



Instruction Manual

Model 270SF

Extractive Gas Sample Probe



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1.0 Receiving and Storage

The Universal Analyzers 270SF Extractive Gas Sample Probe are completely pre-assembled. No assembly is necessary when received on-site.

Carefully inspect the product 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.

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

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.

2.0 Definition of Symbols



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



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.

3.0 Product Identification

270SF (subflange design) Gas Sample Probe for General Purpose & Hazardous Areas

270SF Model Extraction Sample Probe (Items marked with ** are not available on FM and ++ for ATEX hazardous area probes All Sample Probes are Configured and Sold WITHOUT probe tubes (Stinger, Quill, Straw)	
Chamber Material (Part Number Configurator: 270)	
SF	316 Stainless Steel <400°F (204°C) (Standard) -Sub-Flange Mount
CF	Hastelloy C-276 < 400°F (204°C) -Sub-Flange Mount
TF	316 Stainless Steel w/TFE Coating < 400°F (204°C) -Sub-Flange Mount (no chamber isolation valve option)
NF	316 Stainless Steel w/ SilcoNert™ 2000 Coating < 400°F (204°C) -Sub-Flange Mount
SHF	316SS Hi Temp w/Kalrez® < 550°F (288°C) -Sub-Flange Mount
CHF	Hastelloy C-276 Hi Temp w/Kalrez® < 550°F (288°C) -Sub-Flange Mount
NHF	316 Stainless Steel w/ SilcoNert™ 2000 Coating Hi Temp w/ Kalrez® < 550°F (288°C) -Sub-Flange Mount
xxxU	For Chamber Isolation Valve, add a 'U' to the End of the Chamber Material Selection for Unheated
xxxV	For Chamber Isolation Valve, add a 'V' to the End of the Chamber Material Selection for Heated **++
	Unheated - 316SS Valve, Monel (used with Hast. C-276 chamber), 316SS SilcoNert™ 2000
	Low Temp (heated to 270 °F) - 316SS Valve, Monel (used with Hast. C-276 chamber), 316SS SilcoNert™ 2000
	High Temp (heated to 550 °F) - 316SS Valve, Monel (used with Hast. C-276 chamber), 316SS SilcoNert™ 2000
Flange Size (Other Sizes Available, Consult the Factory)	
F1	1.5" Flange
F2	2" Flange
F3	3" Flange
F4	4" Flange
F6	6" Flange
F1T	1.5" Flange - Top Dead Center
F2T	2" Flange - Top Dead Center
F3T	3" Flange - Top Dead Center
F4T	4" Flange - Top Dead Center
F6T	6" Flange - Top Dead Center
Chamber Heat Control	
340	340°F (171°C) Temp Switch (Standard) - Mandatory for FM/ ATEX Approved Units (Standard)
375	375°F (190°C) Temp Switch****
550	550°F (288°C) Temp Switch**** (use high temp chamber in Chamber Material)
R	RTD Only**** (includes 550 °F safety switch)
K	T/C Only, Type K**** (includes 550°F safety switch)
J	T/C Only, Type J**** (includes 550°F safety switch)
Blowback Type	
BB	Blowback (Standard)
BT	Blowback w/ Smart Timer (Same as system voltage, 115 or 230 VAC. BB valve must match)****
HB	Heated Blowback****
HT	Heated Blowback w/Smart Timer (Same as system voltage, 115 or 230. BB valve must match)****
N	No Blowback
Blowback Port	
S	Standard Blowback
P	Blowback Probe Tip Filter Only - No Chamber Blowback
N	No Blowback
Blowback Valve	
24	24 VDC Actuator
1	115 VAC Actuator
2	230 VAC Actuator
A	Pneumatic Actuator
N	No Blowback
Enclosure (If Heatshrink Boot is other than 3", identify size after enclosure designator) 2 = 0.75" - 1.6" (19.05mm - 40.64mm) Dia. 3 (Standard) = 1.38" - 2.75" (35.05mm - 69.85mm) Dia. 4 = 1.43" - 4.47" (36.32mm - 113.54mm) Dia.	
FG	Fiberglass Enclosure (Standard), 3" Boot
FI	Fiberglass Enclosure, Insulated, 3" Boot
SS	Stainless Steel Enclosure, 3" Boot
SI	Stainless Steel Enclosure, Insulated, 3" Boot
Enclosure Heat Control (Heating requires Insulated Enclosure)	
N	No Enclosure Heat (Standard)
T	225°F (107°C) Temp Switch** (ATEX Enclosure uses a 150°F (65°C) T-Stat)
K	T/C Only, Type K****
J	T/C Only, Type J****
R	RTD Only****
Power/Classification	
1	115 VAC General Purpose
2	230 VAC General Purpose
1FM	115 VAC Approved for Class I, DIV. II, Grp. B, C, D (FM/ CSA)
2FM	230 VAC Approved for Class I, DIV. II, Grp. B, C, D (FM/ CSA)
1EX	115 VAC ATEX Approved for Zone IIC (TUV)
2EX	230 VAC ATEX Approved for Zone IIC (TUV)
Filter	
2	2µm Ceramic (standard)
1	1µm Ceramic
C	0.1µm Ceramic coated
S	2µm Sintered 316SS

Additional Options Shown on Next Page

270	-SF	-F1	-340	-BB	-S	-24	-SS	-N	-1	-2	-R	-N	-N	-N	-N
Temperature/Alarm (do not choose R/K/J option if used above)															
F	Failsafe (Open on Alarm)														
C	Closed on Alarm														
R	100 Ohm RTD (Includes Failsafe Alarm Contact)														
K	Type K ThermoCouple (Includes Failsafe Alarm Contact)														
J	Type J ThermoCouple (Includes Failsafe Alarm Contact)														
N	None														
Ammonia Converter (General Purpose area only)															
A	Integrated on the Right Side of the 270***														
N	None														
Extended Length Probe Tube Support (not with HPA)															
N	Std PTS														
2C	Extended Length Probe Tube Support														
2S	x = Length in Ft (2,3,4,5)														
2T	y=Material of Construction														
3C	S = 316SS (up to 1100°F (593°C))														
3S	T = 310SS (up to 1600°F (871°C))														
3T	C = Hast C-276 (up to 1900°F (1038°C))														
4C															
4S															
4T															
5C															
5S															
5T															
Heated Probe Adapter (adds Terminal Blocks to 270)															
N	None														
K	Type K T/C Terminal Blocks														
J	Type J T/C Terminal Blocks														
R	RTD Terminal Blocks														
Z-Purge Panel															
N	None														
H	Mounted on Top of 270***														
V	Mounted on Side of 270***														

4.0 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
Maximum Stack Temperature	700°F (370°C)
Oven Temperature	340°F (171°C)
Enclosure Dimensions:	
Fiberglass	H 18" x W 16" x D 10" (H 458mm x W 407mm x D 255mm) f
SS	H 16" x W 14" x D 8" (H 407mm x W 356mm x D 203mm)
Weight	25 lbs (12kg) (plus probe)
Input Voltage Requirement	115/230VAC 50/60 Hz
Input Power Requirement	150 watts
With Optional Heated Enclosure	350 watts **External fuse required of 20 A or less**
Electrical Classification	General purpose
Ambient Temperature, Operating	200°F maximum (93°C)
Blowback Tank Volume	0.7 scf (19.8 l) when at 100 psig (7.4 barg)
Blowback Duration	0.5 sec. to empty accumulator
Enclosure	Nema 4x fiberglass (standard) Stainless steel (optional)
Sample Line Connection	3" Heat shrink boot (standard) 4" Heat shrink boot (optional) 2" Heat shrink boot (optional)
Heater Type	Rod heaters in aluminum block, controlled w/ thermal switch
Available Filter	2 µm ceramic (standard) 316SS (optional)
Chamber Materials	316SS (standard) 316SS, SilcoNert™ coated Hastelloy C-276

5.0 Description and Principle of Operation

APPLICATION

The Universal Analyzers Model 270SF Extractive Gas Sample Probe Assembly is designed to be installed on sample stacks containing non-hazardous gases. The 270 may be installed in an unclassified location. Filter changes can be made in less than one minute.

The 270SF 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", 6" or DIN type. A 1/2" NPT female threaded connection is provided for the sample probe to mount inside the mounting flange. Stack temperatures and corrosive gases will determine the material and design of the probe to be used.

Sample flow rates of up to 20 liters per minute can be extracted and filtered through the Model 270 with a minimal amount of pressure drop.

GENERAL DESCRIPTION, HEATED FILTER SECTION

The Model 270SF is a Extractive Gas Sample Probe Assembly consisting of the filter body mounted in a NEMA 4X Fiberglass Enclosure or Stainless Steel Enclosure. An optional blowback system is provided to allow the blowback to occur on command from a computer, data logger, PLC, 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 heater holds the temperature of the filter at 340°F (171°C). A hermetically sealed bi-metallic thermal switch mounted to the filter body keeps the temperature from exceeding 350°F (177°C) by opening the circuit at 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. In colder climates, an additional heater can be supplied for the enclosure. This heater will maintain 150°F (65°C) inside the enclosure.

Several types of filter elements can be supplied with the Model 270. The 2µm ceramic filter is supplied as an economical general-purpose filter. A similar ceramic filter with an internal 0.1µm coating is available for finer filtration or to provide a surface to enhance the blowback capability where the particulates have a tendency to fill the pores of the 2µm element. A 2µm, 316SS Filter can be inserted for those applications where the ceramic filter is determined to be unsuitable. Additional filtration materials and pore sizes are available on request.

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 125psig (8.8barg). High pressure air fills the accumulator (a 7" (178mm) diameter SS 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 of time 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 fifteen minutes but no less frequently than once per day. The time period between blowback cycles can be based on a calculation to estimate the amount of sample required to deposit from three to five grams of solids in the filter element.

Instrument air usage is minimal and smoothed by the fact that the air accumulator is charged over a period of time through a 1/4" instrument airline. 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 more slowly.

The calibration gas is 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 ensure that calibration gas does not leak into the sample while the sample is being drawn through the filter.

6.0 Installation

The probe tube (stinger) should be screwed into the 1/2" NPT fitting on the inside of the mounting flange. To prevent galling, coat the threads with an anti-seize compound. Remove and anti-seize compound from the inner wall of the probe tube before attaching it to the probe. 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', at least 6' into that stack. The studs on the mounting flange should be joined to the sampling nozzle on the stack and the assembly bolted into place.

A heated sample line should be supported close to the Model 270. The heated sample line should be fed through the heat shrink boot on the bottom of the enclosure. Connect the sample tube to the center tubing fitting (3/8") 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 1/4" tubing fitting located on the left side of the chamber and is connected to the chamber via a check valve. If the compressed air line is part of the heated sample line, it can be connected to the 1/4" fitting adjacent to the blowback accumulator. If an external airline 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, typically the mounting location is in the bottom of the enclosure, and connect the air to the same 1/4" fitting.

Provide power to the terminal block(s) within the stack filter enclosure in the Model 270. 150 watts (without heated enclosure) or 350 watts with heated enclosure, at 115/230VAC is required.



NOTE: The supply power circuit MUST include an overprotection device with a maximum rating of 20A. A disconnect switch must be located in close proximity to the probe.



A thermal switch mounted in the aluminum heater will control the temperature to 340°F (171°C). Insure the power supplied to the heater matches the heater voltage requirement shown on the serial number tag. The voltage requirement can be changed by changing the jumpers on the terminal strips (reference terminal strip label or drawings for details). **An independent ground wire should be run to the grounding terminal on the terminal strip.**

If an independent measurement and display of the oven temperature is desired, a temperature sensor can be slipped into a 1/8" diameter thermowell supplied on the heater tube assembly.

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.

7.0 Start-Up

Apply power to the Model 270. Allow fifteen to twenty minutes for the filter to come to temperature. This warm-up period is extremely important to avoid the condensation within the Model 270 filter which would cement the particulates to the filter surface.

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

Perform a calibration cycle to ensure that the calibration lines are properly installed and sealed. 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 270 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 stack.

Open the instrument air valve to charge the blowback accumulator. Exercise the blowback solenoid valve to insure it is properly wired. After a blowback cycle, the presence of a slight 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.

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.

8.0 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.
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.

9.0 Maintenance

CHANGING THE FILTER



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

Changing the filter in the Model 270 Heated Filter Assembly is extremely easy. Using gloves to protect the hand, grasp the cap on the end of the filter body opposite the probe and turn it counterclockwise. The cover may be hot to the touch and may cause burns to the hand if not protected. Removing the cover exposes the filter. The cover is secured to the assembly with a retainer chain. Reach into the heated oven with pliers to pull out the old 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 O-Rings if they are charred or deformed.

Replace the filter with a new one, again handling it with pliers. Ensure that the filter is pushed 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. The filter replacement procedure is complete.

10.0 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	Check/ replace filter element
	Filter chamber exit port plugged	Remove filter element and inspect exit port. Exit port will be located at 0° or 180° depending on configuration
Low temperature alarm	Insufficient warm-up time	Ensure power has been applied to the unit for a minimum of 15 minutes
	Power disconnected	Ensure power is supplied to the unit. Check by measuring for AC voltage on TB1-1 & 2
	Control switch defective	Verify by measuring for a closed circuit between TB1-1 & 4
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
		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

11.0 Spare Parts

Consumable Spare Parts	
Part	P/N
O-Ring, Viton 2-208, Filter Element	4904-0015
O-Ring, Viton 2-217, Knob Assembly	4904-0016
Heater Element Paste	8010-0001
Filter Element Ceramic Alumina, 2 µm (Standard)	4980-0007
Filter Element Ceramic Coalesc.1µm Coated	4980-0018
Filter Element Sintered 316SS, 2 µm	4980-0023
Filter Element Ceramic Alumina, 1 µm	4980-0127

Spare Parts	
Part	P/N
Temp. Switch Heater Control, Normally Closed Below 340°F (171°C)	3103-0014
Knob Assembly	5209-0083
Low Temp. Switch, Normally Closed Below 225°F	3103-0013
Low Temp. Switch, Normally Open Below 225°F (107°C) "Fail Safe"	3103-0012
Valve Check 1/4" Tube X 1/4" Tube 316SS Set At 3 PSI	4955-0148

Optional Parts	
Part	P/N
Heater Tube Assembly (Incl. Alum Oven, Heater Elements, Temp. Switch's &	3014-0002
Heater Tube Assembly (Incl. Alum Oven, Heater Elements, Temp. Switch's & Insulation Blanket) – "Fail Safe"	3014-0026
Solenoid Valve Blowback, 2-Way 24VDC	4955-0010
Solenoid Valve Blowback, 2-Way 120VAC	4955-0002
Solenoid Valve Blowback, 2-Way 240VAC	4955-0005
Check Valve Calib. Gas, Adjustable Pressure	5150-0014
Accumulator Sphere Blowback, Unheated	4956-0001
Acid Blocker Assembly, Blowback	5110-0015
Gasket Ring For 4" 150# Flange Garlock 9850 1/16" Thk	4903-0001

* Commissioning Spare Part

12.0 Drawings 270SF

For the current revision of all Model 270SF Probe drawings, visit the Universal Analyzers website.

<https://www.universalanalyzers.com/>

Navigate to: Products -> Gas Sample Probes -> Model 270SF

Links to all current drawings for standard probe configurations are provided at the bottom of the page.

13.0 Standard Terms & Conditions of Sale and Warranty

THE FOLLOWING TERMS/CONDITIONS, TOGETHER WITH ANY OTHER TERMS/CONDITIONS SPECIFICALLY AGREED TO IN WRITING BY SELLER, SHALL APPLY TO ALL ORDERS ("Order(s)") FROM, AND SALES OF PRODUCTS ("Products") OR SERVICES ("Services") TO BUYER. ANY ACCEPTANCE OF ANY ORDER OF BUYER IS CONDITIONED UPON THESE TERMS/CONDITIONS. ANY ADDITIONAL OR DIFFERENT TERMS/CONDITIONS PROPOSED BY BUYER IN ANY DOCUMENT ARE OBJECTED TO AND SHALL NOT BE BINDING UPON SELLER.

No salesperson is authorized to bind Seller to any promise or understanding not expressed herein.

I. PRICES

All prices are subject to change without notice in the event of any changes in cost of materials or labor, specifications, quantities, delivery schedules, customs duties, other factors beyond Seller's control, or in the event of delays caused by instructions of the Buyer, or failure of the Buyer to give Seller adequate information. Further, prices payable by the Buyer shall be subject to immediate increase, should the Seller as a result of governmental action or regulation including, without limitation, those contemplated by an investigation under Section 232 of the Trade Expansion Act of 1962 (19 U.S.C. §1862), incur additional duties, tariffs or restrictions on products sold hereunder, or on the raw materials that are used in making such products. In no event shall prices include any amounts imposed on the Buyer in connection with Buyer's purchases from Seller, such as taxes, including but not limited to Value Added Tax (VAT) or excise taxes, duties, tariffs, or any other costs assessed against the Buyer by a governmental authority.

II. DELIVERY

Delivery dates are approximate and are dependent on prompt receipt by Seller of all necessary information. Seller may deliver all or any part of Products/ Services as early as 30 days in advance of agreed schedule. The point of delivery shall be "Exworks" Seller's premises, unless otherwise specified by Seller. Upon delivery, title to Products and all risk of loss or damage thereto shall pass to Buyer. Where Buyer notifies Seller that it cannot take timely delivery of the Products, Seller may place such Products in storage, at the risk of Buyer, and Buyer shall reimburse Seller for all expenses incurred in connection with such storage. Buyer shall dispose of the packing materials for Products at its own expense, and shall defend, indemnify and hold harmless Seller from any legal obligations in connection with such packing waste.

III. PAYMENT

A. The term of payment shall be net 30 days from date of Seller's invoice, unless otherwise specified. Payments shall be made by Buyer without any deduction or set-off. Unless otherwise agreed, payment shall be made in U.S. dollars. Seller may charge late payment fees at the rate

of 1.5% per month, or the highest rate permitted by law, whichever is less, accruing daily.

B. If the financial condition of Buyer is unsatisfactory to Seller, Seller may require full or partial payment in advance, or satisfactory security, in the form of a letter of credit or otherwise. In the event of bankruptcy or insolvency of Buyer, Seller may immediately cancel any Order then outstanding.

C. Buyer grants Seller a purchase money security interest in Products located in the United States, or Services, as well as any proceeds, for the purpose of securing the obligations of Buyer hereunder. Buyer authorizes Seller to execute on Buyer's behalf and file such financing statements as Seller deems appropriate to perfect and notify Buyer's creditors of Seller's security interest.

IV. VARIATIONS IN QUANTITY; CHANGES.

Buyer shall accept delivery of quantities greater or smaller than the quantity specified in Order(s), provided that any such variation shall not exceed 5% of the quantity originally specified, or 2 units, whichever is greater. Seller shall not be required to give notice of any such variations other than in the applicable shipping notice and invoice. Seller reserves the option to make changes to Products or Services which do not affect form, fit, or function, and shall deliver Products to the latest configuration part number at the time of delivery.

V. EXPORT CONTROLS; FCPA; ANTI-BOYCOTT

A. Buyer shall not make any disposition of the Products, by way of transshipment, re-export, diversion or otherwise, except as applicable U.S. export laws and regulations may expressly permit, and other than in and to the ultimate country of destination specified on Order(s) or declared as the country of ultimate destination on Seller's invoices or in the End Use Statement that Buyer supplies Seller. Seller shall not be named as shipper or exporter of record or U.S. principal party-in-interest (USPPI) unless specifically agreed to in writing by Seller in which case, Buyer shall provide Seller with a copy of the documents filed by Buyer for Export clearance purposes. At Seller's request, Buyer shall supply end-use and end-user information to determine export license applicability. Failure of Buyer to comply

with this section shall constitute a material default allowing Seller to cancel related Order(s) without liability.

B. Buyer warrants that it shall not violate or cause the Seller to violate the U.S. Foreign Corrupt Practices act of 1977 (FCPA), as amended, the United Kingdom Bribery Act (UKBA) of 2010, as amended, or their respective implementing regulations in connection with Buyer's sale or distribution of the Products and/or Services, and that Buyer does not know or have reason to believe that any consultant, agent, representative or other person retained by Buyer in connection with the sale and/or distribution of Products/Services has violated, nor caused Seller to violate the FPCA and/or the UKBA. Where Buyer learns of or has reason to know of any violation of FCPA and/or or UKBA in connection with the sale or distribution of Products/Services, Buyer shall immediately advise Seller.

C. Buyer further warrants that Buyer shall not violate or cause Seller to violate the U.S. Antiboycott Provisions of the U.S. Export Administration Regulations issued pursuant to the U.S. Export Administration Act of 1979, as amended, in connection with Buyer's purchase of Products/Services and that Buyer shall not request or require Seller to make statements or certifications against countries that are not subject to boycott by the U.S.

VI. WARRANTIES

A. Seller warrants that Products manufactured by Seller, when delivered, shall be free from defects in material/workmanship. Seller warrants that Services shall be performed in accordance with generally accepted industry practice. Seller's obligations under this warranty shall be limited exclusively to repairing or replacing, at Seller's option, any part of Products which, if properly installed, used and maintained, proved to have been defective in material or workmanship within 1 year from the date of shipment or re-performing the Services. Seller warrants for a period of 1 year from the date of shipment that software or firmware, when used with Products, shall perform in accordance with Seller's published specifications. Seller makes no warranty, express or implied, that the operations of the software or firmware shall be uninterrupted or error-free, or that functions contained therein shall meet or satisfy the Buyer's intended use/requirements. Buyer shall notify Seller of any defect in the quality or condition of Products (including software/firmware) or Services within 7 days of the date of delivery or performance, unless the defect was not apparent on reasonable inspection, in which case, within 7 days after discovery of the defect. If Buyer does not provide such timely notification, it shall not be entitled to reject Products (including software/firmware) or Services, and Seller shall have no liability for such defect.

B. Seller's warranty obligations shall not apply to Products which (1) have been altered or repaired by someone other than Seller, or (2) have been subjected to misuse, neglect, or improper use or application, or (3) are normally consumed in operation, or (4) have a normal life inherently shorter than the warranty period stated therein.

C. No Products may be returned unless authorized in advance by Seller, and then only upon such conditions to which Seller may agree. Buyer must obtain a Return

Material Authorization (RMA) number from Seller prior to any return shipment, and such RMA number must appear on the shipping label and packing slip. Buyer shall be responsible for returned Products until such time as Seller receives the same at its facility, and for all charges for packing, inspection, shipping, transportation or insurance associated with returned Products.

D. This section VI sets forth the exclusive remedies and obligations for claims based upon defects in or nonconformity of Products/Services, whether the claim is in contract, warranty, tort (including negligence of any degree or strict liability) or otherwise. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESS, IMPLIED OR STATUTORY. NO IMPLIED OR STATUTORY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY.

VII. PATENTS/INDEMNITY

If Buyer receives a claim that Products, or part thereof manufactured by Seller infringes a patent, Buyer shall notify Seller promptly in writing and give Seller information, assistance and exclusive authority to evaluate, defend and settle such claim. Where Buyer has furnished specifications/designs for the manufacture of the allegedly infringing Products, Buyer shall defend, indemnify and hold harmless Seller against third-party claims for infringement arising out of Seller's use of such specifications/designs.

VIII. LIMITATION OF LIABILITY

The total liability of Seller on any claim, whether in contract, tort (including negligence of any degree and strict liability) or otherwise arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair, replacement or use of any Products/Services, shall not exceed the price allocable to the Products/Services or part thereof which gives rise to the claim. IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT, WARRANTY, TORT, (INCLUDING NEGLIGENCE OF ANY DEGREE, STRICT LIABILITY OR PATENT INFRINGEMENT) OR OTHERWISE, SHALL SELLER, ITS AFFILIATES, SUBCONTRACTORS, OR SUPPLIERS BE LIABLE FOR ANY LOSS OF PROFIT OR REVENUES, LOSS OF USE OF THE PRODUCTS OR SERVICES, OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES, SERVICES OR REPLACEMENT POWER, DOWNTIME COSTS OR CLAIMS OF BUYER'S CUSTOMERS FOR DAMAGES OR FOR ANY SPECIAL, PROXIMATE, CONSEQUENTIAL, INCIDENTAL, INDIRECT OR EXEMPLARY DAMAGES. If Buyer transfers title to, or leases Products sold hereunder to, or otherwise permits or suffers use by, any third party, Buyer shall obtain from such third party a provision affording Seller and its subcontractors/suppliers the protection of the preceding sentence. Any action against Seller must be brought within 18 months after cause of action accrues.

IX. EXCUSABLE DELAYS

A. Seller shall not be liable for delays in delivery or failure to perform due directly or indirectly to causes beyond Seller's reasonable control including but not limited to:

acts of God; war; terrorism; civil commotion; riots; embargoes; government regulations, orders, instructions or priorities; port congestion; acts of or failure to act on the part of Buyer or its agents/employees; fires; floods; sabotage; nuclear incidents; earthquakes; storms; epidemics; strikes; lockouts or other labor difficulties; shortages of or inability to timely obtain proper labor, materials, components, shipping space or transportation, fuel, supplies or power at current prices; or due to limitations imposed by the extent of availability of Seller's normal manufacturing facilities.

B. If a delay excused per the above extends for more than 90 days and the parties have not agreed upon a revised basis for continuing providing Products/Services at the end of the delay, including adjustment of the price, then either party (except where delay is caused by Buyer, in which event only Seller) upon thirty (30) days' notice may terminate the Order with respect to the unexecuted portion of the Products/Services, whereupon Buyer shall promptly pay Seller its reasonable termination charges upon submission of Seller's invoices thereof.

X. SOFTWARE/TECHNICAL/PROPRIETARY INFORMATION

A. Buyer shall not acquire any rights to any software which may be delivered with Products, except as granted in Seller's standard software license. Any software license granted in connection with Products shall be an interim license, which may be withdrawn, pending payment for Products in full.

B. The purchase of Products shall not include any right to supply of technical information such as drawings or specifications.

C. Proprietary information, including drawings, documents, technical data, reports, software, designs, inventions and other technical information supplied by Seller in connection herewith (hereinafter called "Data"), shall remain Seller's sole property and shall be held in confidence by Buyer. Data shall not be reproduced, used or disclosed to others by Buyer without Seller's prior written consent. Upon completion of Order, Buyer shall promptly return all Data to Seller together with all copies or reprints thereof then in Buyer's possession or control, and Buyer shall thereafter make no future use, either directly or indirectly, of any Data or any information derived therefrom without Seller's prior written consent. The foregoing shall in no way obligate Seller to provide or supply Data.

XI. DIES, TOOLS, PATTERNS

Seller's charges for dies, molds, patterns and the like represent the Buyer's proportionate cost thereof, it being expressly understood that they remain the property of Seller. Modifications made to dies, molds, patterns and the like in order to manufacture Products shall be at the discretion of Seller.

XII. GENERAL

A. The rights and obligations of the Buyer and Seller hereunder shall be governed in all respects by the law of the Commonwealth of Pennsylvania, U.S.A. The exclusive forum for adjudication of any disputes shall be the federal or state courts of the Commonwealth of Pennsylvania, and Buyer/Seller hereby consent to personal jurisdiction and venue in such courts in any

proceeding. The United Nations Convention on the International Sale of Goods shall not apply.

B. These Terms and Conditions of Sale together with any other terms specifically agreed to in writing by Seller constitute the entire agreement between Buyer and Seller and supersede any prior or contemporaneous representations, agreements, proposals, warranties, or understandings, oral or written, express or implied. No waiver, modification, amendment, rescission or other change to these Terms and Conditions of Sale shall be binding unless specifically agreed to in writing by an authorized representative of Seller.

C. The invalidity, of any part hereof shall not affect the validity of the remainder. The failure of Seller to assert any right at any time hereunder shall not prevent Seller's subsequent assertion of the same or different rights.

D. Buyer may not assign this contract without the prior written approval of the Seller.

XIII. PROHIBITION FOR HAZARDOUS USE

Products sold hereunder are not intended for application in, and shall not be used by Buyer in construction or application of a nuclear installation or in connection with use or handling of nuclear material or for any hazardous activity or critical application, where failure of a single component could cause substantial harm to persons or property, unless Products have been specifically approved for such activity or application. Seller disclaims all liability for loss or damage resulting from such unauthorized use and Buyer shall defend, hold harmless and indemnify Seller against any such liability, whether arising under breach of contract, warranty, tort (regardless of the degree of fault or negligence), strict liability or otherwise. Where Seller approves the application of the Products in a nuclear facility, the Buyer shall, before such use or provision, arrange for insurance or governmental indemnity protecting the Seller against liability and hereby releases and agrees to indemnify the Seller and its suppliers for any nuclear damage, including loss of use, in any manner arising out of a nuclear incident, whether alleged to be due, in whole or in part to the negligence or otherwise of the Seller or its suppliers.

XIV. STATUTORY REQUIREMENTS

Seller reserves the right to make any changes in the general specifications of the Products which are required for the Products to conform to any statutory requirement.

XV. GOVERNMENT CONTRACTS

Only Federal Acquisition Regulation ("FAR") supplement clauses expressly accepted in writing by Seller shall be included or incorporated by reference herein. Seller shall not be bound by and makes no representation of compliance with any FAR or FAR supplement clauses that Seller shall not have expressly accepted in writing