Rod Seals or Bite Adjustment Screw for System

Removal Procedure (refer to Figure 38)

1. Purge the system as shown in step 1.1 and Figure 24.
2. If your sampler is powered by an outside source, disconnect the cable ① at the terminal block inside the NEMA 3R enclosure and remove the cable from the enclosure.
3. Close the enclosure lid and lock it with the toggle clamp.
4. Remove the bulkhead fitting nut ② to disconnect the 4mm tubing.
5. The next two steps require that you create an airtight seal over the **piston stroke inspection hole** Ⓐ and the **moisture drain hole** Ⓑ using your thumb. Hold this seal until completing step 7. When the seal is broken, the piston and the pump rod will be pushed upward from the pump body.
6. With the seal in effect, remove the end cap ③ by hand, turning counter-clockwise.
7. Now place the palm of your other hand over the top of the piston ④ and remove your thumb. The piston and the pump rod ⑤ will now be released from the pump body ⑥.
8. Remove the piston rod nut ⑦ using a 1/2" hex wrench.
9. Unscrew the piston ④ from the pump rod ⑤.
10. Remove the quad ring ⑧ from the piston, and the O-ring ⑨ from the end cap .

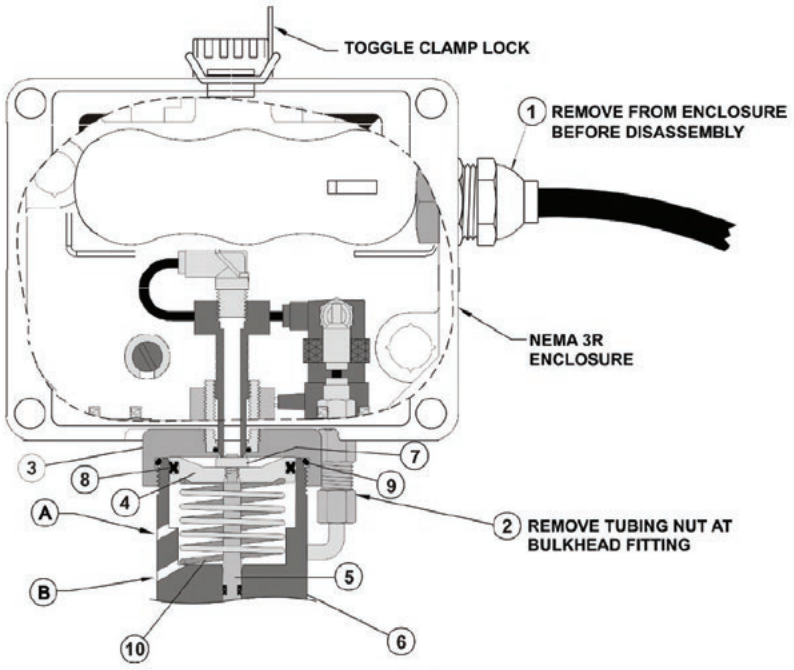

Figure 38: Inspection of Actuator and Pump Rod Seals or Bite Adjustment Screw

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1.11 Replacement of Actuator and Pump Rod Seals or Bite Adjustment Screw

Reassembly Procedure (refer to Figure 39)

1. Thread the pump rod ⑤ into the piston ④ by hand until it is snug.
2. Install the piston rod nut ⑦ and tighten it against the piston with a 1/2" hex wrench.
3. Place the piston spring ⑩ into the pump body.
4. Place the piston ④ and the pump rod assembly on top of the piston spring.
5. Gently press the piston about 1/4” into the actuator bore. As the piston and spring are being pressed into the bore, the pump rod seal and back-up ring will enter the pump body bore. This motion must be done straight down and evenly to ensure that the seals are not damaged.
6. While holding the piston in the bore, place your thumb over the **piston stroke inspection hole** Ⓐ and the **moisture drain hole** Ⓑ, creating an airtight seal. (Holding this seal will effect a vacuum that will hold the piston in the bore while you install the end cap.)
7. Install the end cap ③ and tighten, hand-tight, then remove your thumb.
8. Reconnect the 4mm tubing to the enclosure bulkhead fitting ②.
9. Reconnect the cable, if so equipped. **Observe ‘Polarity Sensitive’ connection.**
10. Pressure the system with pipeline gas as stated in Section III, paragraph 3.1, and use a liquid leak detector (Parker PHinder) on all fittings and threaded connections before returning to service.

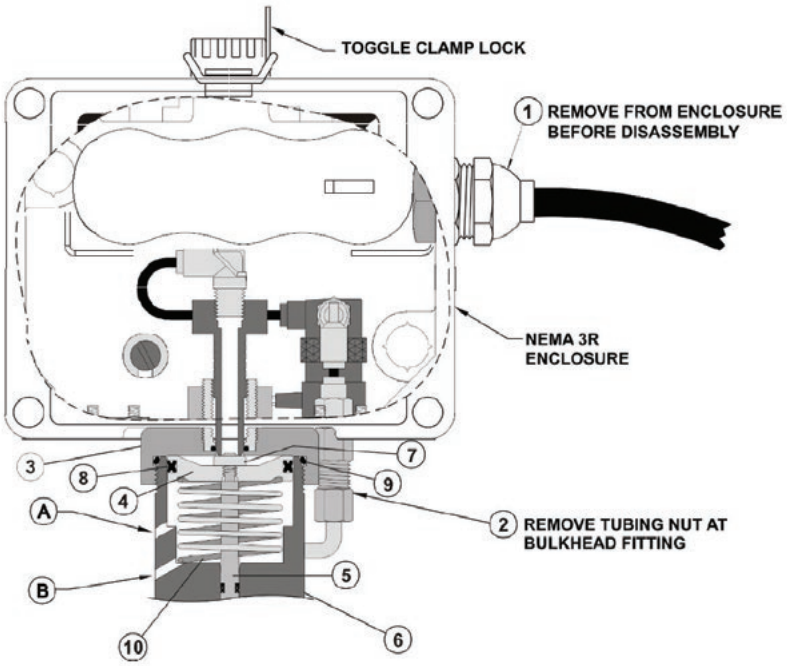

Figure 39: Replacement of Actuator and Pump Rod Seals or Bite Adjustment Screw

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2.0 Service Parts List

2.1 Kit Numbers

Kit Number	For Base Model Number(s)	Description
SK-PF-01	PF1	FKM soft goods standard – includes pump rod assembly
SK-PF-02	PF2	FKM soft goods standard – includes pump rod assembly
SK-PF-03	PF3	FKM soft goods standard – includes pump rod assembly
SK-PF-07	PF2 & PF3	Balance Valve Assembly
SK-PF-08	PF1	Outlet Spring Check Rebuild Kit
SK-PF-09	PF3	Regulator Rebuild Kit – FKM soft goods
SK-PF-10	PF1 & PF2	Upper Body Rebuild Kit, FKM soft goods with Pump Rod Assembly
SK-PF-11	PF3	Upper Body Rebuild Kit, FKM soft goods with Pump Rod Assembly
SK-PF-12	ALL	Lower Body Rebuild Kit, FKM soft goods
SK-PF-13	ALL	Inlet Strainer Service Kit (40 micron)

2.2 O-Ring Reference Chart

3.0 Troubleshooting Tips

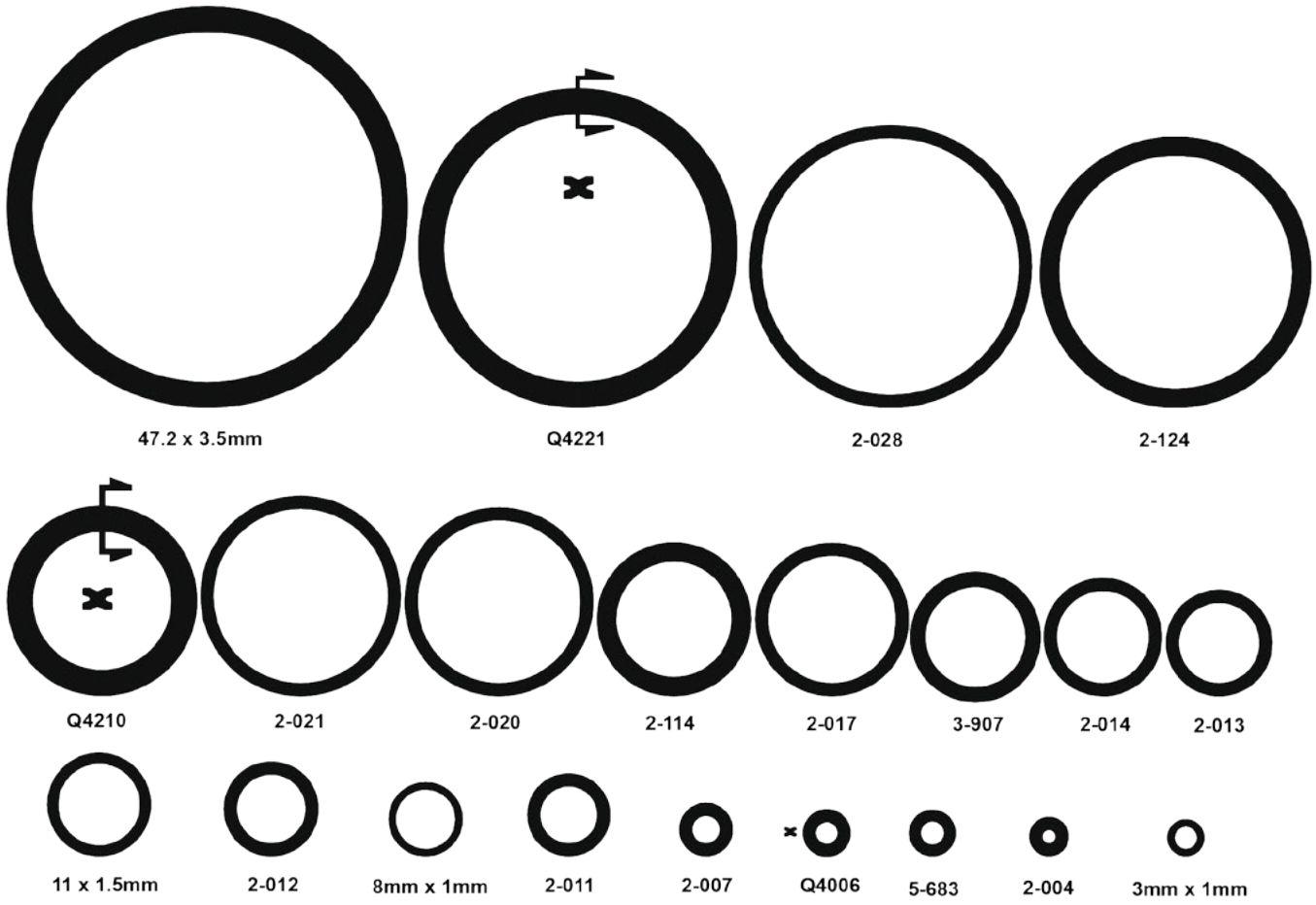

Figure 40: O-Ring Reference Chart

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Problem	Possible Remedy
Pressure not building in Sample Cylinder	**Quick Check 1 – 6** 1. Make sure the probe valve / valves are in OPEN position. 2. Make sure sample cylinder valves are OPEN at inlet and CLOSED at outlet connections. 3. Check all thread and tubing connections for leaks. 4. Inspect all solenoid valve fittings and tubing for leaks. 5. Check coil voltage. Check for exhausting gas when de-energized. 6. Check the battery voltage (See Section III, paragraph 2.3) 7. Look through the piston stroke inspection hole to see if the piston is making a full stroke. Use the 'Test Sample' feature as outlined in Section II, paragraph 2.2A. 8. For PF1 Models – Adjust the internal spring check (See Section III, paragraph 1.4B)
	If Pumping Full Stroke a) Inspect the inlet check valve O-ring (see Maintenance Instructions, Section IV, paragraph 1.6) and replace, if necessary. b) Check the actuator and pump rod seals (see Maintenance Instructions, Section IV, paragraph 1.8) and replace, if necessary (paragraph 1.9).
Sample Cylinder builds to line pressure too quickly	**Quick Check 1 – 4** 1. Check the bite size. 2. If 'time-based', check the frequency of sampling. 3. If 'flow proportional' sampling, the flow rate may have increased. 4. The sample cylinder may be too small for the 'bite size and frequency of sampling'. 5. For base model PF1: a) Inspect the spring check poppet O-ring for debris or cuts. b) Refer to procedure for Field Setting of Spring Check, Operation Instructions, Section III, paragraph 1.4B. 6. For base models PF2 and PF3: a) Leak test the balance valve with a sample out connection to a container of water, as shown in Figure 30. b) Inspect the balance valve poppet O-ring for debris or cuts. c) Replace the balance valve assembly.
Pressure builds in Sample Cylinder too slowly	**Quick Check 1 – 4** 1. Check the bite size. 2. If 'time-based', check the frequency of sampling. 3. If 'flow proportional' sampling, the flow rate may have decreased. 4. Sample cylinder may be too large for the 'bite size and the frequency of sampling'. 5. For PF1 models – Adjust the internal spring check (See Section III, paragraph 1.4B)
Pressure bleeds directly into Sample Cylinder after Cylinder Change-Out	1. Purge valve needs to be tightened or seat needs to be replaced (see Maintenance Instructions, Section IV, paragraphs 1.1 and 1.2). 2. Inspect the balance valve poppet O-ring for debris or cuts. 3. Replace the balance valve assembly.

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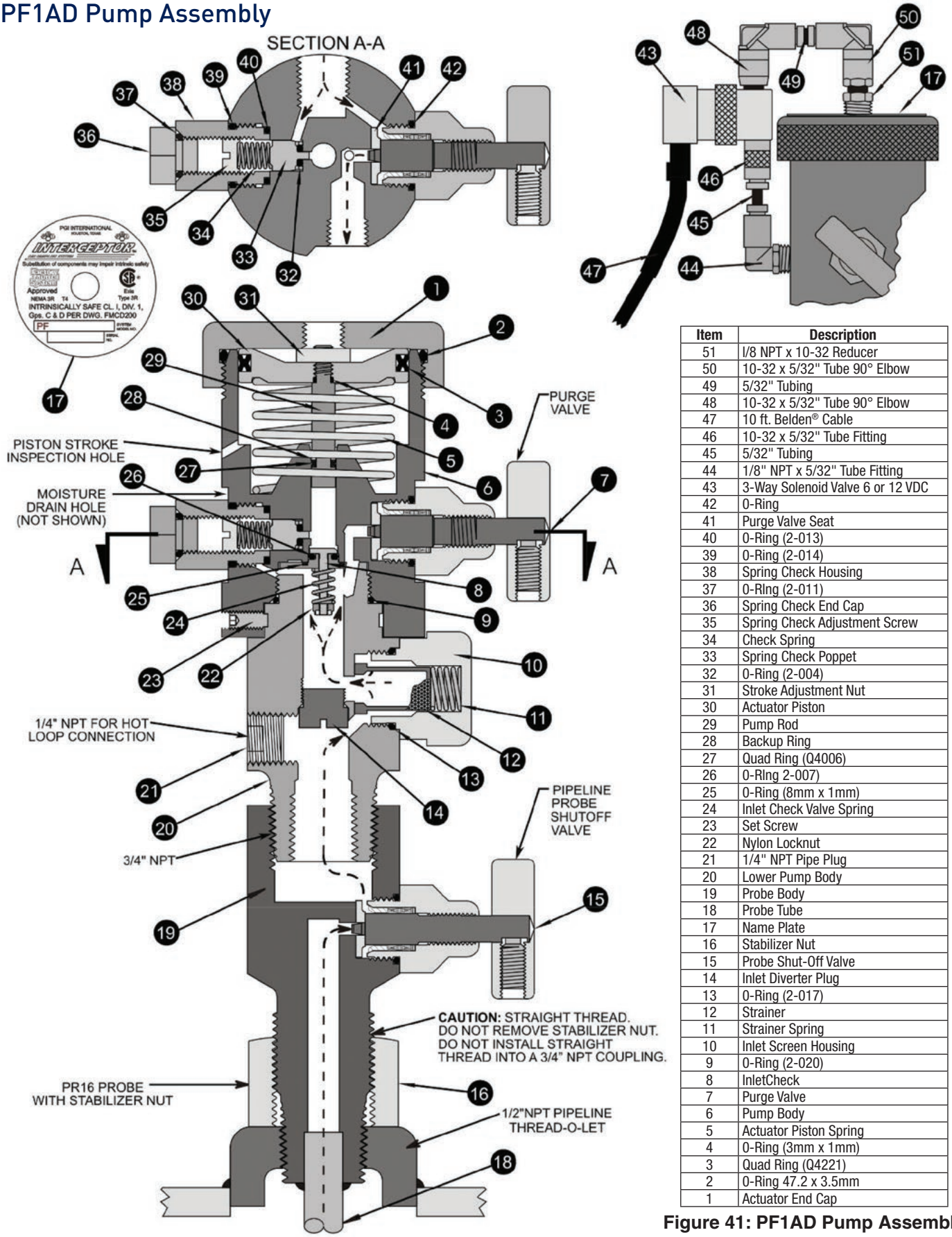
PF1AD Pump Assembly



Item	Description
51	I/8 NPT x 10-32 Reducer
50	10-32 x 5/32" Tube 90° Elbow
49	5/32" Tubing
48	10-32 x 5/32" Tube 90° Elbow
47	10 ft. Belden® Cable
46	10-32 x 5/32" Tube Fitting
45	5/32" Tubing
44	1/8" NPT x 5/32" Tube Fitting
43	3-Way Solenoid Valve 6 or 12 VDC
42	0-Ring
41	Purge Valve Seat
40	0-Ring (2-013)
39	0-Ring (2-014)
38	Spring Check Housing
37	0-Rlng (2-011)
36	Spring Check End Cap
35	Spring Check Adjustment Screw
34	Check Spring
33	Spring Check Poppet
32	0-Ring (2-004)
31	Stroke Adjustment Nut
30	Actuator Piston
29	Pump Rod
28	Backup Ring
27	Quad Ring (Q4006)
26	0-Rlng 2-007)
25	0-Ring (8mm x 1mm)
24	Inlet Check Valve Spring
23	Set Screw
22	Nylon Locknut
21	1/4" NPT Pipe Plug
20	Lower Pump Body
19	Probe Body
18	Probe Tube
17	Name Plate
16	Stabilizer Nut
15	Probe Shut-Off Valve
14	Inlet Diverter Plug
13	0-Ring (2-017)
12	Strainer
11	Strainer Spring
10	Inlet Screen Housing
9	0-Ring (2-020)
8	InletCheck
7	Purge Valve
6	Pump Body
5	Actuator Piston Spring
4	0-Ring (3mm x 1mm)
3	Quad Ring (Q4221)
2	0-Ring 47.2 x 3.5mm
1	Actuator End Cap

Figure 41: PF1AD Pump Assembly

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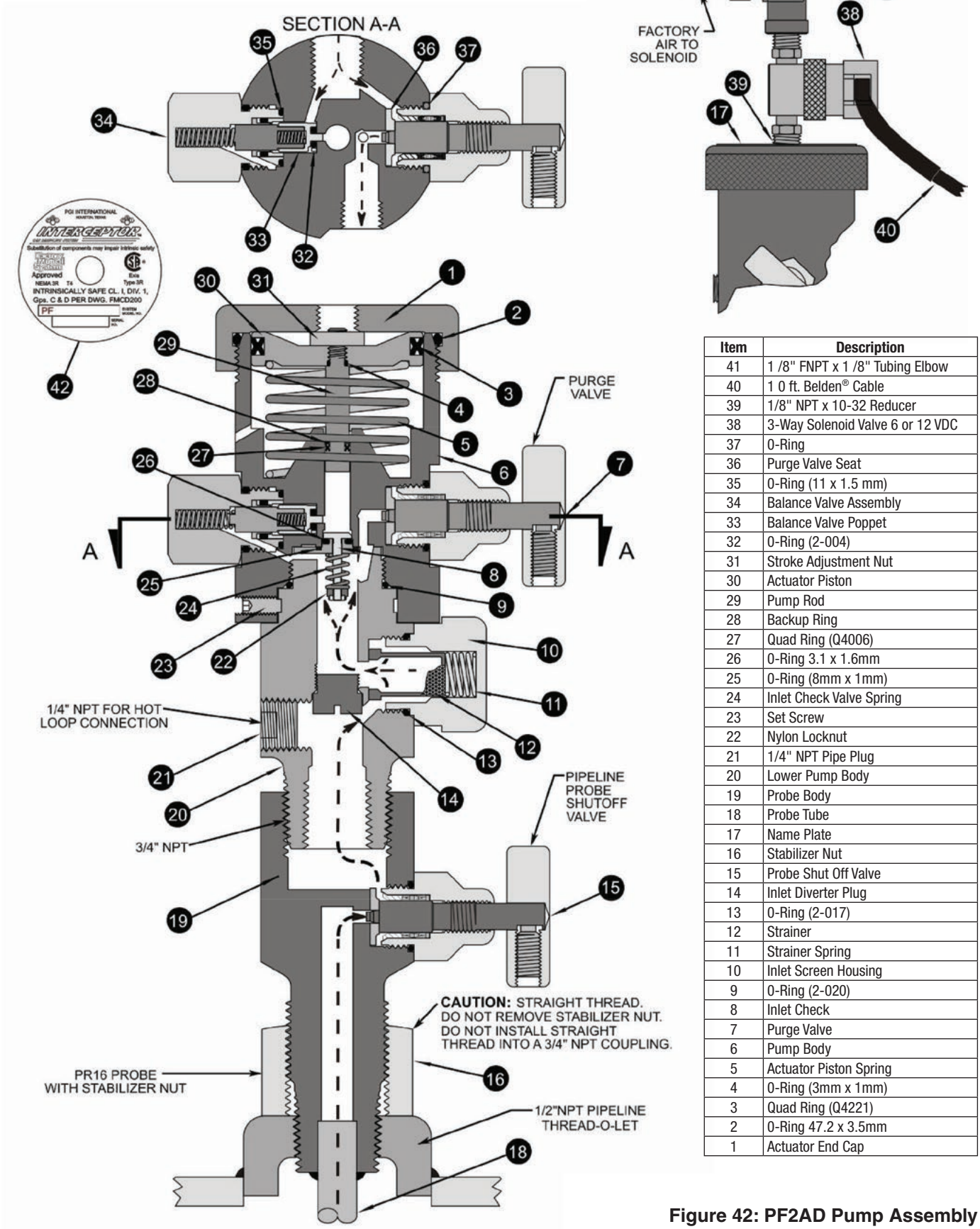
PF2AD Pump Assembly



Item	Description
41	1 /8" FNPT x 1 /8" Tubing Elbow
40	1 0 ft. Belden® Cable
39	1/8" NPT x 10-32 Reducer
38	3-Way Solenoid Valve 6 or 12 VDC
37	0-Ring
36	Purge Valve Seat
35	0-Ring (11 x 1.5 mm)
34	Balance Valve Assembly
33	Balance Valve Poppet
32	0-Ring (2-004)
31	Stroke Adjustment Nut
30	Actuator Piston
29	Pump Rod
28	Backup Ring
27	Quad Ring (Q4006)
26	0-Ring 3.1 x 1.6mm
25	0-Ring (8mm x 1mm)
24	Inlet Check Valve Spring
23	Set Screw
22	Nylon Locknut
21	1/4" NPT Pipe Plug
20	Lower Pump Body
19	Probe Body
18	Probe Tube
17	Name Plate
16	Stabilizer Nut
15	Probe Shut Off Valve
14	Inlet Diverter Plug
13	0-Ring (2-017)
12	Strainer
11	Strainer Spring
10	Inlet Screen Housing
9	0-Ring (2-020)
8	Inlet Check
7	Purge Valve
6	Pump Body
5	Actuator Piston Spring
4	0-Ring (3mm x 1mm)
3	Quad Ring (Q4221)
2	0-Ring 47.2 x 3.5mm
1	Actuator End Cap

Figure 42: PF2AD Pump Assembly

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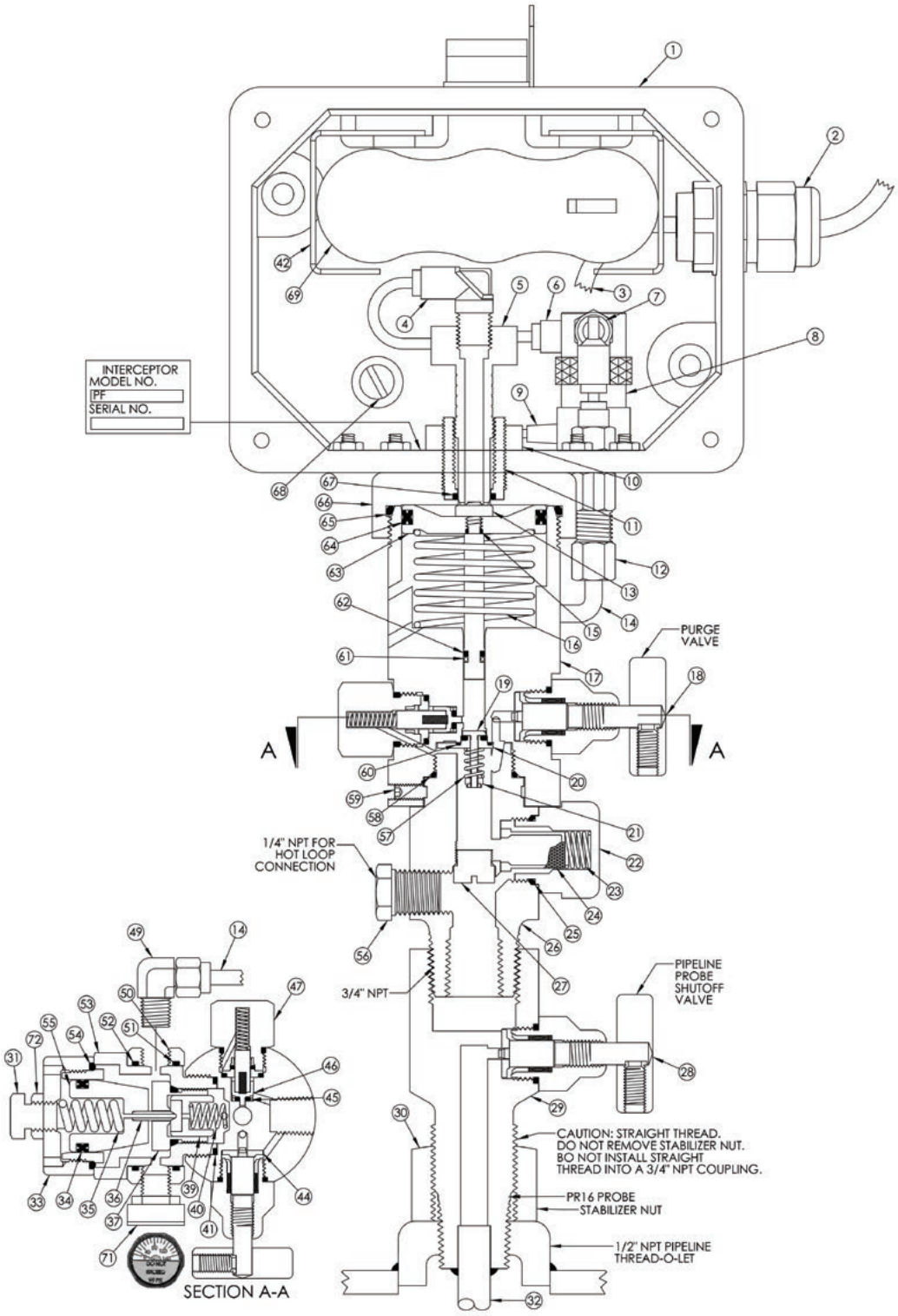
PF3MD Pump Assembly



Item	Description
72	Lock Nut
71	Gauge
70	Name Plate
69	Battery Pack
68	Pan Head Screw
67	0-Rjng (2-012)
68	Actuator End Cap
65	0-Ring 47.2 x 3.5 mm
64	Quad Ring Q4221
63	Actuator Piston
62	Back Up Ring
61	Quad Ring (Q4006)
60	0-Ring 3.1 x 1.6 mm
59	Set Screw
58	0-Ring (2-020)
57	Inlet Check Valve Spring
56	1/4" NPT Pipe Plug
55	Regulator Piston
54	0-Ring (2-124)
53	Regulator Body
52	0-Ring (2-028)
51	0-Ring (2-114)
50	Regulator Collar
49	1/8" NPT x 1/8" Tube 90° Elbow
48	0-Ring (11 mm x 1.5 mm)
47	Balance Valve Assembly
46	Balance Valve Poppet
45	0-Ring (2-004)
44	Purge Valve Seat
43	0-Ring (2-004)
42	Battery Retainer
41	0-Ring (2-021)
40	Dart Spring
39	Dart
38	1/8" NPT Pipe Plug (Not Shown)
37	Relief Nut
36	Relief Rod
35	Piston Spring
34	Quad Ring (Q4201)
33	Regulator End Cap
32	Probe Tube
31	Adjusting Screw
30	Stabilizer Nut
29	Probe Body
28	Probe Shutoff Valve
27	Inlet Diverter Plug
26	Lower Body
25	0-Ring (2-017)
24	Strainer
23	Strainer Spring
22	Inlet Screen Housing
21	Nylon Locknut
20	0-Ring (8 mm x 1 mm)
19	Inlet Check
18	Purge Valve
17	Pump Body
16	Actuator Piston Spring
15	0-Ring (8 mm x 1 mm)
14	Regulator to Solenoid Tubing
13	Piston Rod Nut
12	1/8" Bulkhead Fitting
11	Box Adapter Bushing
10	Hex Jam Nut
9	Solenoid Electrical Connector
8	3-Way Solenoid Valve 6 VDC
7	10-32 x 1/8" Tubing Elbow
6	10-32 x 5/32" Tube 90° Elbow
5	Bite Adjustment Screw
4	1/8" NPT x 5/32" Tube 90° Elbow
3	Belden® Cable
2	Straight Belden® Cable Fitting
1	Drilled Box Nema 3R Enclosure

Figure 43: PF1AD Pump Assembly

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