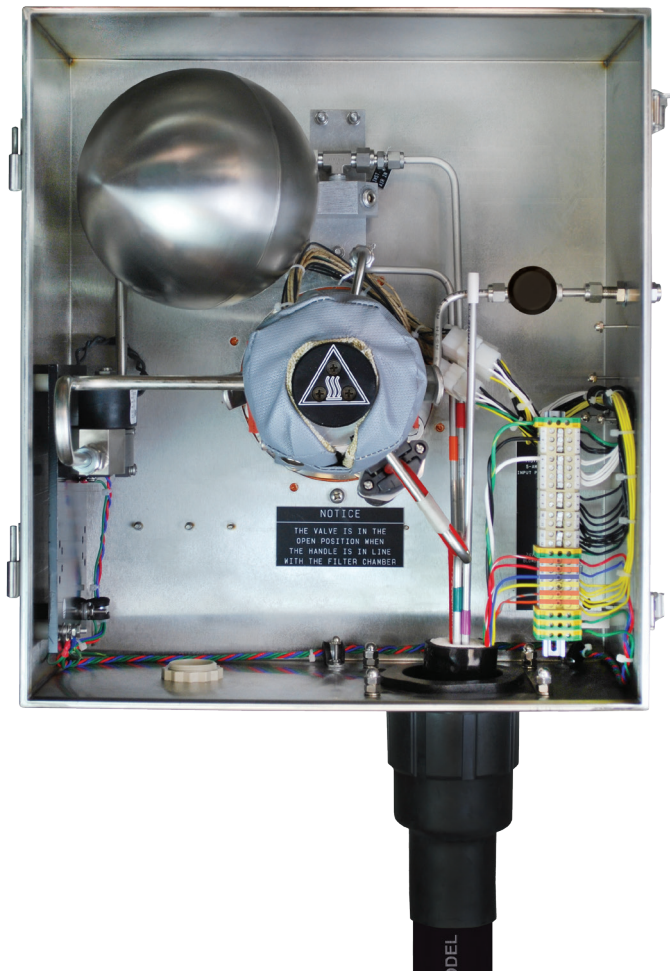




Instruction Manual

Model 270F *Flare Gas Probe*



AMETEK[®]

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Contents



Receiving and Storage	3
Definition of Symbols	4
Declaration of Conformity	5
Specifications	6
Description and Principle of Operation.....	7
Installation.....	9
Electrical Connections.....	11
Process and Piping Connections.....	12
Start-Up.....	13
Operation.....	13
Shutdown.....	13
Maintenance	14
Troubleshooting.....	15
Spare Parts.....	16
Drawings - Model 270F.....	18
Limited Warranty.....	30

Receiving and Storage

Carefully inspect the sample probe and any special accessories included with it immediately on arrival by removing them from the packing and checking for missing articles against the packing list.

Due to the weight of the unit, use of a lifting device with a sling is advised. If the unit is lifted by personnel, at least three persons should be used to lift it. Lift the unit by placing hands underneath the main enclosure itself (not the door), or by using the flange/flange bolts.

DO NOT LIFT THE UNIT BY ANY OF THE FOLLOWING:

HEATER CONTROLLER MOUNTED ON THE BOTTOM OF THE UNIT

FLEXIBLE CONDUIT BETWEEN THE HEATER CONTROLLER AND THE ENCLOSURE ENTRY

HEATER CONTROLLER SENSE WIRE (BLUE CABLE BETWEEN THE CONTROLLER AND THE ENCLOSURE)

SAFETY VENT

SAFETY PURGE PANEL

Check the items for any damage in transit and, if required, inform the shipping insurance company immediately of any damage found.

The sample entry boot and mounting flange gaskets are placed inside the enclosure for shipping. Items should not be removed until immediately before installation at the sampling point to ensure they do not get misplaced.

Storage location should be protected from the elements. Although all components provided are designed to resist corrosion, additional protection from heat (>140°F/ 60°C) and humidity is recommended.

Definition of Symbols



WARNING, RISK OF DANGER - SYMBOL INDICATES INJURY MAY OCCUR IF MANUFACTURER'S INSTRUCTIONS ARE NOT ADHERED TO. PLEASE READ MANUAL CAREFULLY WHEN SYMBOL IS DISPLAYED

WARNING, EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS

WARNING, EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR HAZARDOUS AREA INSTALLATION

THE SUPPLY POWER CIRCUIT MUST INCLUDE AN OVERPROTECTION DEVICE WITH A MAXIMUM RATING OF 20 A. A DISCONNECT SWITCH MUST BE LOCATED IN CLOSE PROXIMITY TO THE PROBE

IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED PER CLAUSE 5.4.4(i) IN STANDARD EN 61010-1

WARNING, SUBSTITUTION OF THE FOLLOWING COMPONENTS MAY IMPAIR SUITABILITY FOR DIVISION 2:

Reference Designation	Description	Type of Protection
SW1	Cutoff switch	Sealed contacts
TS1, TS2, TS3, TS4, TS5, TS6	Thermal switch	Hermetically sealed
TB1, TB2, TB3	Terminal block	Normally non-arcing



CAUTION, HOT SURFACE - SYMBOL INDICATES EXPOSED SURFACE TEMPERATURE CAN CAUSE BURNS OR PERSONAL INJURY. CARE SHOULD BE TAKEN WHEN CONTACT IS REQUIRED



CAUTION, RISK OF ELECTRICAL SHOCK - SYMBOL INDICATES ELECTRICAL SHOCK MAY OCCUR. CAUTION SHOULD BE TAKEN BEFORE DISCONNECTING OR CONTACTING ANY ELECTRICAL CONNECTIONS



PROTECTIVE CONDUCTOR TERMINAL SYMBOL INDICATES THE TERMINAL LOCATION FOR THE PROTECTIVE CONDUCTOR. FAILURE TO CONNECT TO THE PROTECTIVE CONDUCTOR TERMINAL MAY RESULT IN A SHOCK HAZARD

Declaration of Conformity

The product described in this manual complies with the following certifications:



CE – Certification

LVD – Low Voltage Directive (Directive 2006/95/EC)

Second Edition EN 61010-1:2001 - Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements.

SPV – Simple Pressure Vessels Directive (Directive 87/404/EEC)

EN 286-1:1998 – Simple unfired pressure vessels designed to contain air or nitrogen - Part 1: Pressure vessels for general purposes.

EMC – Electromagnetic Compatibility (Directive 2004/108/EC)

EN 61326-1:2006 – Electrical equipment for measurement, control and laboratory use.

Specifications

OPERATING SPECIFICATIONS	
Sample Flow Rate	0 to 20 l/m
Calibration Gas Requirement	Sample flow rate plus 10%
Operating Pressure Drop at 10 l/m	12" water column (0.03 bar)
Maximum Stack Temperature	700°F (370°C)
Oven Temperature	270°F (132°C)
Enclosure Dimensions	19" H x 17" W x 17" D (480mm H x 430mm H x 430mm D)
Weight	108 lbs (49 kg) (plus probe)
Input Voltage Requirement	115VAC 50/60 Hz / 230VAC 50/60 Hz
Input Power Requirement	575 watt maximum
EXTERNAL FUSE REQUIRED OF 20 A OR LESS	
Ambient Temperature, Operating	176°F maximum (80°C)
Blowback Tank Volume	.01 scf (2.8l)
Blowback Duration	1.5 sec to empty accumulator
Enclosure	SS, IP 65
Sample Line Connection	3" Heat shrink boot (standard) 4" Heat shrink boot (optional)
Heater Type	Rod heaters in aluminum block, controlled with thermal switch
Available Filter	2 µm ceramic
Chamber Material	316SS, SilcoNert™ coated
Hazardous Area Classification	Class I, Div. 2, Groups B, C, D

Description and Principle of Operation

APPLICATION

The Universal Analyzers Model 270F Flare Gas Probe Assembly is designed to extract sample gases from a flare exhaust line, filter it, and deliver it to a heated sample line for delivery ultimately to a gas analyzer. It is designed to be installed on sample stacks containing non hazardous gases. It has been designed specifically for sulfur (total or especiated) in flare gas applications. It is suitable to install in an unclassified or Class I, Division 2 location.

Filter changes can be made in less than one minute.

The Model 270F filter will mount by means of a pipe flange to a mating flange on the stack. The size of the flange can be specified by the user and can include 2", 3", 4" or 6". Other flange sizes may be available; contact the factory for more information. The probe tube used is specific to the Model 270F and is specified with the Model 270F.

For more accurate and faster response time, all sample wetted stainless steel parts have been SilcoNert™ coated. Sample flow rates of up to 20 l/m can be extracted and filtered through the Model 270F with a minimal amount of pressure drop.

GENERAL DESCRIPTION

The Model 270F is a Flare Gas Probe Assembly consisting of the filter body mounted in a NEMA 4X stainless steel enclosure. A blowback system is provided to allow the blowback to occur on command from a data logger, PLC or UAI timer card or external switch mounted in a safe area.

Two 63 watt heaters are mounted in an aluminum sleeve around the filter cavity. The heaters hold the temperature of the filter near 270°F (132°C). A hermetically sealed bi-metallic thermal switch mounted to the filter body keeps the temperature from exceeding 280°F (138°C) by opening the circuit before that temperature. An optional independent temperature sensor can be provided as a means to measure and transmit or record the temperature of the filter. A second thermal switch, set at 225°F (107°C) is provided to be used as an alarm contact if the temperature drops below the switch temperature. An isolation valve is included in the sample path leading to the heated chamber. This valve is provided to protect maintenance personnel. It isolates the chamber from the process flare gas during filter changes. This valve is also heated with two 63 watt heaters, controlled to 270°F (132°C) and alarmed at 225°F (107°C) in the same manner as the heated filter. A second valve, heated and alarmed in the same manner, can be provided for further protection to personnel. A bleed port from between the first and second isolation valves will also be provided to allow releasing any trapped gases between these valves to avoid pressure build up due to valve leakage or temperature changes.

In colder climates an additional heater can be supplied for the enclosure. This heater will maintain 194°F (90°C) inside the enclosure.

The Model 270F Flare Gas Probe is provided with a 2 µm ceramic filter. This filter is supplied as an economical general purpose filter. It also has the advantage of being relatively non-reactive to the sulfur content of the sample gas. Additional filtration materials and pore sizes are available.

Blowback air is used to clean the filter element. Compressed air supplied to the blowback assembly needs to be clean and dry (-40°F/°C recommended). Instrument quality air is preferred. The pressure should be as high as possible, up to 125 psig (8.6 barg). High pressure air fills the accumulator (a 7" (178mm) diameter stainless steel sphere) and provides a substantial blast when the high flow solenoid valve opens. This loosens the particles on the filter surface and forces them back through the sample probe into the sample point. The period between blowback cycles should be set to occur before the pressure drop across the filter begins to increase beyond acceptable limits. By installing and monitoring a vacuum gauge ahead of the sample pump, a maintenance interval can be established. This can be as often as every 15 minutes but should be no less frequently than once per day. The period between blowback cycles can be based on calculations to estimate the amount of sample required to deposit from three to five grams of solids in the filter element.

Description and Principle of Operation

Instrument air usage is minimal and smoothed by the fact that the air accumulator is charged relatively slowly through a 1/4" instrument air line. The recharge time could be extended with a restriction in the air line if it were desired to reduce the pressure pulses on the instrument air supply and to consume instrument air even more slowly.

The calibration gas may be injected into the chamber ahead of the filter. This is close to the sample source, as is required by many EPA officers. A back pressure check valve (set at 3 psig (0.2 barg)) is provided in the cal gas injection path to insure that calibration gas does not leak into the sample while the sample is being drawn through the filter. Alternately, a three-way valve may be supplied to switch between calibration gas or sample gas, providing for a closed loop calibration with no calibration gas lost to the flare line.

System seal between the enclosure and process is provided by a subflange mounted on the main flange. The probe tube and filter chambers are mounted on a separate subflange. The primary subflange mounts the isolation valves and filter chamber on one side, and the probe tube on the other. The remainder of the system seal between the enclosure and the process is maintained either by a triple O-Ring seal, or by a retractable probe tube support assembly.

For the triple O-Ring seal, the secondary subflange is mounted directly onto the flange. This secondary subflange seals the probe enclosure from process with a gasket between the subflange and the main flange, and with a triple O-Ring seal on the probe tube. The primary subflange may be removed from the flare probe assembly without disturbing the secondary subflange. This allows the filter chamber assembly and probe tube to be extracted from the process and isolated from the process by means of a process side root valve, without ever losing system seal.

Because the probe tube is sealed by the triple O-Ring seal in the secondary subflange, a specific style of probe tube is required. The probe tube will need to be specifically sized, and must be coated with SilcoNert™ to maintain a faster response time in samples containing sulfur. The probe tube must have a probe stop to prevent it from being ejected from the secondary subflange and allowing process gas to escape.

The retractable probe tube support assembly has a secondary and a tertiary subflange. The tertiary subflange mounts to the main flange and seals the enclosure from the process with a gasket. The secondary subflange has a probe tube support attached, and seals to both the probe tube and to the tertiary subflange by means of O-Rings. The probe tube attaches to the primary subflange, with its filter and isolation valves. The probe tube can be retracted into the probe tube support, and the probe tube support can then be retracted through the tertiary subflange, all without losing system integrity.

The probe tube used with the retractable probe tube support is unique to this style of probe. The probe tube used with the triple O-Ring design cannot be used with a retractable probe tube support.

Installation

Due to the weight of the unit, use of a lifting device with a sling is advised. If the unit is lifted by personnel, at least three persons should be used to lift it. Lift the unit by placing hands underneath main enclosure itself (not the door), or by using the flange/flange bolts.

DO NOT LIFT THE UNIT BY ANY OF THE FOLLOWING:
HEATER CONTROLLER MOUNTED ON THE BOTTOM OF THE UNIT
FLEXIBLE CONDUIT BETWEEN THE HEATER CONTROLLER AND THE ENCLOSURE ENTRY
HEATER CONTROLLER SENSE WIRE (BLUE CABLE BETWEEN THE CONTROLLER AND THE ENCLOSURE)
SAFETY VENT
SAFETY PURGE PANEL

Because of the separate primary and secondary subflanges, the Model 270F Flare probe may be installed on an operating flare stack, provided that a process side isolation valve with at least 1.6" (4.1 cm) straight through internal clearance is installed on the sample nozzle. If a retractable probe tube support is to be used, internal clearance must be at least 2" (5.1 cm).

Installation

The Flare probe enclosure should be mounted to the stack sample nozzle using the studs on the flange. Ensure the probe is mounted so that the enclosure is vertical. Several items in the probe will not work properly without being oriented vertically, including the Safety Purge vent and the Liquid Stop.

Prior to installation, ensure the process is shut down and safe for personnel, or verify the process side isolation valve is closed, and remove the primary and secondary subflanges from the Flare probe by disconnecting the electrical and gas connections between the enclosure and the filter assembly, and removing the primary and secondary subflange retaining bolts. If the retractable probe tube option is used, the tertiary subflange may remain installed.

TO INSTALL A TRIPLE O-RING MODEL 270F:

Insert the probe tube (stinger) through the secondary subflange, taking care to prevent damage to the O-Rings inside the subflange. Slide the probe tube into the subflange up to its probe stop. The probe tube should be screwed into the 3/8" NPT fitting on the inside of the primary subflange. To prevent galling, coat the threads with an anti-seize compound. Clean any anti-seize compound from the inner wall of the probe tube before attaching it to the subflange. The length of the probe should be selected to extend into the center third of the stack; or if the stack diameter is greater than 12' (3.7 m), at least 6' (1.8 m) into that stack.

Ensure the probe tube is correctly oriented and the subflange gasket is in place, then secure the secondary subflange to the main flange using the 4 shorter subflange retaining bolts.

Verify the filter sample isolation valve(s) are shut, and open the process side isolation valve. Slide the probe tube into the secondary subflange and mate the primary subflange to the secondary subflange. Secure the primary subflange to the secondary subflange using the longer 4 of the subflange retaining bolts. Ensure the spacer with cutout is in place when inserting the bolts.

Attach the electrical and gas connections between the enclosure and the filter assembly.

TO INSTALL A RETRACTABLE PROBE TUBE SUPPORT MODEL 270F:

Insert the probe tube (stinger) through the probe tube support and secondary subflange, taking care to prevent damage to the O-Ring inside the end of the probe tube support. Slide the probe tube into the probe tube support up to its probe stop. The probe tube should be screwed into the 3/8" female NPT fitting on the primary subflange. To prevent galling, coat the threads with an anti-seize compound. Clean any anti-seize compound from the inner wall of the probe tube before attaching it to the subflange. Ensure the probe tube is correctly oriented with regard to probe tube tip and filter. Insert the probe tube support into the tertiary subflange, taking care to avoid damage to the O-Ring in the subflange. Verify the filter isolation valve(s) are shut, and open the process side isolation valve.

Insert the probe tube support and probe tube into the nozzle. Mate the secondary subflange to the tertiary subflange, and secure using the subflange retaining bolts with the 1/2" spacer. Ensure the spacer is in place when installing the bolts, slide the probe tube through the probe tube support to make the primary subflange with the secondary subflange. Secure the primary subflange with the subflange retaining the bolts with the 1" spacer. Ensure the spacer is in place when installing the bolts. Attach the electrical and gas connections between the enclosure of the filter assembly.

Installation

TO INSTALL A HEATED SAMPLE LINE:

A heated sample line should be supported close to the Model 270. The Model 270F is not designed to support a heated sample line. The heated sample line should be fed through the heat shrink boot on the bottom of the enclosure. Connect the sample tube to the sample out fitting on the filter. The unheated portion of the sample line should be kept short and insulated to avoid condensation. Connect the calibration gas line to the marked 1/4" tube fitting. It is connected to the chamber via a check valve, or to a 3-way valve used to select between sample and calibration gas. If the compressed air line is part of the heated sample line, it can be connected to the 1/4" tube fitting marked for instrument air in. If an external air line is to be used for blowback, bring the air into the enclosure through a bulkhead fitting (supplied by others) to be installed in the wall of the enclosure, and connect the air to the same 1/4" tube fitting.

Provide power to the terminal block(s) within the stack filter enclosure in the Model 270F. 575 watts at 115VAC or 230VAC is required. If the external cutoff switch option is used, connect the power to the terminals in the switch.



NOTE: The supply power circuit MUST include an overprotection device with a maximum rating of 20 A. A disconnect switch must be located in close proximity to the probe. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired per Clause 5.4.4(i) in Standard EN 61010-1.



A thermal switch mounted in the aluminum heaters will control the temperature of the filter chamber and isolations valve(s) to 270°F (132°C). **An independent ground wire should be run to the grounding terminal on the terminal strip.**

If an independent measurement and display of the filter chamber temperature is desired, the Model 270F probe can be assembled with a temperature sensor inserted into a 1/8" diameter thermowell supplied on the heater tube assembly. The filter and enclosure temperatures can be monitored. Connect wires for this at terminal block 4. If type K thermocouples are selected, make sure to use the correct type of wire to connect between the probe and the instrument.

Control signals for blowback and calibration gas select should be run to terminal block 2. These may be 24VDC, 115VAC, or 230VAC, depending on options chosen. Each solenoid draws approximately 10 watts.

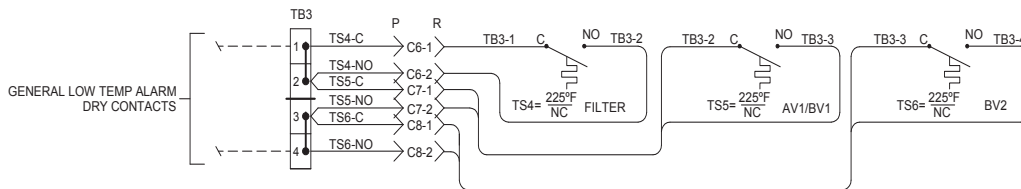
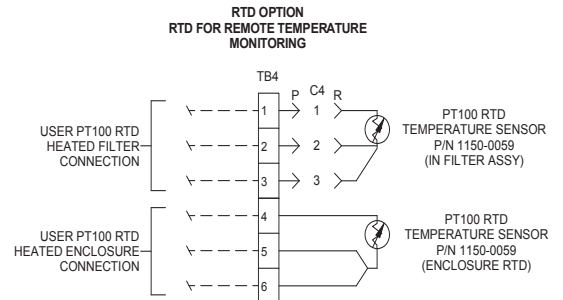
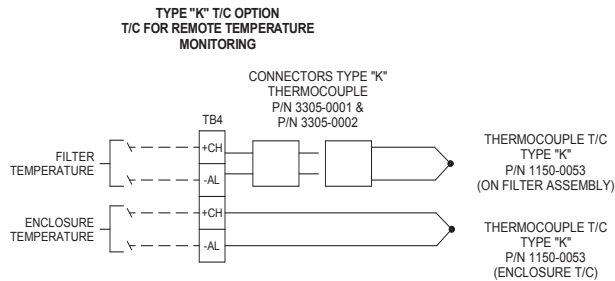
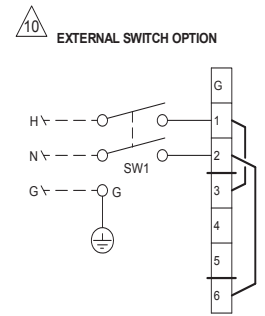
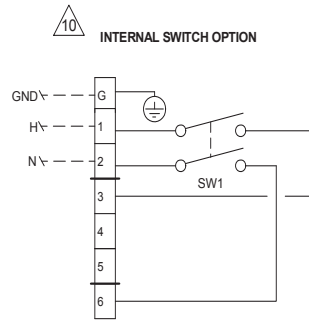
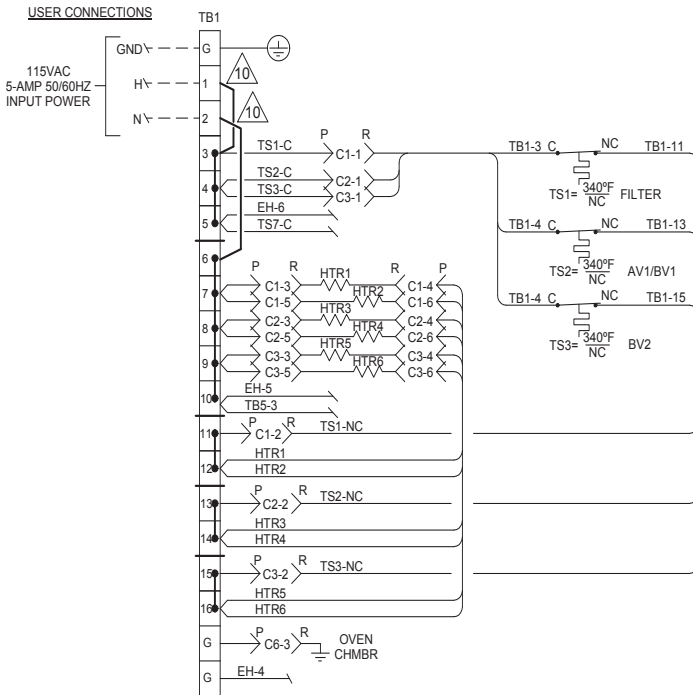


NOTE: The control signal circuits MUST include a current limiting device with a maximum rating of 1 A.

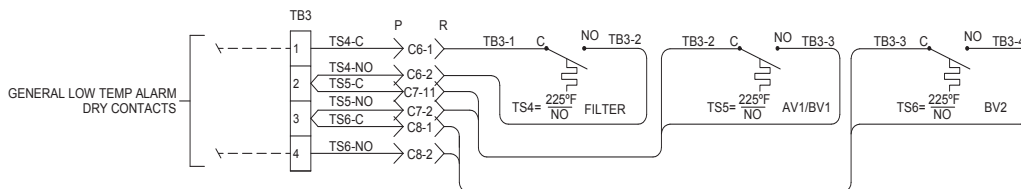
Terminal block 3 is used for low temperature monitoring. Connect a pair of signal wires to this block to monitor for low temperature alarm.

The final installation step is to ensure that the sample line is insulated completely. Close the cover of the enclosure and secure the latches. After securing the heated sample line, use a heat gun to shrink the entry boot onto the sample line. The goal is to keep the temperature of the gas sample at a temperature above the dew point of the gas all the way from the stack to the sample cooler/dehydrator.

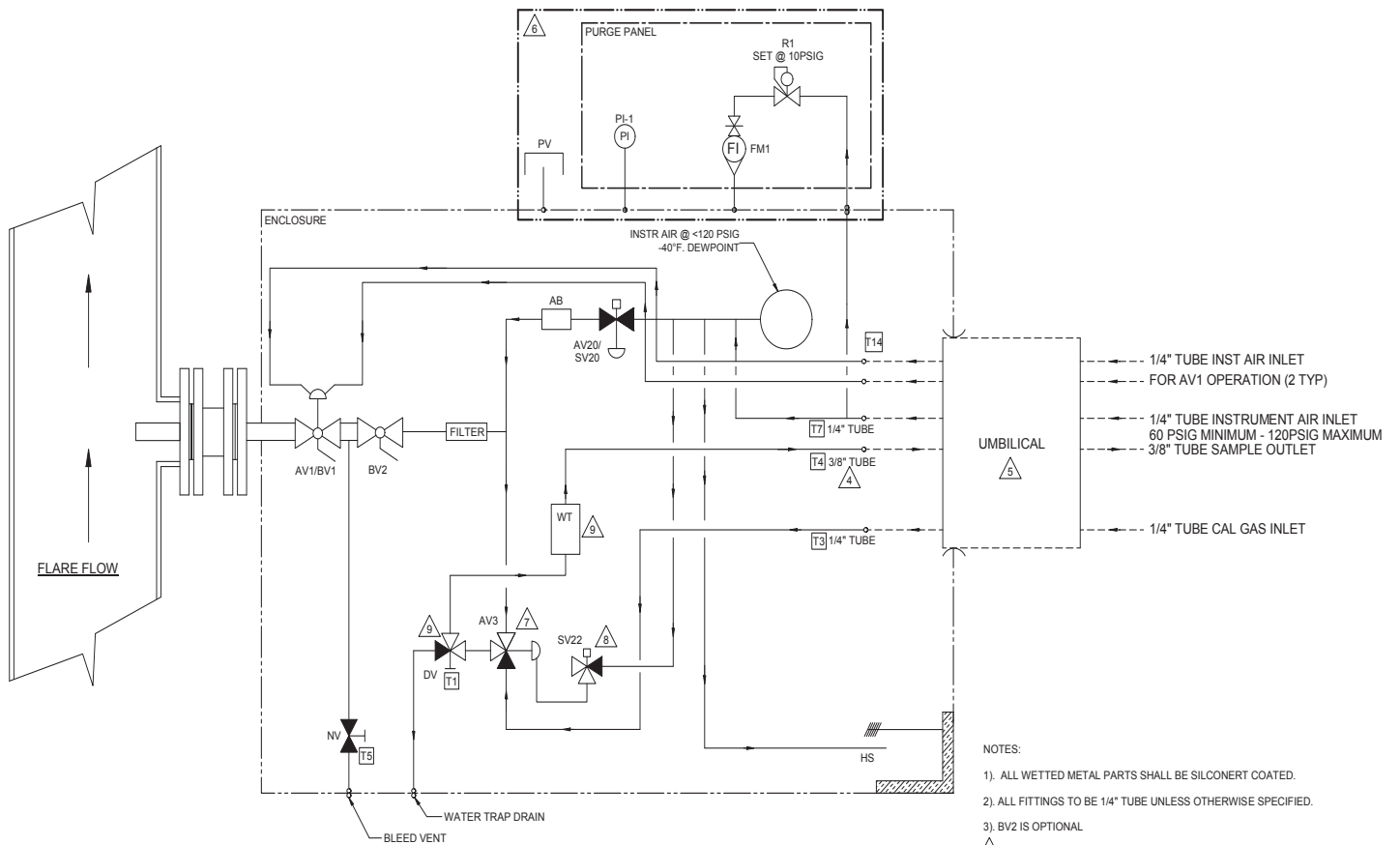
Electrical Connections Model 270F



OR



Process and Piping Connections Model 270F



NOTES:

- 1) ALL WETTED METAL PARTS SHALL BE SILCONERT COATED.
- 2) ALL FITTINGS TO BE 1/4" TUBE UNLESS OTHERWISE SPECIFIED.
- 3) BV2 IS OPTIONAL.

4) SAMPLE OUT MAY BE 1/4" TUBE OR 3/8" TUBE.

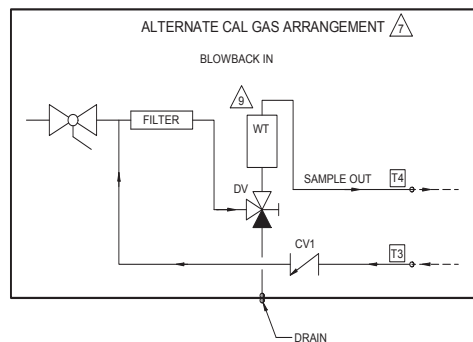
5) IF AIR CONTROL IS USED FOR BLOWBACK (AV20), FILTER ISOLATION VALVE (AI) ADDITIONAL INSTRUMENT AIR LINES WILL BE IN UMBILICAL. ADD TAGS T6, T13.

6) INCLUDED WITH SAFETY PURGE OPTION.

7) AV3 OPTIONAL - SEE ALTERNATE CAL GAS ARRANGEMENT FOR CAL GAS IN & W/O AV3. (FLOOD CAL.)

8) SV22 OPTIONAL - NOT REQUIRED IF AV3 IS AIR CONTROLLED

9) LIQUID TRAP (WT) & DRAIN VALVE (DV) OPTIONAL.



Start-Up

Apply power to the Model 270F Flare Gas Probe. Allow 15-30 minutes for the filter to come to temperature. This warm-up period is extremely important to avoid the condensation within the Model 270F filter which would cement the particulates to the filter surface. If an enclosure heater is used, it may take up to two hours to bring the enclosure to temperature.

Start the sample pump and determine that the proper amount of sample is being supplied to the instrumentation.

Perform a calibration cycle to insure that the calibration lines are properly installed and sealed. If using flood calibration, a flow meter should be installed in the calibration gas supply line to ensure that there is at least 10 percent more calibration gas being supplied to the Model 270F than is being withdrawn as sample. This will ensure that the filter and probe are being properly flooded with calibration gas. The excess calibration gas will pass through the probe tube into the process.

Open the instrument air valve to charge the blowback accumulator. Exercise the blowback solenoid valve to insure it is properly wired. During and after a blowback cycle, the presence of a slight pressure pulse on the sample tubing in the analyzer shelter, and the momentary dilution of the sample with instrument air, is normal and signifies that a blowback cycle has occurred. If desired, and if installed, the Calibration Select valve can be cycled during blowback to block the pressure pulse down the sample line.

The optimum time between blowback cycles is to be determined by experience. Once a day is sufficient in relatively clean applications. The requirement could be as frequent as every fifteen minutes where the dust and soot levels are severe. It is better to blowback too often than not often enough. A vacuum gauge in the sample line can be helpful to indicate if the particulate loading of the filter has started to restrict the flow of sample. The blowback cycle should be initiated before unacceptable pressure drop occurs.

Operation

The Model 270F Flare Gas Probe normally operates with no required input. The filter will require regular maintenance as covered in the Maintenance section.

Should the need arise, there are valves in the unit that may be operated by hand. First are the filter isolation valve(s), isolating the process from the filter chamber. These ball valves are inside the enclosure, closer to the flange from the filter chamber. They are closed when the handle is crosswise to the filter chamber, and open when in line with the filter chamber.

Second is the optional vent valve. This valve is used to vent the space between the two filter isolation valves, and is only included if there are two filter isolation valves. This valve should never be opened during normal operations, and should only be opened if the primary filter isolation valve is closed.

The final manual valve is the drain valve. This valve is used if necessary to drain the Liquid Stop after it has sealed the system upon being flooded with liquid. It should never be opened during normal operations, and should only be opened if the filter isolation valve(s) is closed.

The vent valve and drain valve are tagged with identification labels. The filter isolation valve(s) are identified by their location.

Shutdown

Before removing power from the unit, ensure filter chamber has been purged of any potentially hazardous components.

To purge the chamber, perform the following:

1. If equipped, perform a manual blowback operation.
2. Close the filter stack isolation valve(s).
3. Ensure no sample is being drawn through the filter chamber. If the sample is being drawn using a sample pump, turn off the power to the pump or disconnect the sample line.
4. If not already done, disconnect the sample line.
5. Use instrument air or other inert gas, flow ~10 l/m for 15-30 minutes through the filter chamber.
Note: Inert gas can be routed through the chamber via the calibration gas line if flood calibration option is installed.
6. After purging is complete, follow the maintenance procedure to change the filter.
7. Cap the sample outlet tube connection and disconnect power from the unit.

Note: If electrical wires are to be disconnected, follow applicable 'Lock Out/ Tag Out' requirements.

Maintenance

CHANGING THE FILTER



CAUTION: THIS PROCEDURE CAN CAUSE SEVERE BURNS. USE PROPER PROTECTION.

Changing the filter in the Model 270F Flare Gas Probe Assembly is extremely easy. Unsecure the door latches and open the door to the Heated Filter. Close the filter isolation valve(s) to isolate the filter chamber from process. Using gloves to protect the hand, grasp the cap on the end of the filter body opposite the probe and turn it counter clockwise. **The cap may be hot to the touch and may cause burns to the hand if not protected.** Removing the cap also removes the filter.

Inspect the O-Rings which are at each end of the filter to ensure they are still elastic and will seal the filter. Replace them if they are charred or deformed.

Replace the filter with a new one. Ensure it is in the center of the oven so that it is in contact with the O-Ring on the far end of the filter.

Screw the cap back on the filter body. Open the filter isolation valve(s). Close the door and secure the door latches. The filter replacement procedure is complete.

REMOVING THE PROBE TUBE



CAUTION: THIS PROCEDURE CAN CAUSE SEVERE BURNS. USE PROPER PROTECTION.

Removing the probe tube (e.g. for maintenance or inspection) can be done while the process is still running. Shut down the probe in accordance with shut down instructions. Disconnect the electrical and gas connections to the filter chamber and isolation valve stack. Remove the subflange retaining bolts holding the primary subflange to the secondary subflange. **Caution: Parts in the filter stack including the flange and probe tube may be hot. Use proper protection to avoid burns.** Pull the filter stack assembly away from the secondary subflange, allowing the probe tube to slide through the secondary subflange or retractable probe tube support.

If using a retractable probe tube support, remove the bolts holding the secondary subflange to the tertiary subflange. Pull the filter stack and probe tube support away from the tertiary subflange, until the stop is reached. Do not pull the probe tube support out of the tertiary subflange.

When the filter stack assembly and probe tube (and probe tube support) are fully withdrawn, close the process side isolation valve. For the triple O-Ring seal, remove the secondary subflange from the main flange by removing the remaining subflange retaining bolts. For the retractable probe tube support, remove the filter and probe tube assembly. The probe tube may be removed from the filter stack assembly and primary subflange for maintenance. See the section on installation to reinsert the probe tube and filter assembly into the stack.

Troubleshooting

The following table should give an overview of possible errors and an instruction to check and to repair them (is not valid for the starting-up period of cooler).

Error	Possible reason	Check/Repair
No sample gas flow	Filter element plugged Filter chamber exit port plugged	Check/ replace filter element Remove filter element and inspect exit port. Exit port will be located at 180°
Low temperature alarm	Insufficient warm-up time Power disconnected Control switch defective	Ensure power has been applied to the unit for a minimum of 15 minutes Ensure power is supplied to the unit. Check by measuring for AC voltage on TB1-1 & 4 Verify by measuring for a closed circuit between TB1-1 & 8 for the filter, between TB1-2 & 10 for the primary isolation valve, and between TB1-2 & 12 for the secondary isolation valve
High oxygen readings/ low pollutant readings	Leak	Leaking past the filter element O-Rings. Remove filter element and inspect O-Rings. There are two O-Rings, one located at the base of the filter element and the other in the cap. Ensure both are pliable and seated in their respective grooves Leaking blowback solenoid valve. Block or disconnect the blowback supply to verify Leaking/open bleed valve. Verify bleed valve between isolation valves is fully shut Loose connection Verify all fittings are leak free
Low readings during calibration	Insufficient calibration gas flow	Ensure calibration flow is at least 110% of the sample gas flow

Spare Parts

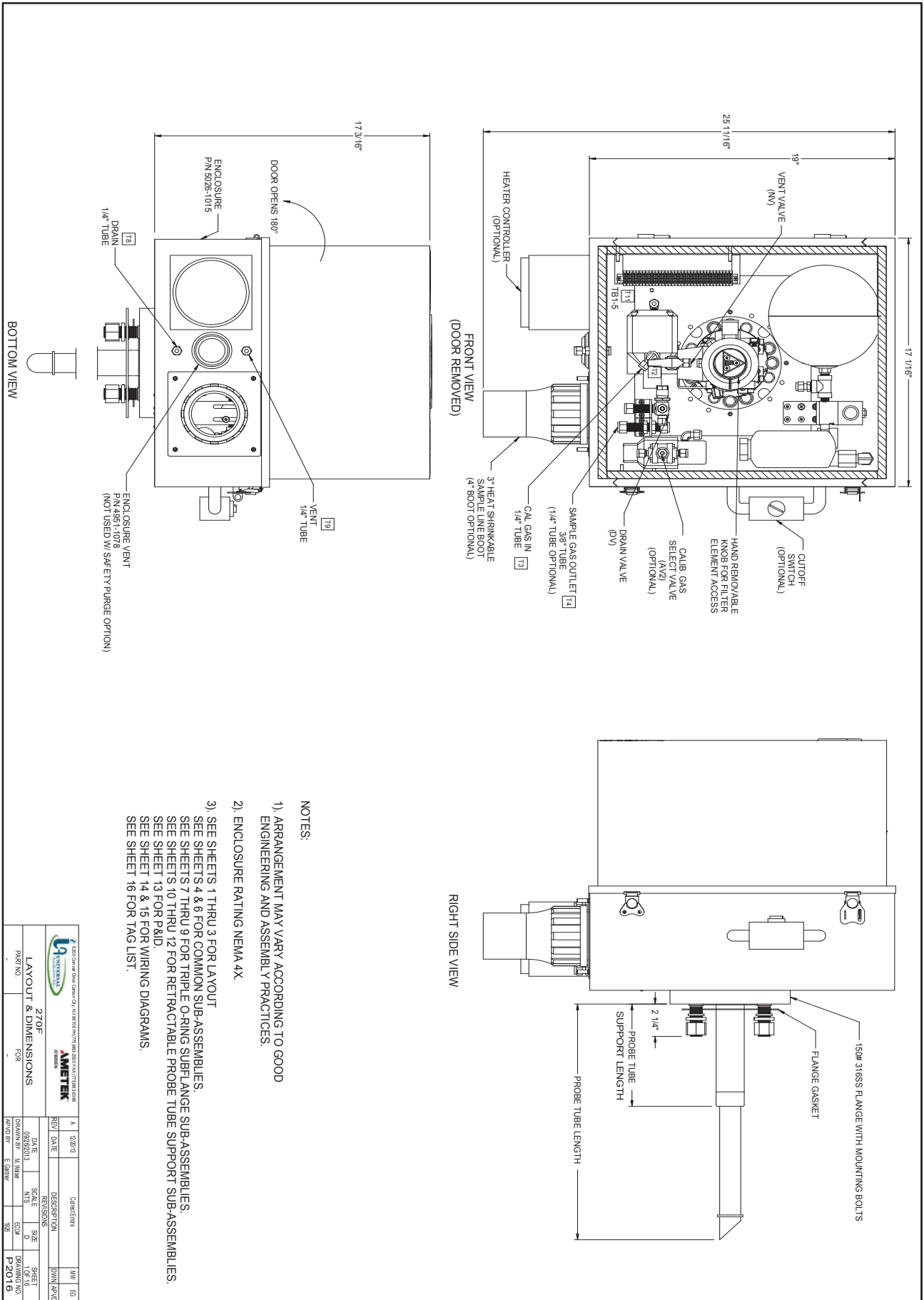
Constumable Parts	
Part	P/N
O-Ring, Kalrez, 2-120, Filter Capture	4904-2037
O-Ring, Kalrez 2-208, Filter Element	4904-2002
O-Ring, Viton 2-217, Knob Assembly	4904-2001
Filter Element Ceramic Alumina, 2 µm (Standard)	4980-0007
Filter Element Ceramic Coalesc., 1 µm Coated (optional)	4980-0018
Filter Element Ceramic Alumina, 1 µm (optional)	4980-0127

Basic Spare Parts	
Part	P/N
Temp. Switch Heater Control, Normally Closed Below 340°F (171°C)	3103-0014
Knob Assembly	5209-0103
Low Temperature Switch, Normally Closed Below 225°F (107°C)	3103-0013
Low Temperature Switch, Normally Open Below 225°F (107°C) (fail safe)	3103-0012
Valve Check 1/4" tube, 316SS, Kalrez, Silconert	4955-0254-SN
Gasket, 2" Flange	4903-1002
O-Ring, Kalrez, 2-117, Triple O-Ring Seal	4904-2021
O-Ring, Kalrez, 2-132, Tertiary Subflange	4904-2031
O-Ring, Kalrez, 2-125, Probe Tube Support	4904-2030
Solenoid Valve Blowback, 2-Way 24VDC	4955-0010
Solenoid Valve Blowback, 2-Way 120VAC	4955-0002
Solenoid Valve Blowback, 2-Way 240VAC	4955-0005
Valve, Air Toggle, NC	4955-0256

Optional Parts

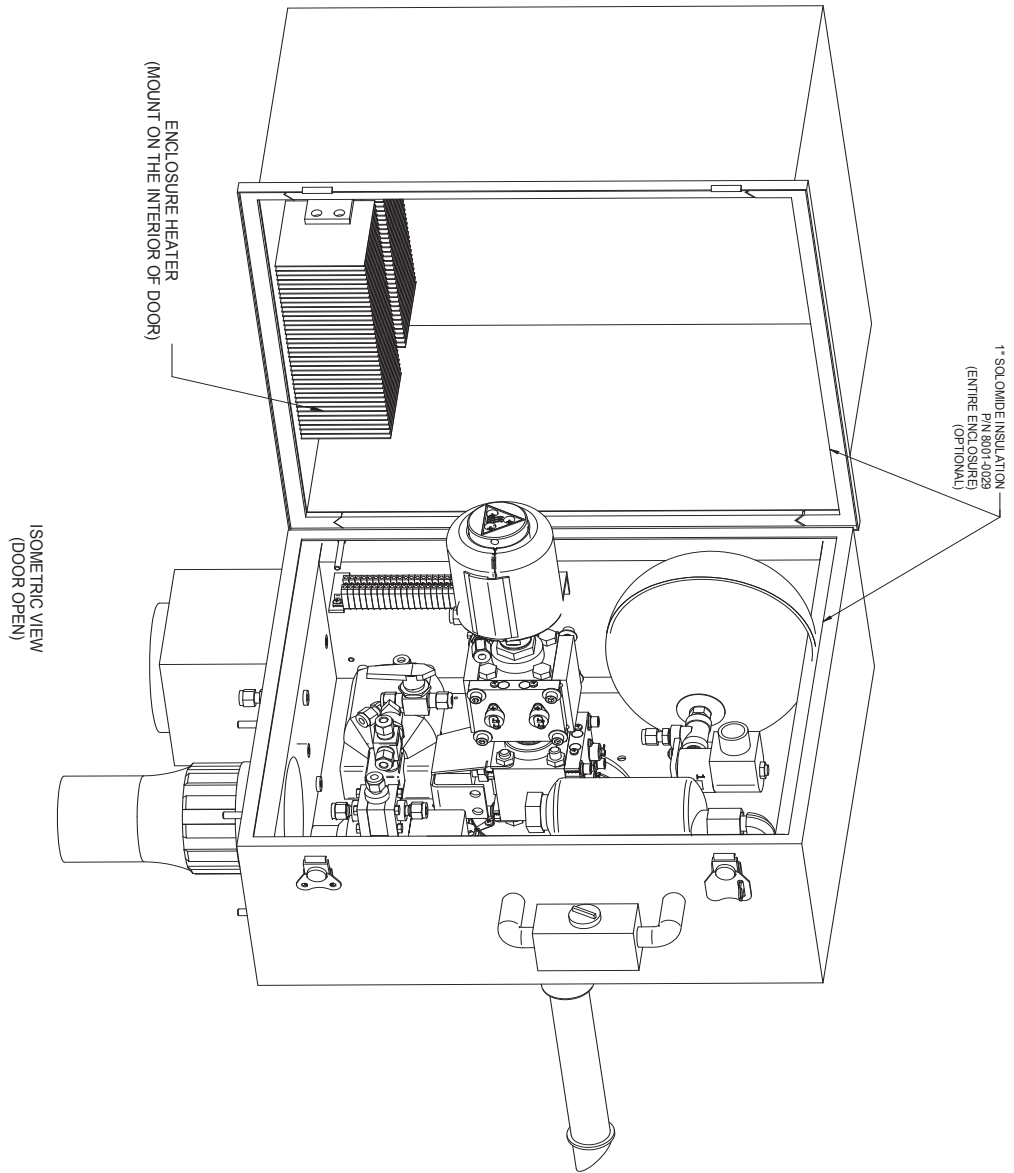
Part	P/N
Solenoid Valve, 3-way, 115VAC	4955-0131
Solenoid Valve, 3-way, 24VDC	4955-0132
Solenoid Valve, 3-way, 230VAC	4955-0140
Thermocouple (Hi-Temp) Type K 1/8" OD x 2.45	1150-0053
RTD 1/8" OD X 2.0" length 60" 3-Wire	1150-0059
Valve Needle, 1/4"T Straight 316SS, Vent	4955-0261
Gasket Ring For 3" 150# Flange	4903-0003
Boot 3" Heat Shrinkable Aperseal For 3.50" Panel Hole	4907-0004
Blanket Heater Silicone Snap 600F for 270	5150-1041
Acid Blocker Assembly, Blowback	5110-0015
Gasket Ring For 4" 150# Flange Garlock 9850 1/16" Thk	4903-0001
Boot 4" Heat Shrinkable for 4.5" Panel Hole	4907-1000
Insulation Jacket for Filter Isolation Valve	5150-1076
Valve, Filter Isolation, Manual, Silconert	4955-1042-SW-SN
Liquid trap, 0.5 SG Float, Silconert	4955-1046-SN
Accumulator Sphere Blowback, Unheated	4956-0001
Spacer, 1/2", with Captured Bolt	4910-1020
Spacer, 1", with Captured Bolt	4910-1026
Valve, 3-way, Pneumatic, Silconert	4955-1063-SW-SN
Heater Sparger	5110-2146
Liquid Stop, 316SS, 1/2" x 1/2", Silconert	4955-1046-SN
Valve, Ball 2-way, 1/4" tube, Drain, Silconert	4955-1047-SN
Valve, Ball, Pneumatic, 2-way, 3/4" FNPT, Double Acting, Silconert	4955-1080-SW-SN

Drawings Model 270F





		AMETEK <small>ANALYTICAL INSTRUMENTS</small>	
LAYOUT & DIMENSIONS PART NO. 270F FOR P2016			
REV	DATE	DESCRIPTION	DATE
1	02/01/13	CHANGES	MM 13
2			
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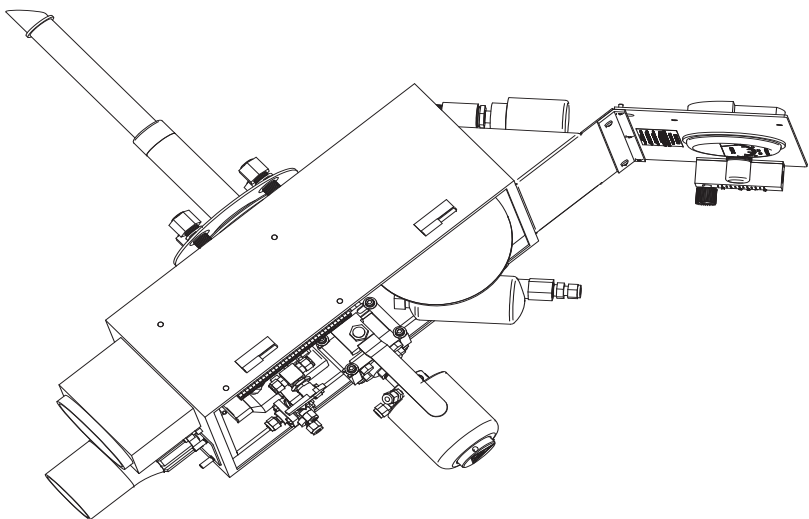
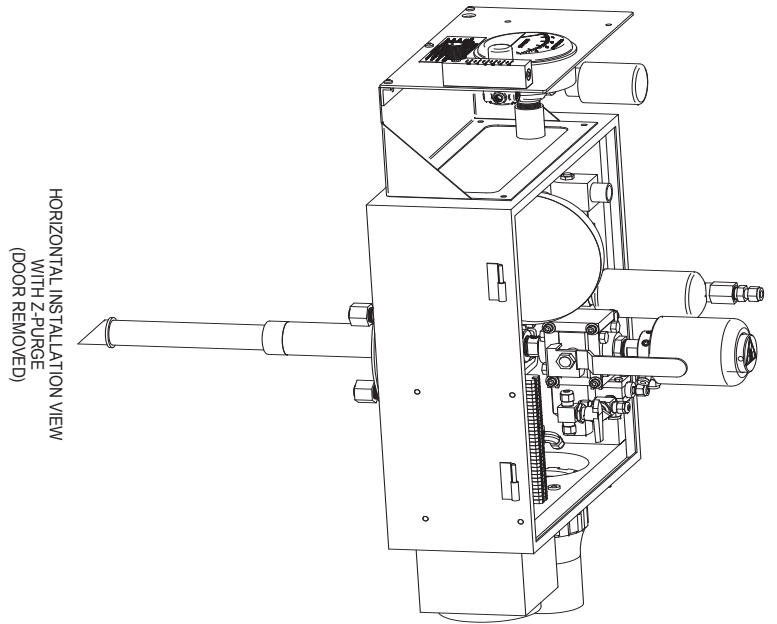
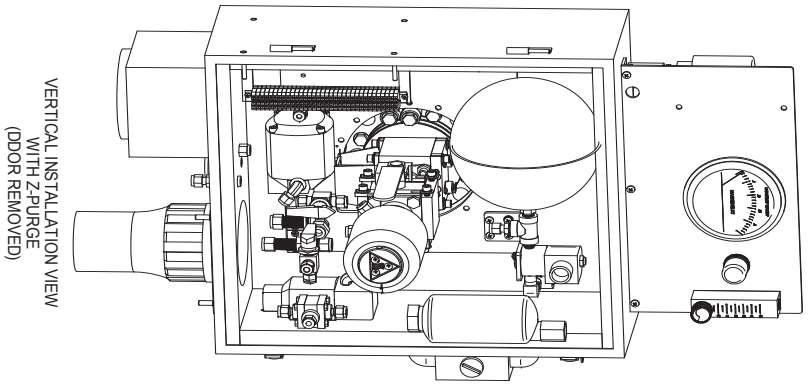
Drawings Model 270F



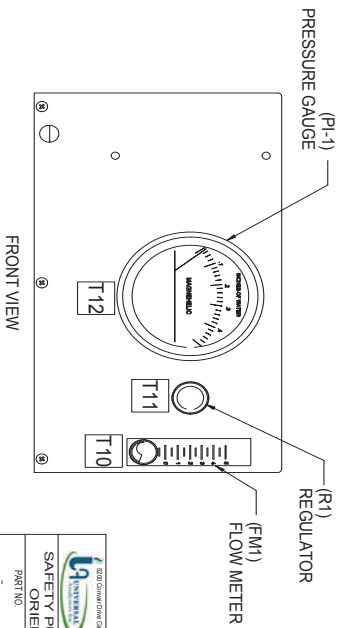
ISOMETRIC VIEW
(DOOR OPEN)

 <small>4300 Central Drive, Suite 101, W. Salem, NY 13158-1001, USA</small>		 <small>© METEK</small>	
270F HEATER DETAILS		1 10/01 10/01	
REV	DATE	DESCRIPTION	BY
DATE	SCALE	SIZE	SHEET
DRAWN BY	LIBR	ECO	DRAWING NO.

Drawings Model 270F



Z-PURGE FLOW CONTROL PANEL

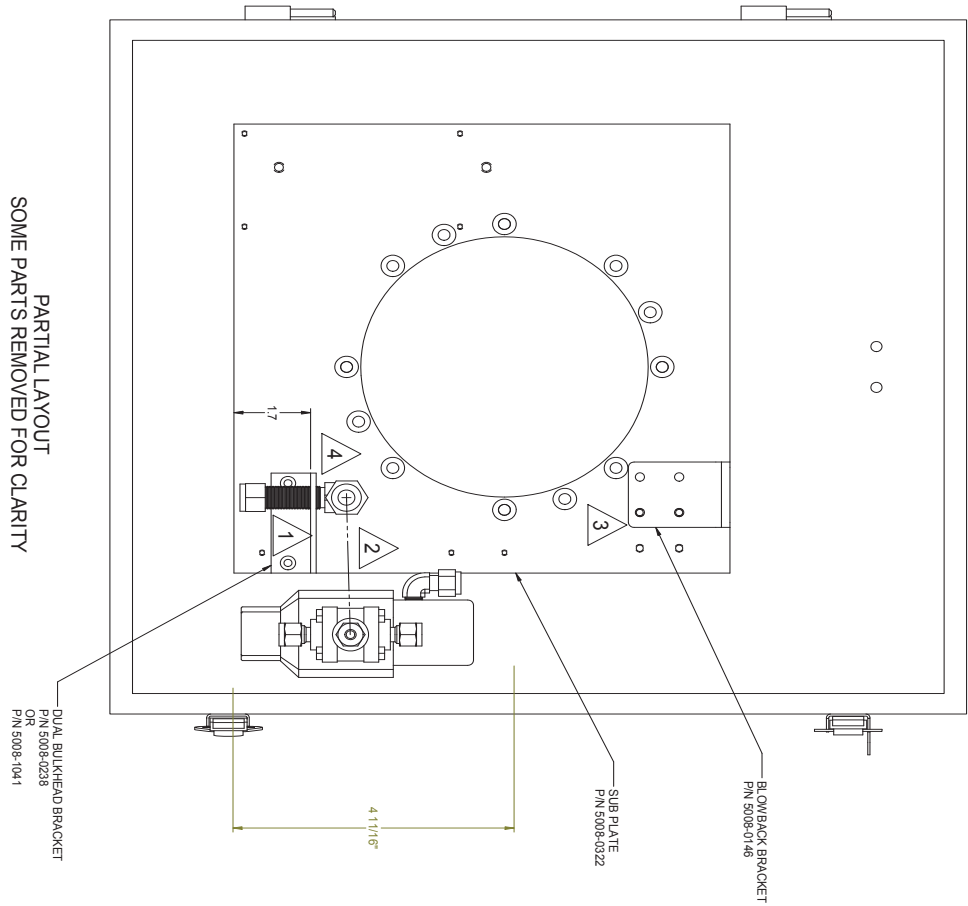


NOTES:

- 1). SAFETY PURGE IS OPTIONAL.
- 2). SAFETY PURGE NOT REQUIRED FOR HAZARDOUS AREA CERTIFICATION.

		UNIVERSAL METER SAFETY PURGE INSTALLATION ORIENTATION VIEWS FOR	
DATE	09/26/13	SCALE	1:1
DRAWN BY	NUMBER	SIZE	3.0" x 1.6"
APPROVED BY	ES/MSW	SHEET	1 OF 16
		DRIVING NO.	F2019
		REV	
		DATE	02/01/13
		DESCRIPTION	Order Bids
		REV	53
		DATE	
		DESCRIPTION	
		REV	

Drawings Model 270F

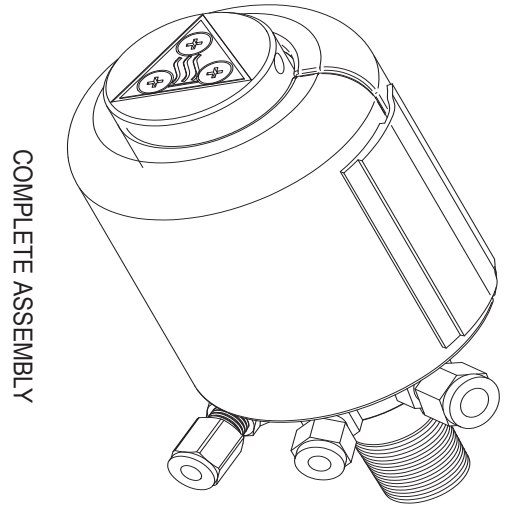


PARTIAL LAYOUT
SOME PARTS REMOVED FOR CLARITY

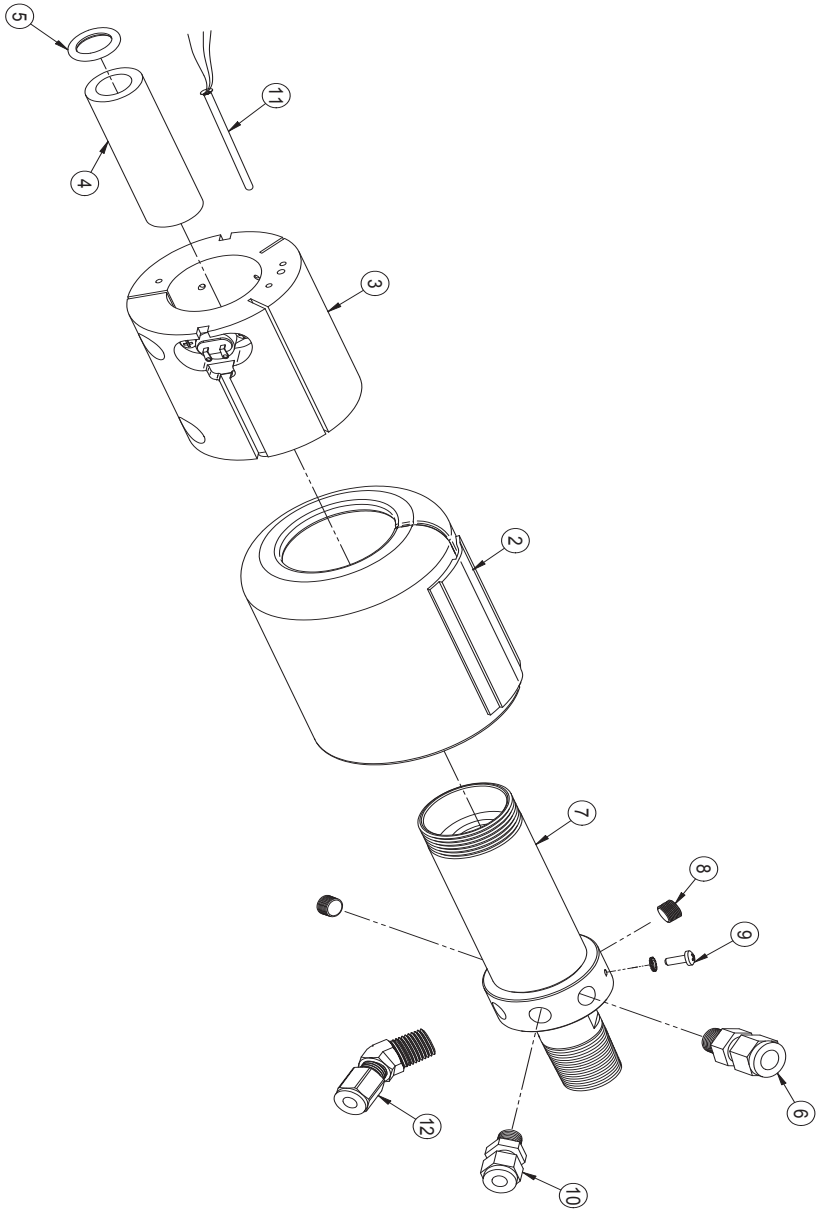
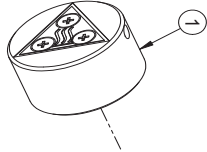
- NOTES:
- 1 BRACKET MAY BE REVERSED IF NEEDED TO CHANGE POSITION OF 3/8" FITTING.
 - 2 COMMON PORT OF 3-WAY CALIBRATION VALVE SHOULD LINE UP WITH ELBOW BULKHEAD.
 - 3 USE TWO PREDRILLED HOLES FOR BLOWBACK BRACKET TO LINE UP TWO NEW HOLES.
 - 4 ELBOW BULKHEAD IS PART OF DRAIN PATH FOR UNITS WITH LIQUID STOP, AND IS SAMPLE OUT FOR UNITS WITHOUT LIQUID STOP.

		AMETEK CORPORATION		1300 Central Expressway, North Wales, PA 19381-1598 610-376-8100	
DETAILED SUBPLATE LAYOUT FOR		DATE: 08/20/13	REVISIONS:	SCALE: NTS	SIZE: D
PART NO:	FOR:	DRAWN BY:	CHECKED BY:	DATE:	SHEET:
					TOTAL SHEETS:
					PART NO: P2016

Drawings Model 270F



COMPLETE ASSEMBLY



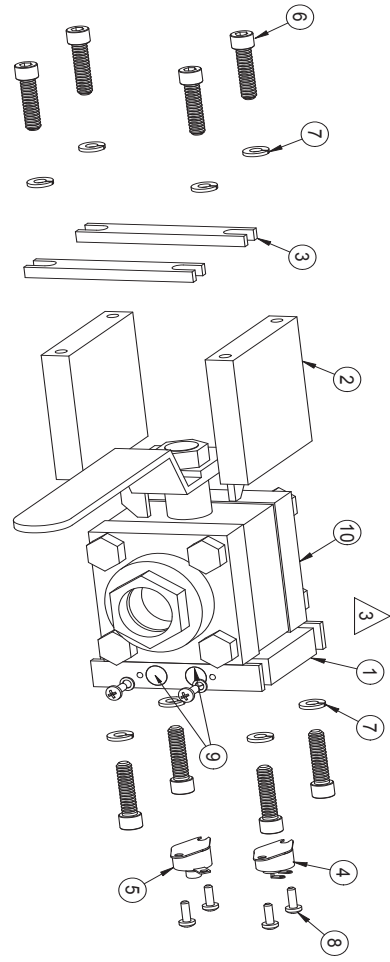
EXPLODED VIEW

PARTS TABLE

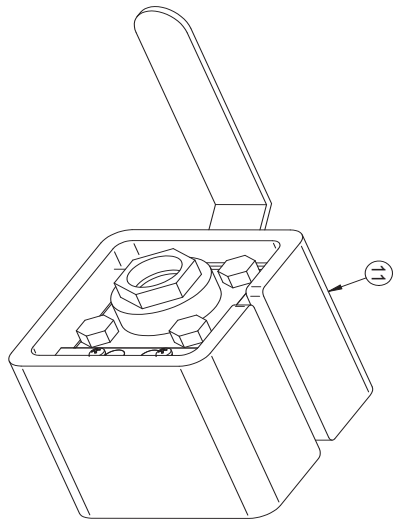
Item Qty	DMC #	Part #	Description
12	1	4954-006-SN	Elbow 45° 1/8" MNPT x 1/4" Tube (Optional)
11	1	1150-0063	T.C. Type K 1/8" x 2.4"
11	1	1150-0069	RTD 1/8" x 2"
10	2	4954-005-SN	Fitting 1/4" Tube x 1/8" MNPT - SN
9	1	-	#6-32 x 3/8 PH Screw w/ Ext. Star Washer
8	3/4	4954-003-SN	1/8" NPT Plug - SN
7	1	5190-006-SN	Chamber Assembly
6	1	4954-005-SN	Fitting 3/8" T x 1/8" NPT - SN
5	1	4904-2012	Karel (Filter Element) #2208
4	1	M0080	Filter Element, 2 Micron Ceramic
3	1	A4A76	3014-0048 Heater Tube Assembly (Blue) - FH
2	1	A4A76	3014-0047 Heater Tube Assembly (Yellow) - FH
1	1	V0234	5150-1041 Silicone Insulation Bracket
1	1	A0152	5209-0103-SN Cap Assembly

		12000 Central Blvd. Denver, CO 80231 (303) 751-7800 FAX (303) 751-7801	
FILTER CHAMBER ASSEMBLY PART NO. 270F		UNIVERSAL METER MODEL 270F	
DATE	09/26/13	DESIGNER	DMC
DRAWN BY	M. WARR	CHECKED BY	E. SHIBER
SCALE	N.T.S.	SIZE	D
SHEET	5 OF 16	PARTS NO.	12019

Drawings Model 270F



EXPLODED VIEW



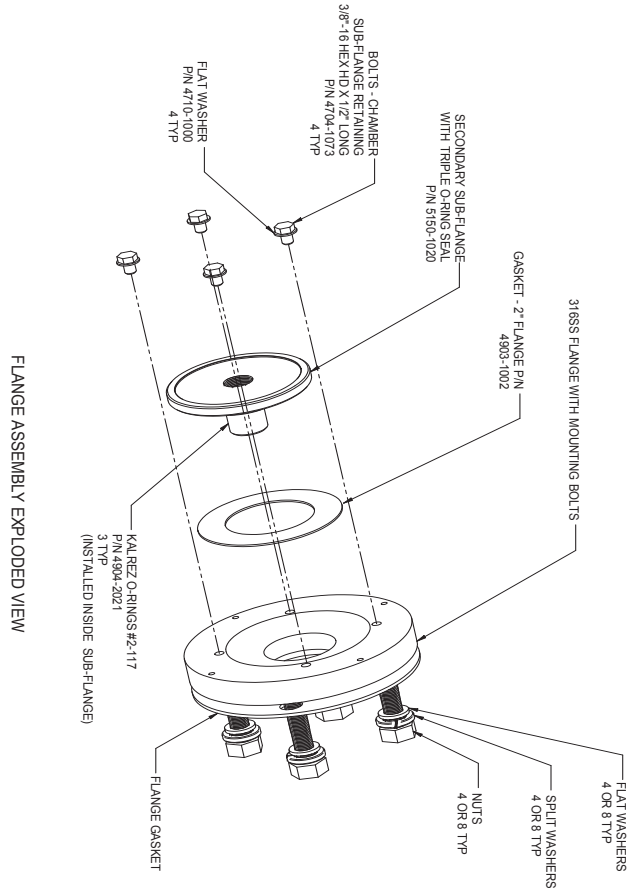
COMPLETE ASSEMBLY

Item	Qty	Part No.	DWG	Description
1	1	5110-0257	M1226	Oven Wall Side Temp. Switch Mount & Heater Wells
2	2	5110-0258	M1227	Oven Wall Top & Bottom Oven Base Clamps
3	2	5110-0259	M1228	Switch Oven Control TS2, TS3
4	1	See Wiring Schematic	-	Switch Oven Under Alarm Temp TS5, TS6
5	1	See Wiring Schematic	-	1/4-20 x 1" Socket Head
6	8	4704-0170	-	1/4-20 Lock Washer
7	8	4710-0019	-	6-32 x 1/4" Panhead Phillips Heater Rods, 1.5" HTR 3,4,5, & 6
8	4	4704-0001	-	Ball Valve
9	2	See Wiring Schematic	-	Insulation Jacket
10	1	See P&ID	-	
11	1	5150-1076	-	

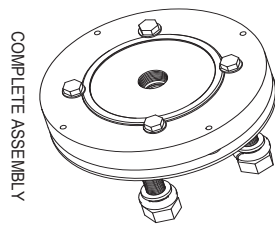
NOTES:

- 1. ONE OR TWO VALVE ASSEMBLIES PER UNIT. (DEPENDING ON NUMBER OF FILTER ISOLATION VALVES)
- 2. HEATER RODS ARE EPOXIED IN PLACE.
- 3. ASSEMBLE ITEMS ① & ② SO THEY ARE TIGHT AGAINST ONE ANOTHER.

		270F HEATED ISOLATION VALVE ASSEMBLY	
DATE	SCALE	SIZE	SHEET
09/29/2013	NIS	D	1 OF 18
DESIGNED BY	DRAWN BY	ECN	REV
			12018



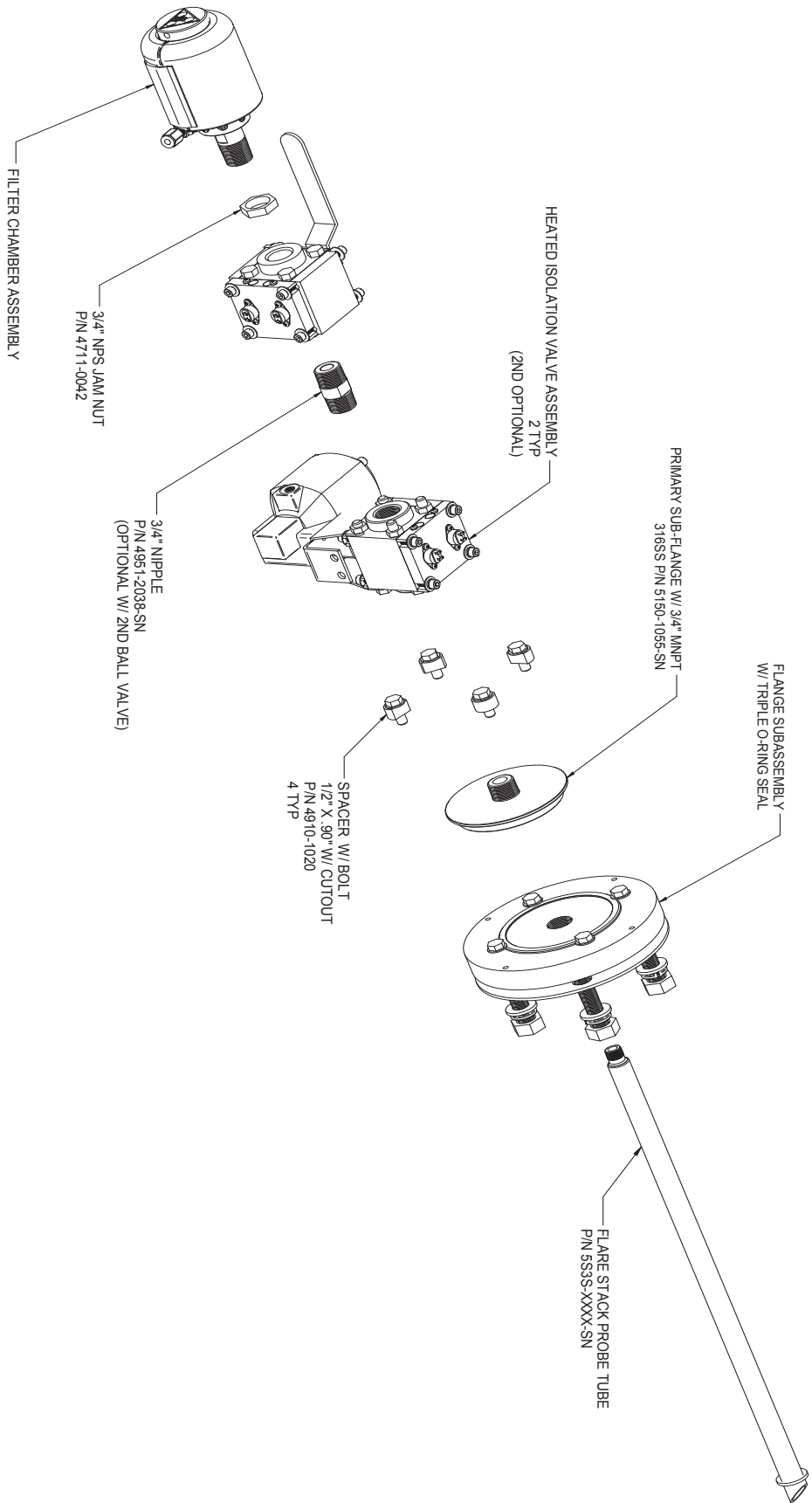
FLANGE ASSEMBLY EXPLODED VIEW



COMPLETE ASSEMBLY

		316SS COMP. FLANGE ASSEMBLY FOR 270F TRIPLE O-RING SUB-FLANGE ASSEMBLY	
PART NO.	270F TRIPLE O-RING SUB-FLANGE ASSEMBLY FOR	REV. DATE	A 02/2013
DATE	09/29/2013	SCALE	1:1
DRAWN BY	MSH/MS	SIZE	D
APPROVED BY	ES/MSH	SHEET	7 OF 16
		DRAWING NO.	12010

Drawings Model 270F



		UNIVERSAL METER <small>GENERAL INSTRUMENTS</small>	
270F TRIPLE O-RING FILTER LINE SUBASSEMBLY			
FOR			
PART NO.	REV.	DATE	DESCRIPTION
	A	02/01/13	Change Desc
		09/28/2013	
DRAWN BY	NUMBER	SCALE	SIZE
ES/BBB	ES/BBB	NIS	D
		ECO	
		99	
			SHEET 8 OF 18
			FIG. NO. P2010

Drawings Model 270F

RETRACTION NOTE:
 TO REMOVE PROBE TUBE FROM ACTIVE SERVICE:

- 1) CLOSE ISOLATION BALL VALVES AV1/BV1 & BV2.
- 2) DISCONNECT PNEUMATIC & ELECTRICAL CONNECTIONS TO HEATED FILTER CHAMBER & ISOLATION BALL VALVE ASSEMBLY.
- 3) REMOVE 4 BOLTS HOLDING PRIMARY SUB-FLANGE TO SECONDARY SUB-FLANGE. USE 9/16 SOCKET TO REMOVE BOLTS. BOLTS ARE MARKED WITH $\frac{3}{8}$ ON DRAWING & ARE ON TOP OF THE PRIMARY SUB-FLANGE VICE PARTIALLY COVERED BY PRIMARY SUB-FLANGE.
- 4) FULLY RETRACT PROBE TUBE TO PROBE STOP.
- 5) CLOSE CUSTOMER SUPPLIED PROCESS ISOLATION VALVE.
- 6) REMOVE REMAINING 4 SUB-FLANGE BOLTS TO SEPARATE SECONDARY SUB-FLANGE FROM FLANGE.

SECTION AA

PROBE TUBE RETRACTED

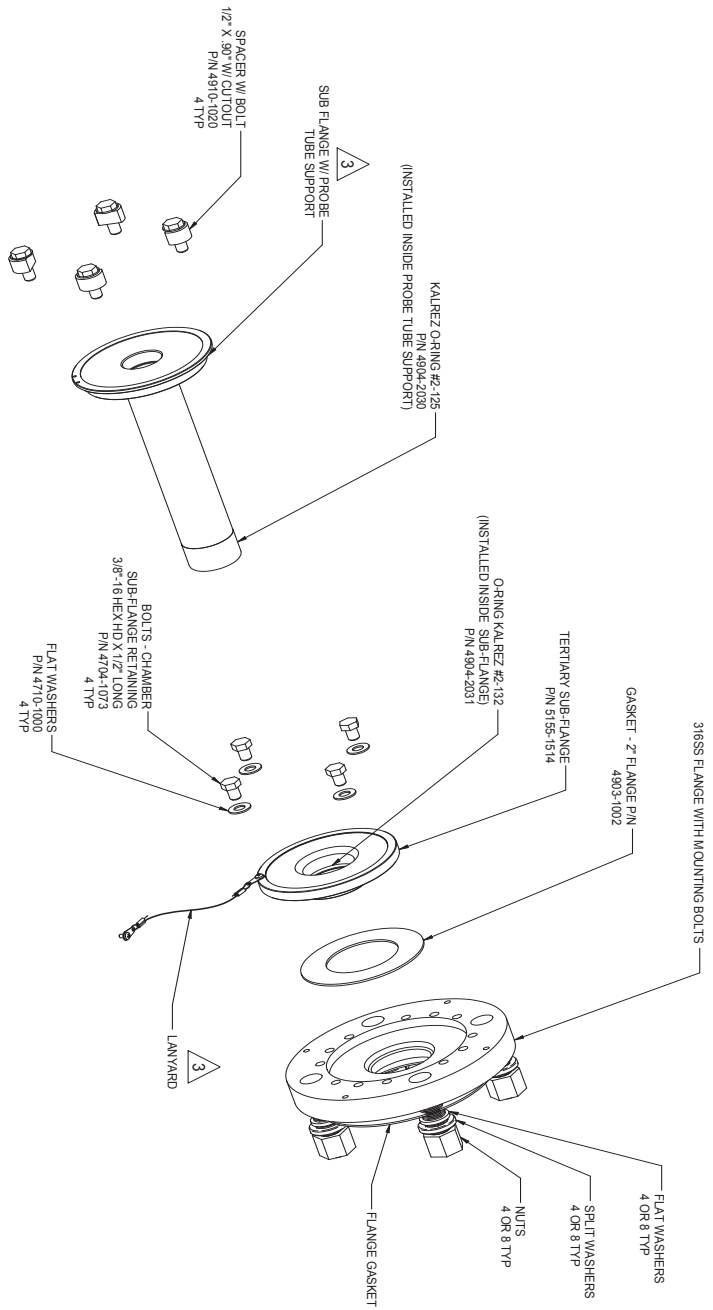
DETAIL B
 PROBE TUBE COLLAR ASSEMBLY

DETAIL C
 PROBE TUBE STOP

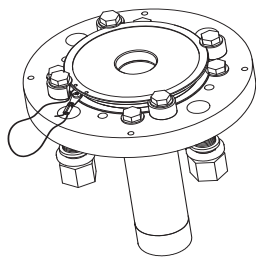
Labels in diagrams: ISOLATION BALL VALVE AV1/BV1, SAMPLE GAS, FLANGE, SECONDARY SUB-FLANGE, PRIMARY SUB-FLANGE, PROBE TUBE, PROBE TUBE STOP, C.

270F TRIPLE CHAMBER SUBFLANGE ASSEMBLY DETAIL FOR		A 12/2013 CONFIDENTIAL	
DATE	02/20/13	SCALE	AS SHOWN
DRAWN BY	M. WILSON	SIZE	AS SHOWN
APPROVED BY	E. GIBNEY	DRAWING NO.	P2016
PART NO.		REV	

FLANGE AND PROBE TUBE SUPPORT SUB-ASSEMBLY



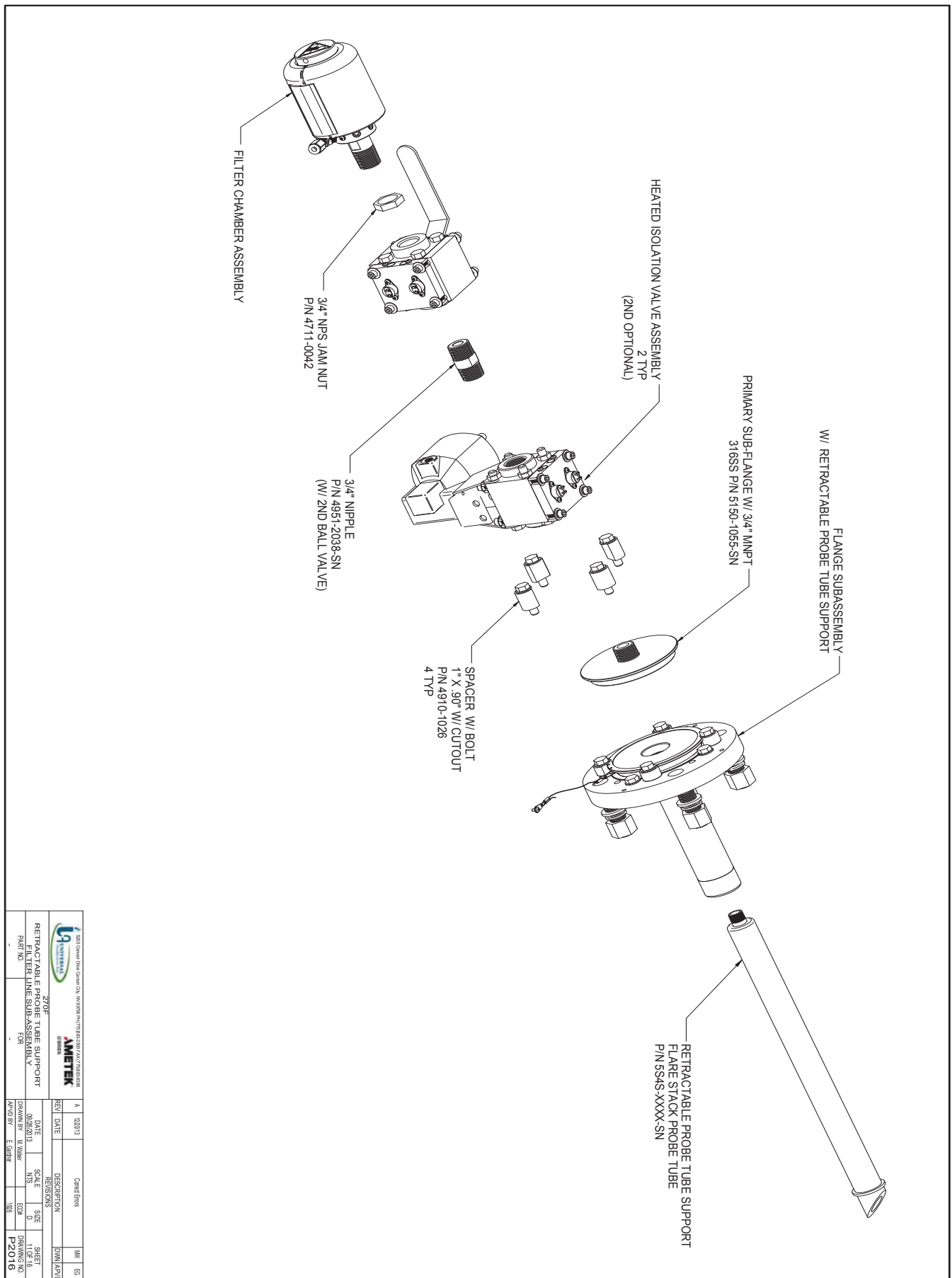
COMPLETE SUB-ASSEMBLY



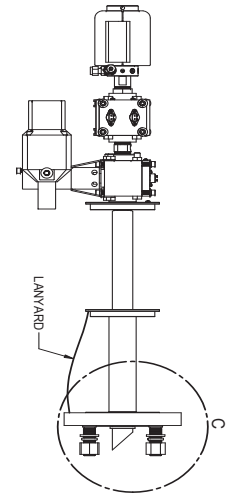
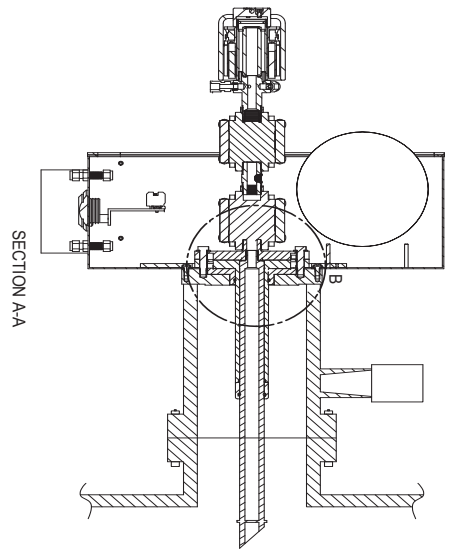
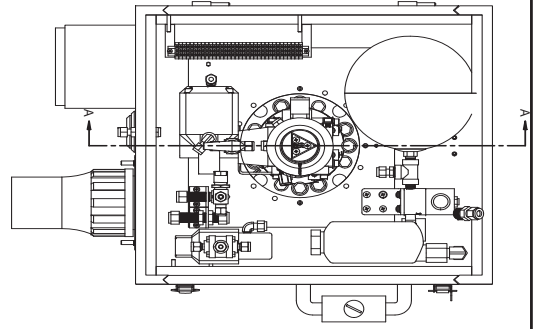
- NOTES:
- 1) 1/2" LONG BOLTS USE CENTER HOLE OF EACH SUB-FLANGE BOLT HOLE CLUSTER.
1/2" SPACERS USE COUNTER CLOCKWISE HOLE OF EACH SUB-FLANGE BOLT HOLE CLUSTER.
 - 2) LANYARD ATTACHED TO SUB-FLANGES AT LANYARD HOLES.
ENSURE SUB-FLANGE HOLES ARE NOT COVERED BY SUB-FLANGE BOLTS & LANYARD HOLES ROUGHLY LINE UP.
 - 3) PROBE TUBE SUPPORT & LANYARD SIZES ARE VARIABLE. LANYARD LENGTH SHOULD BE 1" LONGER THAN PROBE TUBE SUPPORT. LANYARD LENGTH **MUST** PREVENT PROBE TUBE SUPPORT FROM BEING RETRACTED THROUGH TERTIARY SUB-FLANGE WHEN INSTALLED.

270F RETRACTABLE PROBE TUBE SUPPORT SUB-FLANGE ASSEMBLY		316SS FLANGE WITH MOUNTING BOLTS GASKET - 2" FLANGE P/N 4903-1002 TERTIARY SUB-FLANGE P/N 5155-1514 O-RING KALREZ #2-132 (INSTALLED INSIDE SUB-FLANGE) P/N 4904-2031 SUB-FLANGE W/ PROBE TUBE SUPPORT SPACER W/ BOLT 1/2" X .98" W/ CUTOUT P/N 4910-1020 4 TYP BOLTS - CHAMBER SUB-FLANGE RETAINING 3/8"-16 HEX HD X 1/2" LONG P/N 4704-1073 4 TYP FLAT WASHERS P/N 4710-1000 4 TYP FLAT WASHERS 4 OR 8 TYP SPLIT WASHERS 4 OR 8 TYP NUTS 4 OR 8 TYP FLANGE GASKET LANYARD	
REV	DATE	DESCRIPTION	BY
A	12/01/13	Checked Bross	JM
DATE		SCALE	SHEET
02/02/2016		N/A	10 OF 16
DRAWN BY		INCHES	DRAWING NO.
E. BURR		004	P2016
APPROVED BY		NO.	
		503	

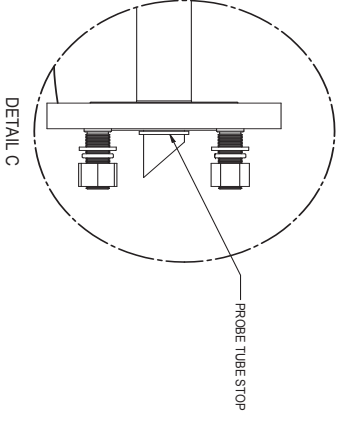
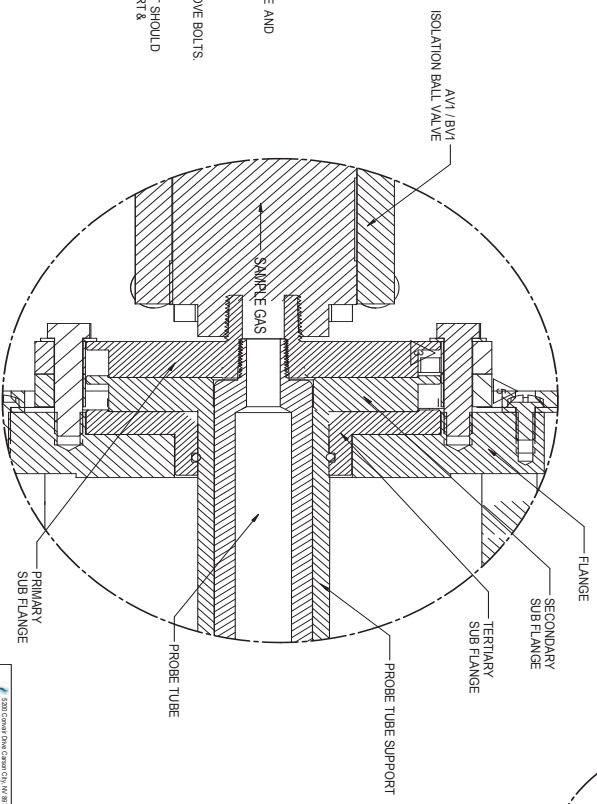
Drawings Model 270F



1500 Columbia Drive, Canby, OR 97103-1001 503-265-2200 www.ametek.com			
PART NO. RETRACTABLE PROBE TUBE SUPPORT FILTER LINE SUB-ASSEMBLY FOR	REV. DATE 1 02/013	DESIGNED BY CHAD EGOS	DWG. NO. P2016
DATE 06/26/2013	DRAWN BY AL WARR	CHECKED BY E. GIBBE	SHEET 1 OF 16
SCALE NIS	SIZE 11" X 16"	DIMENSIONS INCHES	DRAWING NO. P2016



- NOTES
- TO REMOVE PROBE TUBE FROM ACTIVE SERVICE:
- 1) CLOSE ISOLATION BALL VALVES (AV1/BV1 & BV2)
 - 2) DISCONNECT GAS & ELECTRICAL CONNECTIONS TO HEATED FILTER CHAMBER & ISOLATION BALL VALVE ASSEMBLY.
 - 3) REMOVE 4 BOLTS HOLDING PRIMARY SUBFLANGE TO SECONDARY SUBFLANGE. USE 9/16" SOCKET TO REMOVE BOLTS. NOT RETRACTED FURTHER THAN ITS LENGTH TO AVOID BREAKING SEAL BETWEEN PROBE TUBE SUPPORT & TERTIARY SUBFLANGE.
 - 4) FULLY RETRACT PROBE TUBE TO PROBE STOP.
 - 5) REMOVE 4 BOLTS HOLDING SECONDARY SUBFLANGE TO TERTIARY SUBFLANGE. USE 9/16" SOCKET TO REMOVE BOLTS. BOLTS ARE THOSE WHOSE HEADS ARE FURTHEST FROM THE FLANGE & ARE NOT PARTIALLY COVERED.
 - 6) RETRACT PROBE TUBE & PROBE TUBE SUPPORT TO EXTENT ALLOWED BY LANYARD. PROBE TUBE SUPPORT SHOULD NOT BE RETRACTED FURTHER THAN ITS LENGTH TO AVOID BREAKING SEAL BETWEEN PROBE TUBE SUPPORT & TERTIARY SUBFLANGE.
 - 7) CLOSE CUSTOMER SUPPLIED PROCESS ISOLATION VALVE.
 - 8) DISCONNECT LANYARD & REMOVE PROBE ASSEMBLY FROM FLANGE.
 - 9) TO INSTALL PROBE ASSEMBLY:
 - A) INSTALL PROBE ASSEMBLY INTO FLANGE. CONNECT LANYARD TO PROBE ASSEMBLY.
 - B) SECURE ISOLATION VALVE & FULLY INSERT SUBFLANGE IN PROBE TUBE SUPPORT.
 - C) FULLY INSERT PROBE TUBE INTO PROBE TUBE SUPPORT. SECURE FILTER ASSEMBLY SUBFLANGE TO FLANGE USING 1" SPACER W/ BOLT.
 - D) CONNECT GAS & ELECTRICAL CONNECTIONS TO HEATED FILTER & ISOLATION BALL VALVE ASSEMBLY.
 - E) OPEN ISOLATION VALVE (AV1/BV1 & BV2).



270F Retractable Probe Tube Support Assembly 270F RETRACTABLE PROBE TUBE SUPPORT ASSEMBLY		270F RETRACTABLE PROBE TUBE SUPPORT ASSEMBLY	
REV	DATE	DESCRIPTION	DRAWN BY
A	02/20/13	Change Draw	IMI SS
DATE: 02/20/13 DRAWN BY: NUMBER APPROVED BY: E. Chinnar		SHEET: 12 OF 16 DRAWING NO: P2016	

Limited Warranty

I. Limited Warranty

1. Limited Warranty. Universal Analyzers, Inc (UAI) offers a limited warranty on each of its products against failure due to defects in material and workmanship for a period ending the earlier of (i) fifteen (15) months from the date of the invoice relating to the sale of the product and (ii) twelve (12) months from the date of installation of the product (collectively, the "Initial Warranty"). During the Initial Warranty, UAI offers a limited warranty against failure due to defects in material and workmanship on each part of a product repaired or replaced by an authorized service person for a period ending the later of (a) the remaining term of the Initial Warranty of the product and (b) ninety (90) days from the date of such repair or replacement. After expiration of the Initial Warranty, UAI offers a limited warranty against failure due to defects in material and workmanship on each part of a product repaired or replaced by an authorized service person for a period ending ninety (90) days from the date of such repair or replacement. UAI further offers a limited warranty that the products and parts it sells will conform to UAI's written specifications therefor. The foregoing limited warranties cover parts and labor only and UAI does not warrant and will not reimburse the buyer of its products ("Buyer") for any costs relating to the access by service persons of UAI to the product at issue. The foregoing limited warranties cover only the repair or replacement of defective parts and such determination will be in the sole discretion of UAI. In its sole discretion, UAI may make repairs or replacements under these limited warranties with either new or refurbished parts. To the extent Buyer's product cannot be remedied under these limited warranties through repair or replacement of parts, Buyer may return the product for a refund of the purchase price, less a reasonable reduction in such purchase price equal to the depreciation expense incurred by Buyer relating to such product. The limited warranties of this Section I.1. are further subject to those warranty exclusions set forth below in Section I.2.

2. Limited Warranty Exclusions. Excluding the warranties provided for in Section I.1., UAI provides all products to Buyer "as-is," without any other warranty of any kind. UAI disclaims any and all express or implied warranties of merchantability, fitness for a particular purpose and non-infringement of the intellectual property of others. UAI makes no warranty, express or implied, as to the design, sale, installation or use of its products. UAI's warranties will not be enlarged by, nor will any obligation or liability of UAI arise due to UAI providing technical advice, facilities or service in connection with any product. There is no warranty by UAI with respect to any product's: (i) uninterrupted or error-free operation; (ii) actual performance, other than the product's capability to meet UAI's specifications therefor; (iii) removal or installation from a worksite or process; (iv) electronic components or associated accessories (including without limitation circuit boards and integrated circuits); (v) maintenance (including without limitation gasket and seal replacements, adjustments, minor repairs and other inspection requirements, preventative or otherwise); (vi) use under inappropriate conditions or not in accordance with operating instructions; or (vii) use in connection with the operation of a nuclear facility. There is no warranty for labor expenses associated with field repairs or the repair or replacement of defective parts in the engine or power unit of any product if such product has been in the possession of the owner or operator for greater than twelve (12) months. There is no warranty for products determined to be, in UAI's sole discretion, damaged as a result of (a) misuse, neglect or accident; (b) improper application, installation, storage or use; (c) improper or inadequate maintenance or calibration; (d) operation outside of the published environmental specification; (e) improper site preparation or maintenance; (f) unauthorized repairs or replacements; (g) modifications negligently or otherwise improperly made or performed by persons other than UAI; (h) Buyer-supplied software or supplies; (i) use in conjunction with or interfacing with unapproved accessory equipment; (j) use of ABC-style or dry powder fire suppression agents; or (k) leaked sample materials. To the extent a UAI product is used in connection with the operation of a nuclear power facility, Buyer agrees to indemnify and hold UAI harmless from any and all actions, claims, suits, damages and expenses arising from such use. UAI provides no warranty on the oral representations made by its personnel while they are attempting to assist Buyer in the operation of a product. This Standard Limited Warranty does not apply to items consumed by the products during their ordinary use, including but not limited to fuses, batteries, paper, septa, fittings, screws, fuses, pyrolysis, dryer or scrubber tubes, sample boats, furnaces or UV lamps.

3. Non-UAI Products. UAI does not in any way warrant products it does not manufacture except to the extent the warranty of the manufacturer of the product at issue passes through or is otherwise assigned to UAI. If a manufacturer warranty is so assigned to UAI, UAI will only be bound to comply with the length of time associated with such warranty. All other terms of such warranty will be governed by this Standard Limited Warranty and UAI's General Terms and Conditions incorporated herein by reference.

Limited Warranty

4. Expenses on Non-Warranty Work. All repairs or replacements by UAI after the expiration of any applicable limited warranty period will be performed in accordance with UAI's standard rate for parts and labor. Further, if upon UAI's inspection and review, UAI determines the condition of the products is not caused by a defect in UAI's material and workmanship, but is the result of some other condition, including but not limited to damage caused by any of the events or conditions set forth in Section I.2., Buyer shall be liable for all direct expenses incurred by UAI to conduct the inspection and review of the product.

5. Exclusive Remedy. The foregoing limited warranty constitutes Buyer's exclusive remedy with respect to products sold by UAI and UAI's liability shall be exclusively limited to the written limited warranty specified herein. No employee, representative or agent of UAI is authorized to either expressly or impliedly modify, extend, alter or change any of the limited warranties expressed herein to Buyer.

6. Procedure and Costs. All limited warranty claims must be made in writing promptly following discovery of any defect. Buyer must hold defective products for inspection by UAI. If requested by UAI, Buyer must send the product to UAI for inspection. Any such returns by Buyer will be at Buyer's expense and Buyer will remain liable for any loss of or damage to the product during such product's transportation to UAI. No products will be sent to UAI for inspection unless UAI has authorized Buyer to do so.

7. Terms and Conditions. UAI's General Terms and Conditions are incorporated herein by reference and Buyer accordingly agrees to be bound by the terms thereof.

II. Limitations on UAI Liability

1. In General. Buyer agrees UAI shall not be liable for any direct, indirect, incidental, punitive or consequential damages, including lost profits, lost savings or loss of use, whether Buyer's claim is based in contract, tort, warranty, strict liability or otherwise, which Buyer may suffer for any reason, including reasons attributable to UAI. Buyer agrees these limitations on UAI's liability are reasonable and reflected in the amounts charged by UAI for its products.

2. Force Majeure. This Standard Limited Warranty does not cover and UAI shall not be liable for either direct or consequential damage caused, either directly or indirectly, as a result of: (i) any act of God, including but not limited to natural disaster, such as floods, earthquakes, or tornadoes; (ii) damages resulting from or under the conditions of strikes or riots, war, damages or improper operation due to intermittent power line voltage, frequency, electrical spikes or surges, unusual shock or electrical damage; or (iii) accident, fire or water damage, neglect, corrosive atmosphere or causes other than ordinary use.

3. Limitation on Warranty Claims. Prior to any obligation of UAI to perform any limited warranty service as set forth herein, Buyer must have: (i) paid all invoices to UAI in full, whether or not they are specifically related to the product at issue; and (ii) notified UAI of the limited warranty claim within sixty (60) days from the date Buyer knew or had reason to know of the defect



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