PREVEX® FLAMMABILITY ANALYZER

MODEL 670 SERIES

INSTRUCTION MANUAL

Control Instruments® Corporation

25 Law Drive, Fairfield, New Jersey 07004, USA

www.controlinstruments.com

Telephone: (973) 575-9114

Fax (973) 575-0013

WARNING!

THIS ANALYZER IS USED FOR THE SAFE OPERATION OF MACHINERY AND PROCESSES, AND TO PREVENT FIRES AND EXPLOSIONS.

YOU MUST READ AND UNDERSTAND THE ENTIRE INSTRUCTION MANUAL BEFORE INSTALLATION, OPERATION, CALIBRATION, OR SERVICING OF THIS ANALYZER.

OBSERVE, UNDERSTAND, AND OBEY ALL WARNINGS IN THIS MANUAL. FAILURE TO PROPERLY INSTALL, OPERATE, CALIBRATE OR SERVICE THIS ANALYZER MAY RESULT IN A FIRE OR EXPLOSION THAT CAN CAUSE DESTRUCTION OF PROPERTY OR SERIOUS BODILY INJURY.

PREVEX® Flammability Analyzer

Model 670 series FTA Instruction Manual
For All Model Numbers
SNR671, SNR672, SNR674 and SNR675
Software Version 5.12 and above
Publication number: H7FTA118 rev Q

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The PrevEx analyzer has patents pending in the USA and Europe.

The contents of this manual are subject to change without notice. While precautions have been taken in the preparation of this manual, the publisher assumes no responsibility for errors or omissions. Control Instruments Corporation assumes no liability for damages resulting from the use of information contained in this manual.

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WARRANTY INFORMATION

If within one year from the date of shipment, the equipment purchased from Control Instruments Corporation, or any part of that equipment, fails because of a manufacturing defect, Control Instruments Corporation will supply a replacement part F.O.B. Fairfield, New Jersey. The furnishing of a replacement part under the terms of this warranty will apply to the original warranty period, and will not serve to extend the warranty period beyond the original one year. This warranty does not cover the cost of labor involved in diagnostic calls or in servicing or replacing parts.

This warranty shall not apply if the equipment has been subjected to misuse, negligence, accident in transit or has been hampered or altered in any way, or if the equipment components have been subjected to forces or stresses beyond those recommended or specified by the manufacturer.

THE FOREGOING CONSTITUTES OUR SOLE WARRANTY WITH RESPECT TO THE EQUIPMENT COVERED HEREBY, AND ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AS WELL AS WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXCLUDED. IN NO EVENT SHALL CONTROL INSTRUMENTS CORPORATION BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES.

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1. Introduction

Read and understand this instruction manual before installation, operation or maintenance of the analyzer.

IMPORTANT: In this manual, the marking WARNING! indicates important instructions. Failure to understand and follow these instructions can result in a fire or explosion, destruction of property or serious bodily injury.

1.1. Warnings

Observe the following warning notices and all additional warnings found within this manual:

WARNING! Read and understand this instruction manual before installation, operation or servicing.

WARNING! This analyzer measures the flammability of gases. It does not provide protection from toxic gases, or from the toxic effects of flammable gases. Many flammable gases have toxic effects. Some can pose an immediate danger to life at concentrations too low for this analyzer to measure.

WARNING! The analyzer contains electric circuits. Proper handling procedures for high voltage circuits must be observed. Keep all covers tight when circuits are energized. Do not remove covers unless circuits are de-energized, or the atmosphere is known to be well below the lower flammable or explosive limit.

WARNING! The analyzer is purged. In hazardous areas, maintain the proper purge rate and pressurization as required by code. If purge or pressurization is lost, restore it immediately or disconnect electrical power. Purge for a minimum of 10 minutes at 24 liters per minute flow before turning on electrical power.

WARNING! Do not operate unless the flame arrestors are installed. Operation without flame arrestors may allow flame propagation that could ignite the process or atmosphere being measured.

WARNING! The analyzer uses hydrogen or propane fuel. Observe proper handling precautions. Turn the fuel supply off whenever the air supply to the analyzer is off.

WARNING! During calibration the analyzer cannot make readings or activate alarms. Perform calibration only when it will not interfere with safety of the process being monitored. During calibration, the analyzer signals cannot be used for control or safety function.

WARNING! Do not bypass, disable, or tamper with this analyzer. Secure it from unauthorized access.

WARNING! Fuel pressure failure, low oxygen conditions or flammable concentrations above the measurement range, can cause reading errors. Off-scale readings in either direction may indicate a hazardous gas concentration.

1.2. Qualified Personnel

Installation, operation and maintenance must be performed by qualified personnel only. This requires understanding of: instrumentation, handling compressed gases, flammable fuels, electric circuits, the behavior of the gases and vapors in the process being monitored, and the relevant codes, standards and recommended practices for flammable gas detectors and the process being monitored.

WARNING! All personnel who install, operate, or maintain this device must read, and understand this instruction manual. Short-form instructions and guides are not an acceptable substitute.

All personnel who monitor, use, or depend upon this device, must understand the hazards associated with flammable gases and vapors, the meaning of the readings made by this analyzer, and the meaning of all alarms and indicators.

Use this manual in conjunction with the codes and standards that apply to the hazards of the flammable gases and vapors, and the intended use of the analyzer as a means of protection. Specifications and requirements vary in different locations. The device must be reviewed for the particular requirements of the local authority having jurisdiction[1].

WARNING! The user must review and ensure compliance with all applicable safety codes.

1.3. Software Versions

This manual covers software versions 5.12 and above. The software version installed in the analyzer can be found in the VERSION register on the ALARMS menu.

1.4. Special Notices

1.4.1. Special Notice for Factory Mutual Research (FMR) approval:

FMR Approval of the 4-20mA output from the SNR670 Series sensor/controller does not include or imply approval of the apparatus connected to the instrument. In order to maintain FMR Approval of the system, all 4-20mA or current loop instruments connected must also be FMR Approved.

FMR Approval allows the presence and operation of serial communications software in the SNR670 Series sensor/controller (Modbus protocol). However, the communications functions provided are not included in the FMR Approval.

In order to maintain FMR approval for Division 2 area it is important to occasionally inspect the alarm relays within the electronics assembly for package integrity.

WARNING! In order to maintain FMR approval, the DANGER alarm must latch, either by the LATCHES register, or through the use of an equivalent external latching relay or device.

1.4.2. Special notice for FMc approval.

ATTENTION: POUR DES RAISONS DE SECURITE, CET EQUIPEMENT DOIT ETRE UTILISE, ENTRETENU ET REPARE UNIQUEMENT PAR UN PERSONNEL QUALIFIE. ETUDIEZ LE MANUEL D'INSTRUCTIONS EN ENTIER AVANT D'UTILISER, 'ENTRETENIR OU DE REPARER L'EQUIPEMENT.

For instructions in French or other languages, please contact the manufacturer or its representative.

1.4.3. Special notice for ATEX approval - using the analyzer for the safe functioning of equipment

The PrevEx analyzer with software version 5.20 has been tested and approved by DEKRA EXAM (PFG No. 41300302) according to the following standards:

EN 61779-1:2000 "Electrical apparatus for the detection and measurement of flammable gases - Part 1: General requirements and test methods"

EN 61779-4:2001-07 "Electrical apparatus for the detection and measurement of flammable gases - Part 4: Performance requirements for group II apparatus indicating a volume fraction up to 100 % lower explosive limit"

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[1] In the USA, refer to the American National Standards Institute ANSI/ISA RP12.13 "Recommended Practice for the Installation, Operation and Maintenance of Combustible Gas Detectors." Under ATEX and CENELEC guidelines see EN 50073 "Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of combustible gases and oxygen."

EN 50271:2002-05 "Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen - Requirements and tests for apparatus using software and/or digital technologies"

To comply with the general requirements of EN 61779-1 the DANGER alarm of the analyzer must always be configured as latching.

1.4.4. Special notice for ATEX approval - installation in a non-hazardous zone

Models which are ATEX marked may be installed in a non-hazardous zone while the sample and exhaust are connected with a Ex Zone 1 without the requirements of section 1.4.5, if instrument air (dry, clean compressed air free of flammables) is supplied to the analyzer with an inlet pressure of 20 psig (1.4 bar) at the inlet “F”, supplying a constant stream of air through the instrument, and if the purge outlet is equipped with the supplied venting outlet using a sintered metal filter to maintain ingress protection. If necessary during installation, move the cap from “F” to inlet “C,” move nut and ferrules from “C” to “F,” and attach vent fitting to position “K” as indicated on the Purge Diagrams in section 1.5.2.

1.4.5. Special notices for ATEX approval - installation in Ex Zone 1

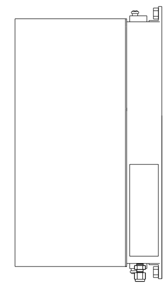
Model designations SNR671-T6, SNR672-T4, SNR672-T3, SNR674-T3 or SNR674-T2 and SNR675-T2 can be installed and operated in, or connected to, Ex Zone 1 or Ex Zone 2 hazardous locations, explosion group II C. The EC-type examination has been performed by DMT - Deutsche Montan Technologie GmbH. The EC-type examination certificate is DMT03 ATEX G 001 X.

If the analyzer itself is installed in Ex Zone 1, then a certified EEx P purge and pressurization device must be used to deliver protective gas to the analyzer, typically air taken from a non-hazardous zone, or an inert gas, and to disconnect the power supply and other electrical connections when the purge is not active or fails. The EEx p safety device must conform to all applicable codes, including EN 50016. It should also meet the requirements listed here:

1. The purge apparatus and analyzer instruction manuals must be read, understood, and followed.
2. All seals of the analyzer housing must be in place and in good condition. Suitable cable glands for wiring must be installed and properly sealed. All seals must be inspected in regular intervals to ensure proper operation. Seals showing signs of wear or leakage must be replaced.
3. The analyzer must be connected to earth ground using the connector on the exterior of the enclosure.
4. The inlet for the protective gas at the analyzer is a ¼ inch compression fitting. The outlet is a 3/8 NPT thread. The tubing between the outlet at the analyzer and the purge system must provide a suitable inner diameter that ensures that the pressure drop across that tubing is at most 5 hPa.
5. Before any electrical circuits in the analyzer enclosure, including input and output connections to other devices, are energized, an initial purge must be made for a minimum of ten minutes, at a flow of not less than 24 liters per minute. Thereafter a minimum purge flow rate of not less than 14 liters per minute shall be maintained. A minimum pressure of 0,5 hPa must be maintained during the initial purge, and thereafter for as long as circuits remain energized. The maximum pressure of 25 hPa must not be exceeded. These pressures are measured relative to the ambient pressure exterior to the analyzer enclosure.
6. If either the continuous purging or pressurization of the analyzer enclosure fails, the purge equipment shall give an alarm, and in the case of Ex Zone 1 installations, shall, via Ex-coupling relays, automatically remove power from all circuits in the analyzer enclosure except those which are intrinsically safe.

7. The analyzer has flame arrestors to prevent flashback through the sample and exhaust tubing. They must be kept in place at all times. The flame arrestors must be replaced if they show any sign of mechanical damage that might reduce their effectiveness. The flame arrestors must never be cleaned with an abrasive.
8. The fuel pressure delivered to the analyzer must not exceed the maximum specified pressure as given in the analyzer instruction manual. A relief valve should be provided at the fuel source to prevent overpressure of the fuel supply to the analyzer.
9. The fuel inlet fitting, part number SNP374 supplied with the analyzer contains a restrictor element that limits the maximum flow of fuel into the analyzer housing during failure of the fuel containment system. This fitting must be kept in place at all times. It should never be cleaned with an abrasive or mechanically damaged. If it becomes contaminated, or is otherwise damaged, it must be replaced only by the same part number.
10. The internal fuel delivery system of the analyzer is assembled using stainless steel capillaries with stainless steel compression fittings. Care must be taken to ensure that the fuel system is not damaged and is free of leaks.

1.5. Models

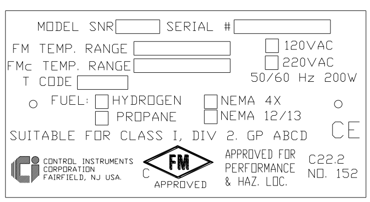


A permanent serial plate (nameplate) is mounted on the lower right side of the analyzer. It contains the model number, serial number, ratings, and the approval mark, if any. Models have differences based on requirements for performance and hazardous locations from their respective approvals. Some models include an overtemperature thermostat. In particular, purging and pressurizing the enclosure for installation in hazardous areas varies between models. Installation in Ex Zone 1 or Division 1 areas requires an additional purge device.

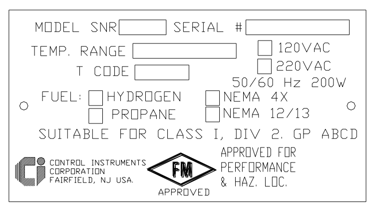
Models suitable for hazardous locations may also be installed in non-hazardous or general-purpose locations without an additional purge device.

1.5.1. FMc and FM Models

Canadian Standards Association (FMc)

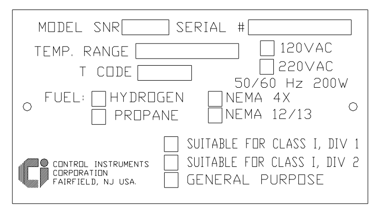


Factory Mutual Research (FM)

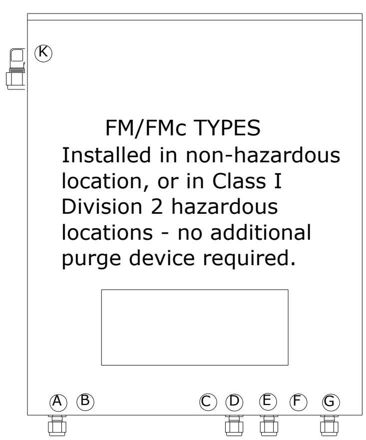


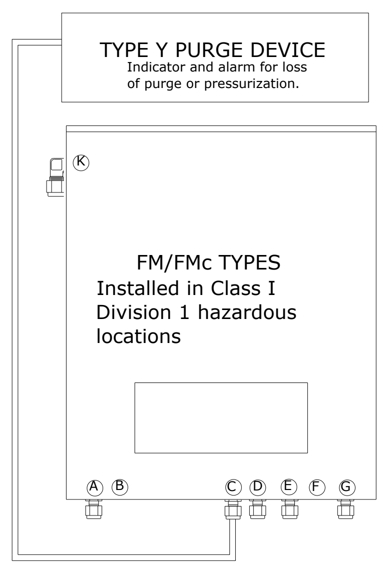
Generic Label

Models with generic labels have options not tested and approved by a third party.



FM and FMc approved models are suitable for installation in Class I Division 2 hazardous locations and for sampling from Class I Division 1 hazardous locations. Installation in a Class I Division 1 hazardous location requires the addition of an approved purge device. Generic types require case-by-case evaluation.





1.5.2. ATEX (CENELEC) and CE Models

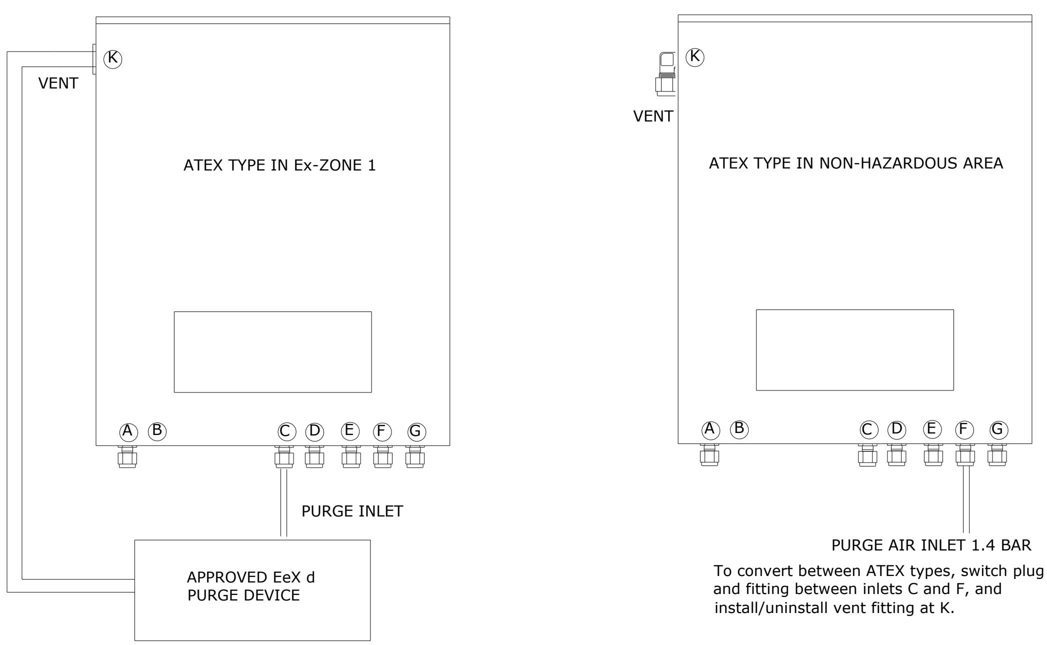
II 2 G EEx p II Tx -20°C ≤ Tamb ≤ 60°C		CE 0344	Control Instruments Corporation Fairfield, New Jersey, USA		
Model	SNR67XXXX		Free volume	18 l	Freies Volumen
Year of manufacture	XXXX		Minimum overpressure	0,5 mbar	Mindest- Überdruck
Serial number	XX-XXXX		Maximum overpressure	25 mbar	Maximaler Überdruck
Certificate number	DMT 03 ATEX G 001 X		Minimum purge volume	240 l	Mindest-Vorspülmenge
Voltage	☐ 230 VAC	☐ 120 VAC	Minimum initial purge flow	24 l/min	Mindest-Vorspül-Volumenstrom
Fuel type	X Hydrogen	☐ Propane	Minimum continuous dilution flow	14 l/min	Mindest-Volumenstrom

Models SNR67x-Ty where x is 1,2,4 or 5 and Ty is the temperature rating carry the ATEX and CE marks. The label includes the year of manufacture, the ratings, and purge information needed for installation in Ex Zone 1 or Ex Zone 2 hazardous locations in conformance with CENELEC EN50014, -016, and -018 norms of the ATEX directive 94/9/EC. A latching safety thermostat with manual reset is installed to prevent overtemperature. It removes power from the heater so the temperature does not exceed the T rating of the analyzer.

ATEX Model Number designations and T ratings

Model Number Designation	Normal Operating Temperature	Overtemperature Safety Thermostat Setting	IEC 79-8 T Rating
SNR671-T6	60°C	82°C	T6
SNR672-T4	100°C	118°C	T4
SNR672-T3	120°C	200°C	T3
SNR674-T3	180°C	200°C	T3
SNR674-T2	200°C	300°C	T2
SNR675-T2	250°C	300°C	T2

ATEX Purge Configurations



2. Theory of Operation

2.1. Hazards of Flammable Gases and Vapors

The hazards of flammable gases and vapors are fire, explosion, and toxicity. The PrevEx analyzer does not protect against short or long-term toxicity and toxic effects. It is designed to give early warning of the possibility of fire and explosion.

2.1.1. Lower Flammable Limit - LFL

The Lower Flammable Limit (LFL), is the leanest mixture of gas or vapor in air, that, when ignited, will continue to burn even after the source of ignition is removed. This means that a combustion wave, or "flame front," can travel through the mixture, releasing energy as it moves, and continuing on its own. It is possible that the combustion wave can travel long distances through the mixture, back to the source of the vapors, and cause a fire. At concentrations above the LFL, the mixture can rapidly increase in speed and the amount of energy it releases as it burns, to the point where it can cause very high pressures and an explosion. This is why the Lower Flammable Limit is sometimes called the Lower Explosive Limit (LEL), an older term used interchangeably with LFL.

Each flammable gas has its own LFL value, the percent by volume concentration in air at which that particular gas becomes flammable. At concentrations below the LFL, there is not enough flammable gas to propagate a combustion wave. By keeping an atmosphere below the LFL, it is possible to isolate sources of ignition from sources of combustion, preventing a flame front from traveling back to the source of vapor or gas and creating a fire or explosion.

There is also an Upper Flammable Limit (UFL), which is the richest mixture of gas or vapor in air such that the ignited mixture will continue to burn after the source of ignition is removed. At concentrations above the UFL, there is not enough air in the mixture to propagate a combustion wave. But once additional air is added to the mixture, it becomes flammable or explosive. The monitoring of mixtures having high concentrations above the UFL requires special considerations that are beyond the scope of the use of this device. In the use of this analyzer, all concentrations above the LFL should be treated as if they were flammable and explosive.

2.1.2. %LFL Readings

This device measures flammability in the range from "zero" air that is free of flammable gas, up to the LFL. The measuring scale is divided into percentages of the LFL, so that 0%LFL means that no flammable gas is present, and 100% LFL means that the Lower Flammable Limit has been reached. Laws for industrial processes typically forbid operation above 50% LFL, and require an immediate response to protect life and property when the flammable gas concentration exceeds 50% LFL.

WARNING! Readings above 50% LFL indicate a potential hazard to life and property.

2.1.3. Flash Point

The Flash Point is the temperature at which a flammable liquid gives off enough vapor to form an ignitable mixture with air. The liquid can form an invisible, explosive "cloud." Many flammable liquids have flash points at or below ordinary ambient temperatures. These will ignite immediately if a source of ignition is brought anywhere near the liquid. When the Flash Point is below the ambient temperature, vapor that forms above the surface of the liquid can very easily travel through the air, away from the spilled liquid, until a source of ignition is reached. The ignited vapor cloud can explode, or it can flash back to the liquid and explode, or it can ignite the surface of the liquid itself and cause a fire.

Liquids with Flash Points above ordinary ambient temperatures can still form hazardous vapor mixtures when heated, and can condense back into liquid when cooled. For accurate measurement, every part of the sampling system and sample tubing must be heated above the Flash Point. Otherwise, condensation prevents flammable vapors from reaching the analyzer. Even a very short section of tubing, at a temperature just below the flash point, can disable the measurement[2].

2.1.4. Autoignition

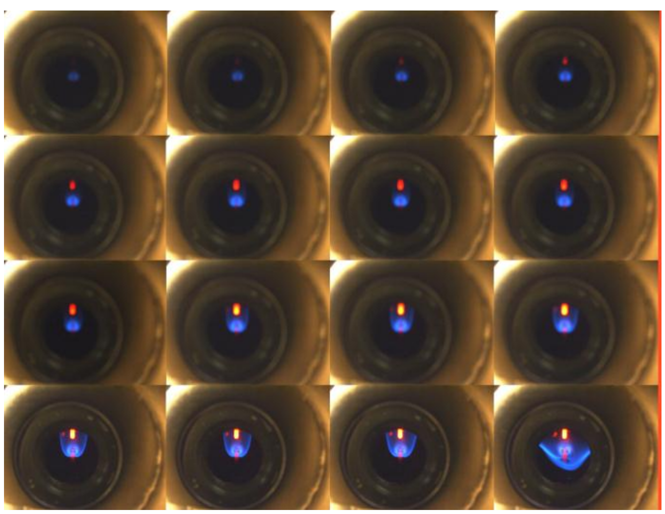
Sufficiently heated, a flammable gas mixture can spontaneously ignite. The auto ignition temperature (AIT) is the lowest temperature at which a flammable vapor spontaneously ignites. The AIT varies for each type and concentration of gas, but usually occurs at the stoichiometric concentration (perfect combustion). Heating a mixture to the AIT can cause a fire or explosion, sometimes after a time delay up to a few minutes. In effect, heated flammable gases are more flammable.

2.1.5. Temperature Dependence

Because heating a flammable gas makes it more flammable, a mixture below the LFL at one temperature can exceed the LFL when heated. For accurate measurement of heated processes, this temperature dependence must be included in the analyzer calibration. Regulations may require an increase in sensitivity of either 7.8% (USA) or as much as 14% (CENELEC) for every 100ºC increase in temperature.[3]

2.2. Measuring Principle

A sample is drawn into the analyzer’s flame cell. Flammable gases and vapors in the sample are burned in the sensing flame. A thermocouple located directly above the sensing flame converts the resulting temperature rise into an electrical signal, which is proportional to the concentration of flammable gas from 0 to 100% of the Lower Flammable Limit (LFL or LEL).



Sensing flames in a hydrogen-fueled analyzer. Flame size and thermocouple temperature increase from low (upper left) to high flammability (lower right - where a flame front is visible).

[2] Small temperature changes have a large effect on the concentration. A temperature drop as little as 10°C below the flash point can cause false low readings from condensation and prevent an alarm. For many solvents, near the flash point the maximum (saturation) vapor concentration is reduced 50% by a -10°C reduction in temperature.

[3] It is important to note that the temperature dependency of flammability is not a physical influence on the analyzer’s reading or its principle of operation. Because it is thermostatically heated, the analyzer does not respond to changes in the temperature of the atmosphere being monitored. Nor is the temperature dependency of flammability due to the expansion or contraction of air. It is an effect that changes the chemical and thermodynamic properties of the flammable gas mixture.

2.3. Flame Cell and Sensing Flame

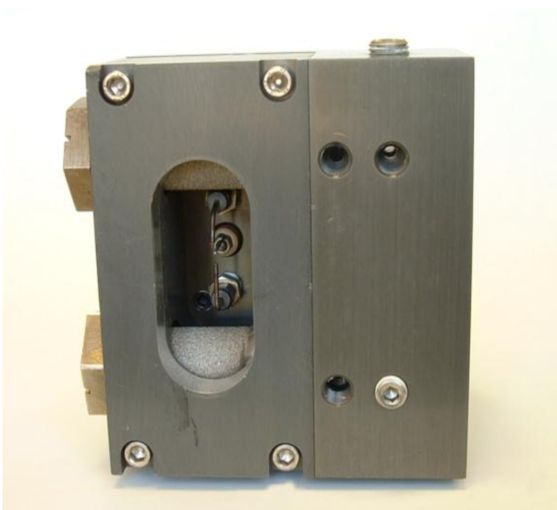
Flammability measurement occurs in the flame cell, where a small “sensing flame” sits on a burner tube. A sample is continuously drawn in through a sample tube by suction produced by an air aspirator. The aspirator runs from a regulated supply at constant pressure on the air inlet. Flammables in the sample burn in the sensing flame and produce a temperature rise, proportional to the Lower Flammable Limit, in a thermocouple that is located above the flame. The sample gases are then exhausted through the aspirator and exit through the exhaust tubing.

The sensing flame is ignited by a discharge from a spark electrode to the grounded burner tube. It is maintained by a constant flow of fuel to the burner. A fuel regulator feeds constant pressure through a sintered metal restrictor inside the base of the burner tube to produce a stable flame with a constant temperature in the absence of flammable gases in the sample.

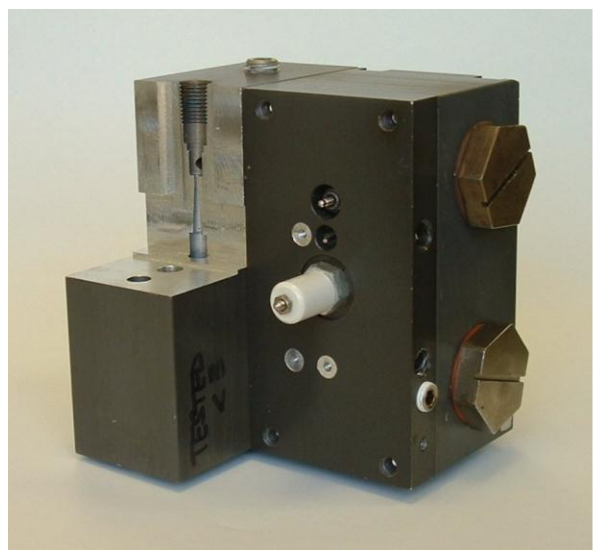
The flame cell has inlet and exhaust flame arrestors to prevent propagation of the sensing flame out of the flame cell. They must be kept clean and properly installed at all times. They should never be subjected to mechanical abuse or cleaning with abrasive substances. They should be replaced if they show signs of wear or damage. Disposable filters inside the inlet and exhaust flame arrestors keep the sensor flow paths clean.

WARNING! Always operate the analyzer with undamaged flame arrestors in place.

The sample flow is measured as it exits the flame cell. An orifice located behind the small sintered metal filter produces a pressure drop proportional to the flow rate. The pressure drop is measured by a transducer in the controller. If the sample flow rate decreases, a message is given to check the flow. If it continues to decrease, a “Low Flow” fault is activated.

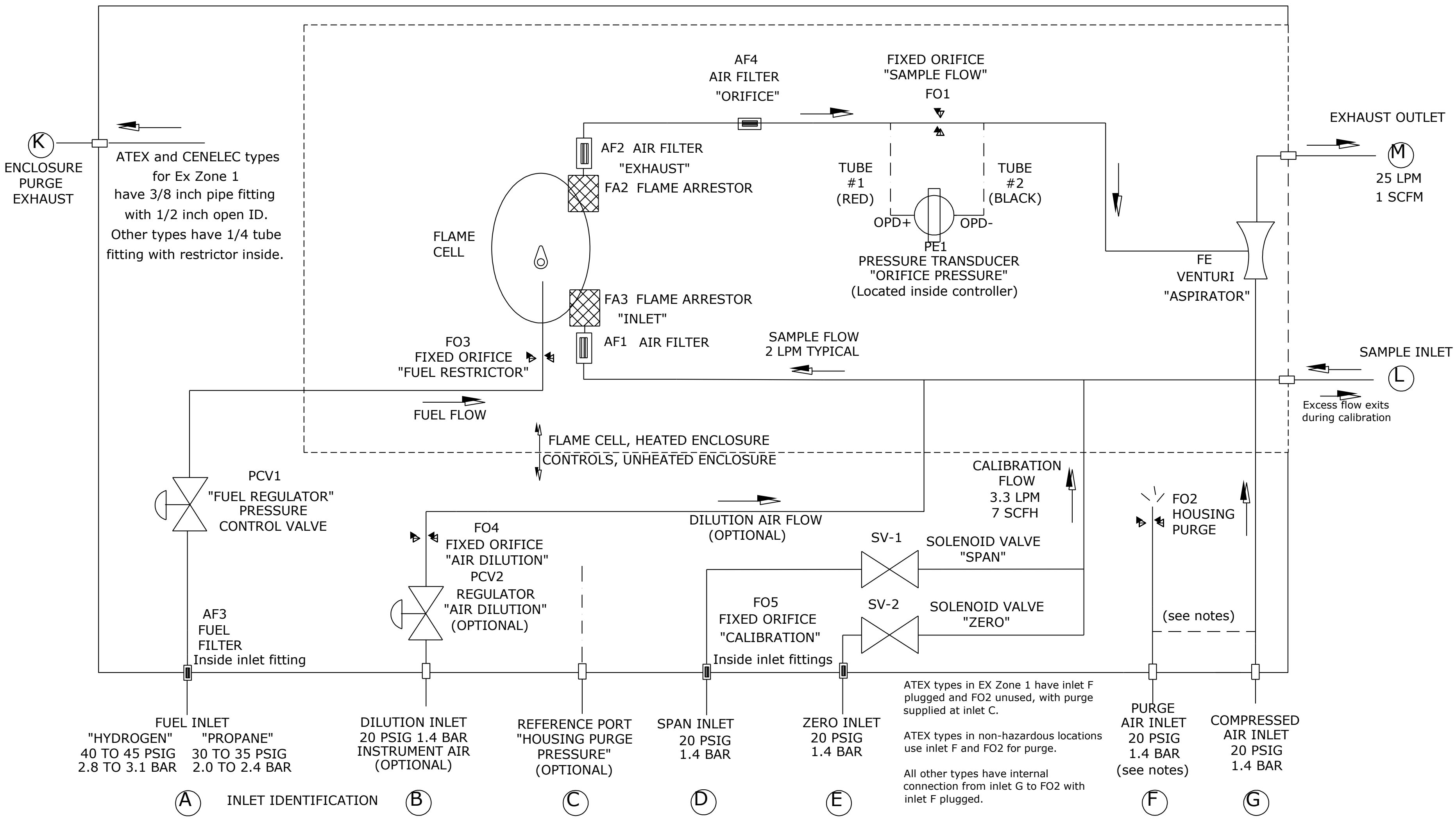


Front view of flame cell with cutaway exposing the internal parts. The flame arrestor caps can be seen along the left edge. Adjacent to the caps are the flame arrestors, positioned at the top and bottom of the flame cell. Directly in the center is the spark plug. The thermocouple is above the spark plug and the burner is below.

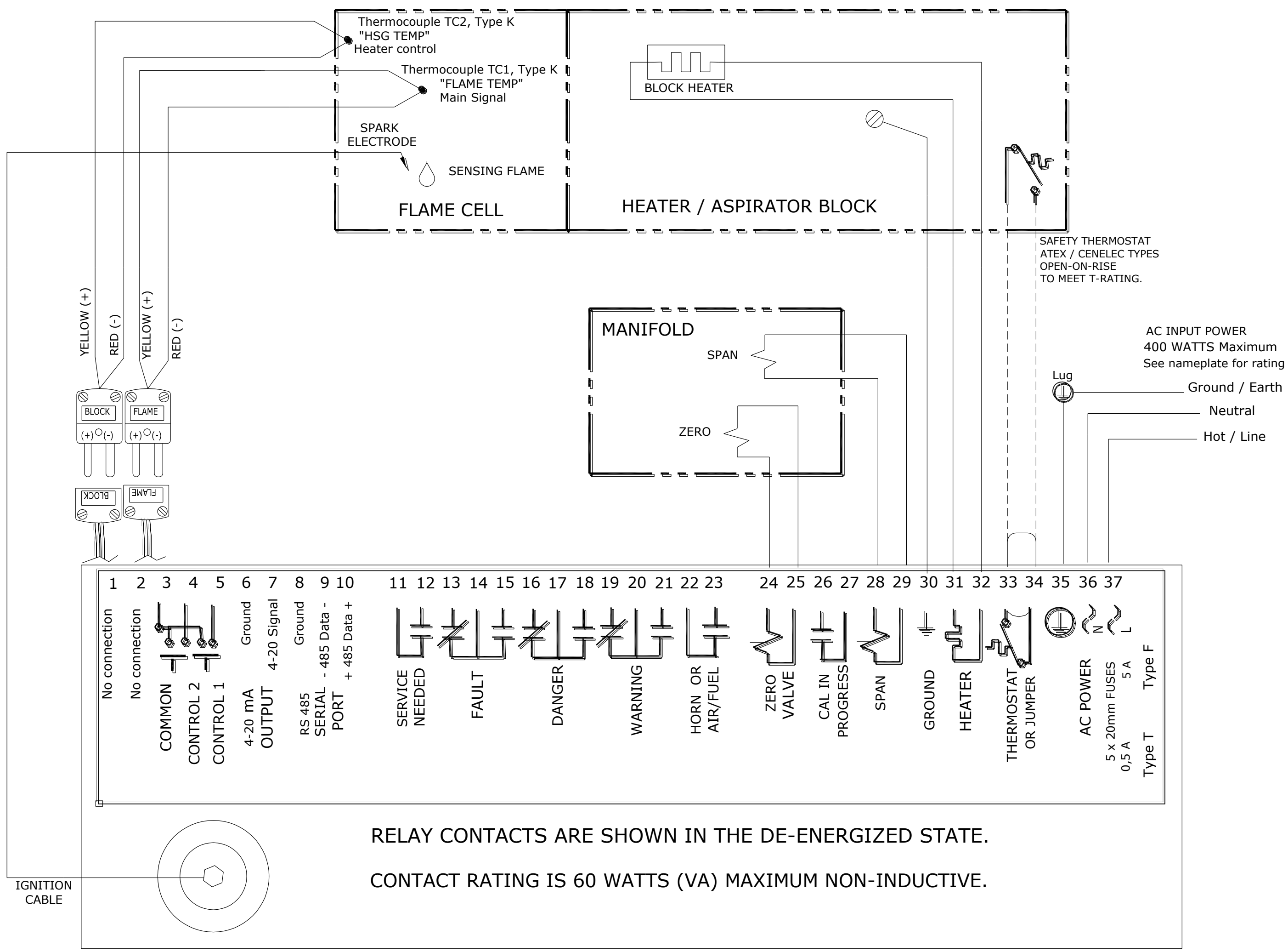


Rear view of flame cell and aspirator block with cutaway showing the location of the aspirator and flow paths. An aspirator nozzle sits inside the block. Compressed air passing through the aspirator creates suction that draws sample flow through the flame cell.

CONTROL INSTRUMENTS CORPORATION - PREVEX FLAMMABILITY ANALYZER - INTERNAL FLOW SCHEMATIC

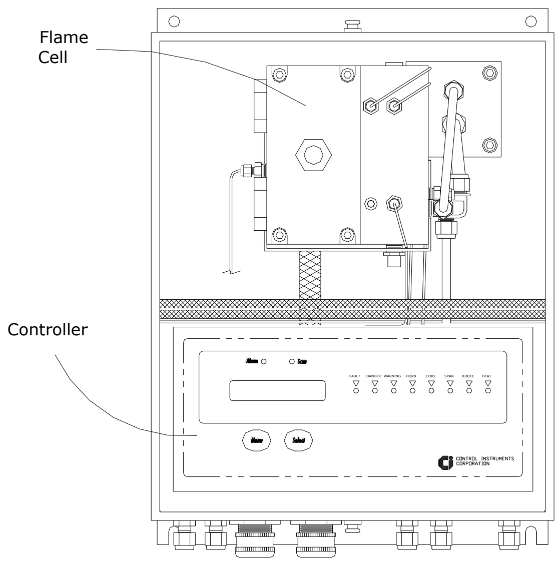


2.5. Electrical Diagram



2.6. The Controller

The controller is an electronic measuring and control device mounted inside the sensor enclosure. It conditions and converts signals from the thermocouples and transducers, and performs control, alarm, and output functions. The controller makes the flammability reading, controls alarms, regulates the flame cell temperature, monitors the sample flow, and generates faults if it detects improper operation. It amplifies the thermocouple signal and performs digital signal processing to obtain a final calibrated flammability reading in percent of the Lower Flammable Limit. It controls two level alarms: a “high” alarm (warning), and a “high high” alarm (danger). It outputs the reading and status of the sensor by means of indicators, electromechanical relays, a 4 to 20 milliamp output, and a serial port.



Front view of typical analyzer, shown with cover(s) removed. The controller is in the lower, unheated section. Pneumatic controls are behind the controller. Pneumatic and electrical connections are at bottom.

2.6.1. Control of Flame Cell Temperature

An electric heater embedded in the sampling system keeps the flame cell temperature constant. The temperature setting is found in the SET TEMP register on the GAUGES menu. A type K thermocouple, called TC2, also embedded in the sampling system, produces the HSG TEMP reading on the GAUGES menu. During warm-up the HEATER indicator is on continuously until the temperature is within a few degrees of the setting, and then it cycles on and off to control the temperature to the setting.

WARNING! Keep the analyzer heated to prevent condensation that could cause false low readings.

2.6.2. Monitoring Sample Flow

The pressure across the sample flow orifice is measured and converted to FLOW on the GAUGES menu, in standard liters per minute (LPM) sample flow. The orifice may require periodic cleaning to keep it clean and accurate. A reduced flow rate will slow down the response time of the sensor.

2.6.3. Making the Flammability Reading

A type K thermocouple, called TC1, passes through the wall of the flame cell and is bent in a 90° angle directly over the sensing flame, so that the tip of the thermocouple can measure the heat given off. This signal is the FLAME reading on the GAUGES menu, and, when captured during the calibration process, it is also the RAW ZERO and RAW SPAN reading on the CAL MENU. When the FLAME temperature equals the RAW ZERO, the reading is 0%LFL. When FLAME is equal to RAW ZERO plus RAW SPAN, the reading is equal to CAL RDNG from the CAL MENU. Other FLAME temperatures produce proportional flammability readings.

2.6.4. Calibration

Calibration uses two test gases: "zero" air with no flammables, and "span" gas containing a known concentration of flammables. Zero calibration sets the reading to 0 %LFL. Span calibration sets the reading to the CAL RDNG, for example 60% LFL. Zero and span solenoid valves automate calibration. When the solenoid valve energizes, pressurized test gas flows into the flame cell, completely filling it, with some excess gas flowing backwards out the sample inlet.

2.6.5. Calibration and Reading Calculations

First, Zero Gas, air completely free of flammable gases, is injected to the flame cell. After a minute or more, the FLAME temperature is captured as the RAW ZERO, which makes the reading 0% LFL. Next, span gas is injected. It has a known flammability concentration, called the calibration reading (CAL RDNG). After a minute or more, the FLAME temperature minus the RAW ZERO is captured as the RAW SPAN, which makes the reading equal to CAL RDNG. Every ¼ second, a new reading is made by comparing the FLAME temperature to the RAW ZERO and RAW SPAN.

RAW ZERO = FLAME temperature measured while sensor is exposed to Zero Gas
RAW SPAN = (FLAME – RAW ZERO), measured while sensor is exposed to Span Gas
%LFL Reading ≅ ((FLAME – RAW ZERO) / RAW SPAN) x LAST CAL RDNG

LAST CAL RDNG is a copy of the CAL RDNG setting saved during the last successful calibration. The LAST CAL RDNG is used to make the reading, so that a change to the CAL RDNG setting has no immediate affect on the readings until a calibration is performed.

2.6.6. Warning and Danger Alarms

When the flammability exceeds the WARNING or DANGER settings in the ALARMS menu, the corresponding alarm and relay is activated. Once activated, the alarms latch, and stay activated until they are manually RESET. If an external device provides the latching function, then alarms can be set to automatically reset, by turning off the LATCHES setting in the ALARMS menu. Then if the reading returns to normal, the alarm indicator and relay are automatically deactivated. If the DANGER alarm is not latching, an external device must be used to provide the latching function.

When both alarms are active, but their settings differ, the DANGER setting controls the WARNING. While is DANGER latched, WARNING will also latch. When DANGER autoresets, WARNING will also autoreset – <u>if</u> the reading is below the WARNING level at the moment DANGER autoresets.

If the DANGER alarm is active, the analyzer is indicating a hazardous concentration of gas, even though the FAULT alarm and indicator might also be active at the same time. Never ignore a DANGER alarm. Faults such as flameout can occur from an explosive concentration of gas.

<u>WARNING!</u> Simultaneous FAULT and DANGER alarms may indicate an explosive atmosphere.

WARNING and DANGER settings should be made as low as possible without giving false alarms. Therefore, if the maximum expected concentration is, for example, 10%LFL, an alarm at 15%LFL is faster and more effective.

2.6.7. Rate-of-Rise Alarm

When the flammability reading is increasing fast enough to exceed the danger alarm, the danger alarm is activated, even if the danger level has not yet been reached. This feature can be enabled or disabled using the RATE register in the ALARMS menu.

2.6.8. 4 to 20 Milliamp Output Signal

The flammability reading is converted to a 4 to 20 milliamp output signal, where 4 milliamps represents 0% LFL and 20 milliamps represents 100% LFL. Registers for 4MA ADJ and 20 MA ADJ in the OUTPUTS menu are used to correct for small amounts of electronic error in the output circuit. The milliamp signal can go below 4 milliamps and above 20 milliamps.

For readings below 0% LFL, the signal is reduced below 4 milliamps, until it reaches 2.0 milliamps (-12.5%LFL). The signal does not go below 2.0 milliamps unless there is a misadjustment of the 4MA ADJ register, or a loss of power, or a disconnected wire.

During calibration, or during faults, the signal can be forced to a special value. The MA CAL register on the OUTPUTS menu defines the value of the signal during calibration. The register MA FAULT on the same menu defines the signal during faults.

WARNING! The 4 to 20 milliamp output is not failsafe under all conditions. Always use both the FAULT and DANGER relays in addition to the milliamp output.

When electrical power is first applied to the analyzer, the milliamp output circuit can temporarily output a high milliamp signal for a short time until the circuit stabilizes.

Some monitoring devices do not accept readings below 4 milliamps. In this case the register 4MA ADJ can be used to offset and scale the output signal. For example, to change the output so that 4 milliamps is output at -5%, increase 4MA ADJ by +0.8 milliamps. An output of 4.8 milliamps now corresponds to 0%, and full scale remains unchanged at 20 milliamps. This change of scale can allow small negative readings to be accepted. The total amount of adjustment of 4MA ADJ cannot exceed +/- 2.0 milliamps.

2.6.9. Serial Communications

An RS 485 serial port with Modbus RTU protocol allows remote monitoring of display and control functions.

2.6.10. "Service Needed" and Faults

If operation is not within the optimal range, but the problem is not yet severe enough to be a fault, a "Service Needed" message and relay activation occurs. The analyzer can still be operated, and can give warning and danger alarms. Service needed gives maintenance personnel the opportunity to correct a problem before it becomes a fault.

If operation is not within the acceptable range, a fault is given. During faults, warning and danger alarms are disabled. The analyzer must be serviced immediately to restore proper operation. If more than one fault exists at the same time, the most serious fault is displayed. If, during the power-on self-test, a fault is found that prevents continued operation, the controller attempts to put the outputs into a failsafe condition. The red "alarm" LED indicator is turned on, and the green "scan" LED indicator is turned off. Under some type of faults, the controller may continually reset itself.

2.6.11. Air/Fuel Cutoff function of the HORN relay

The RLY CNFG settings in the OUTPUTS menu allows the horn relay to control the supply of fuel, and in some cases also the supply of air, to the analyzer.

When RLY CNFG is set to AIR FUEL, the relay is energizes immediately when power is turned on. It de-energizes if one of the follow conditions occur:

1. A FLAMEOUT exists for more than fifteen minutes after the last ignition attempt.
2. The HSG TEMP is too low for normal operation of the analyzer.

There is a fifteen minute delay in the activation of the Air/Fuel cutoff. Turning power on, a RESET command, or automatic ignition attempts will keep the relay energized for at least fifteen minutes.

The Air/Fuel cutoff function has two purposes:

1. Turn off fuel when the flame is not operating properly: A leak in the fuel supply, or the absence of compressed air pressure, will likely cause flameout. Use the relay to shut off the flow of fuel to the analyzer, as added protection against the accumulation of fuel in the analyzer housing
2. Prevent clogging of the analyzer from solid condensates: An analyzer that is not up to temperature can cause condensation. In rare cases a high temperature process might contain vapors that could condense into solids if they are cooled in an analyzer that is not up to temperature. Use the relay to shut off BOTH the flow of fuel to the analyzer AND the flow of compressed air to the analyzer so that the flow of sample into the analyzer stops when the analyzer is cold.

   Note: There is still the chance that vapors can diffuse into the analyzer and condense. The use of the Air/Fuel cutoff can delay, but not completely prevent, clogging of the analyzer from solid condensates.

When RLY CNFG is HORN, an ignition cutoff feature (in VERSION 5.20 and above) is enabled.

Ignition cutoff prevents ignition of the sensing flame when the compressed air supply is turned off, or has recently been off (if FLOW is at or below 0.4 LPM). It lasts as long as the lack of flow lasted, up to ten minutes maximum. During ignition cutoff, automatic re-ignition attempts (see setting AUTO IGN) are skipped.

Ignition cutoff extends the WARMUP state from 45 seconds up to ten minutes, or until all conditions are normal (flame, flow, temperature), which gives extra time for the analyzer enclosure to purge before ignition.

When RLY CNFG is AIR/FUEL or OVERRIDE, there is no ignition cutoff.

Use the AIR/FUEL setting only if a solenoid valve is installed that automatically shuts off the fuel supply when the compressed air supply is turned off, or when an approved purge system is attached to the analyzer enclosure.

The OVERRIDE setting requires a manual shutoff of the fuel whenever the compressed air supply is turned off. The OVERRIDE setting should only be used by a trained technician during maintenance or troubleshooting activities.

WARNING! Keep air pressure supplied to the analyzer whenever fuel pressure is present. If the compressed air is to be cut off, the fuel must also be cut off.

2.6.12. Flameout

WARNING! Flameout may indicate the presence of an explosive atmosphere.

FLAME temperatures below 450°C (~ readings below -35% LFL) indicate flameout. The flame may be out entirely, or too weak for valid measurements. As flameout is detected, a two-second IGNITION pulse causes a spark discharge to the burner tube to re-ignite the sensing flame. If IGNITION is successful, a RESET command can be used to clear the fault indicator and relay. If the attempts fail, a RESET command will repeat ignition. If the AUTO IGN register is set to 1 or more, there will be that number of re-ignition attempts at 15-second intervals – if this re-ignition is successful, and there are no other faults, the flameout fault will be cleared, regardless of the LATCHES setting.

2.6.13. Flameout from Flammable Mixtures - Flooding

If flameout follows a danger alarm, the flameout is probably from flammable gas above 100% LFL. The special state of “flameout subsequent to a danger alarm” is called flooding.[4]

WARNING! Flooding may indicate the presence of an explosive atmosphere.

<u>While in this special state:</u>
The WARNING and DANGER alarm indicators and relays are active.
The milliamp output is forced to 20 milliamps.
The FAULT alarm indicator and relay are inactive, unless a fault other than flameout occurs.
The display indicates “DANGER - FLOODED - 100% LFL”
The READING register may be invalid, for example a reading of –99% LFL.

<u>While in this special state, if another type of fault (not flameout) occurs:</u>
The WARNING and DANGER and FAULT alarm indicators and relays are active.
The milliamp output is either:

a) 20 milliamps, if the MA FAULT register is set to “OFF.”
b) forced to the value programmed into the MA FAULT register.

The display indicates “DANGER - FLOODED - 100% LFL”
The READING register may be invalid, for example a reading of –99% LFL.

The analyzer will recover from this special state by ignition of the sensing flame.

<u>Recovery from the special state following automatic re-ignition:</u>
If the DANGER alarm is not latched in the LATCHES register, and the AUTO IGN setting is nonzero, the analyzer will attempt a series of re-ignition attempts. If ignition is successful, and there are no faults of any kind, and the reading is below the alarm settings, then the alarms will clear and the analyzer will return to NORMAL status.

<u>Recovery from the special state following a RESET command:</u>
The FAULT alarm indicator and relay are active.
The WARNING and DANGER alarm indicators and relays are inactive.
The milliamp output is either:

a) 20 milliamps, if the MA FAULT register is set to “OFF.”
b) forced to the value programmed into the MA FAULT register.

The display is “FLAMEOUT” and the reading may indicate –99% LFL until the flame is lit.
The READING register is invalid, for example a reading of –99% LFL, until the flame is lit.

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[4] Sudden increases above 50% by volume per second can prevent the FLOODED state in analyzer types K and D.

2.7. Air Dilution Option

Air dilution is a factory-installed option that injects air in the sample flow to improve accuracy and prevent flameout over a wide range of sample oxygen concentrations. Half the flow into the flame cell comes from the sample, the rest is dilution air from a pressure regulator. Added air keeps the oxygen concentration in the flame cell high enough for the flame.

Identification of air dilution models

Air dilution models contain option #OPT353HP. Their TYPE contains the letter D or K as in SNR674D. They have a dilution air inlet (B) and dilution air regulator PCV2. For VERSION 5.12 and above, the burner is part number BRN050, and the gap between the burner and thermocouple is 0.5 inches (1.3 cm).

Installation of air dilution models

Connect 20 PSIG (140 kPa) clean, dry "instrument grade" compressed air to the air dilution inlet "B." Compressed air quality will affect accuracy. It must be free of oil and condensed water to prevent flow problems and false readings. A shut-off valve at the Dilution Air Inlet is required.

Protect inert processes from dilution air in the analyzer's exhaust. Make certain that exhaust air cannot adversely affect an inert process, or take special precautions for the exhaust method.

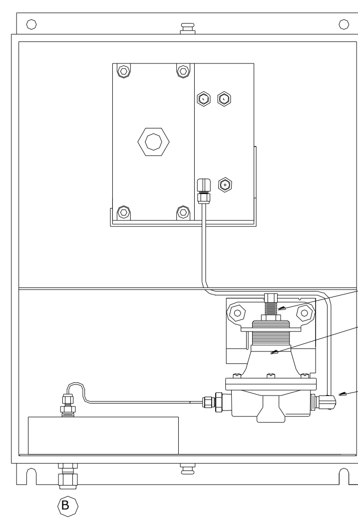
Oxygen Effects[5]

Readings increase approximately +0.7%LFL for each -1% by volume reduction in oxygen concentration in the process being monitored.

Calibration of air dilution type analyzers

Calibration gases are also diluted. To maintain accuracy, the FLOW during the span calibration should be monitored to ensure that it matches the FLOW during sampling.

Air Dilution Option
Option #OPT353HP



Checking for leaks

To perform leak checks as indicated in the maintenance procedures, a valve on the Dilution Air Inlet (B) must installed, so it can be shut for the duration of the test.

Alignment

The burner is aligned 0.5 inch (1.3cm) directly beneath the thermocouple, a gap twice as large as the standard analyzer. The spark electrode is aligned normally, directly behind and slightly above the burner. Typically the alignment does not require adjustment unless the flame cell has been opened for maintenance.

[5] See section 3 for important specifications: response time, pressure, oxygen, and flow effects.

Tuning the dilution air regulator – option #OPT353HP

The dilution air regulator is factory-tuned so that the ratio of sample to dilution air is one-to-one. It does not normally require adjustment.

This procedure tunes the dilution air regulator to get 50% sample and 50% air. Use only for VERSION 5.12 and higher. Use with burner BRN050, having a 0.5 inch (1.3cm) gap between the burner and thermocouple.

1. Start with cover on and analyzer stable.[6]
2. Shut off pressure to the air dilution inlet only. This requires a shutoff valve at the air dilution inlet.
3. Open the cover, and perform the following as quickly as possible.
4. Set CAL TIME in CAL MENU to 4 minutes.
5. Record the FLAME reading in air from the GAUGES menu.
6. Initiate a SPAN TEST with 1.15% Ethylene[7] in Air.[8,9]
7. After one minute, record the FLAME reading for 1.15% Ethylene without dilution.
8. With SPAN TEST still active, turn on pressure to the air dilution inlet.
9. With SPAN TEST still active, adjust the dilution air regulator[10] to get a FLAME reading of:

   For 0.50 inch gaps[11], FLAME = 62% of FLAME reading in air (step 5) plus 38% of FLAME reading for 1.15% Ethylene without dilution (step 7).
10. At the end of span test, return CAL TIME in CAL MENU to 1 minute.
11. Replace the outer cover.
12. Wait for analyzer to stabilize.
13. Perform a FULL CAL from the COMMANDS menu using a flashlight (keep cover on).
14. For SPAN FAIL faults, SPAN°C may require adjustment.

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[6] The analyzer should be checked regularly for leaks. Analyzer leaks cause reading errors. Only leak-free analyzers should be operated or adjusted.

[7] Alternate calibration gas, 0.91% Propane, may also be used.

[8] Misalignment can cause errors similar to incorrect span calibration gas.

[9] Accuracy will depend completely on the accuracy of the span calibration gas.

[10] Following this calculation results in a RAW SPAN that is 45% of the RAW SPAN without air dilution for 0.25"gaps, and 38% for 0.5" gaps.

[11] For 0.25 inch gaps, FLAME = 55% of FLAME reading in air (step 5) plus **45%** of FLAME reading for 1.15% Ethylene without dilution (step 7), if for some reason a 0.25 inch (6.4mm) burner-thermocouple gap is in use.

2.8. Fail-safe Considerations

Safety equipment must give continuous protection. It should notify the operator of failures that might disable protection. The analyzer continually checks itself, and can detect many types of faults. During faults the reading is not reliable, and the warning and danger alarms are disabled. Processes that depend on the analyzer for safety must have the FAULT relay hard-wired to the safety shut down.

WARNING! During faults, the warning and danger alarms are disabled. Because the proper function of the analyzer is required for safety, the FAULT relay must be used to initiate a safety shutdown or equivalent corrective actions suitable to the process or area being monitored.

WARNING! Not all faults are detectable. Investigate unusually low readings. Perform regular leak checks. Abnormal behavior must be recorded, investigated, and resolved.

Incorrect calibration gas type or concentration causes significant errors. The calibration gases should be tested and certified within a tolerance of +/-2% or less prior to use. The RAW ZERO and RAW SPAN should be monitored for significant changes, especially for a new calibration gas cylinder. Keep the old cylinder as a reference until the new cylinder is verified. The RAW SPAN for both should be within the cylinder's stated tolerance, not more than 4% cumulative error.

WARNING! Calibration gas must be the correct type and concentration for valid readings and alarms.

Certain types of leaks in the sampling system might not be detected unless a thorough leak check is performed. Unusually low readings could be caused by a leaking sampling system.

2.8.1. Oxygen Concentration

The sensing flame gets its oxygen from the sample. Oxygen deficiency causes exaggerated readings. Standard hydrogen-fueled analyzers are accurate to at least 12% by volume oxygen and flameout occurs suddenly at about 7% oxygen. Propane-fueled analyzers are affected much more by oxygen deficiency, and should be operated above 18% by volume oxygen. Air dilution type analyzers do not flame out from oxygen deficiency. See section 2.7.

WARNING! Low-oxygen atmospheres can prevent proper operation of the analyzer.

Oxygen enriched atmospheres cause a decrease in the analyzer reading of approximately –1% LFL per percent oxygen. Concentrations above 25% by volume oxygen require special precautions that are beyond the scope of this device and manual. In addition, special precautions for electrical safety must be observed when the possibility exists for oxygen-enriched atmospheres.

2.8.2. Flammable Concentration Limits

Very high concentrations, at or above the LFL, can extinguish the sensing flame. Up to the point of flame out, the readings increase, and then suddenly drop downscale.

2.8.3. Speed of Response

Effective alarms require a fast analyzer and immediate corrective action. Keep sample lines short. Use low-diameter tubing. Do not add extra sample filters. Corrective action must quickly reduce the flammable gas concentration to a minimum. Every second counts. The person responsible for overall safety and design must verify that the total time for the analyzer to respond plus the time needed for effective corrective action is less than the time it takes for any foreseeable upset condition to produce an explosive concentration.

WARNING! An extremely rapid rise may reach 100% LFL before the analyzer can make an alarm.

2.8.4. Fuel Pressure Limits

The sensing flame needs constant fuel pressure to operate. Low pressure causes downscale reading drift. Loss of pressure extinguishes the sensing flame. Keep the entire fuel line clean and free of leaks. Maintain fuel pressure above the minimum. In cases where the analyzer is used to control processes, a pressure switch that monitors the fuel line for a loss of pressure is required.

WARNING! Low fuel pressure can cause false low readings. Always maintain proper fuel pressure.

2.8.5. Flash Point Limitations

Flammable gases and vapors with Flash Points above the operating temperature of the sensor and sampling system will condense before they can be measured. This can result in false low readings, failure to detect a flammable or explosive concentration, or clogging in the sampling system.

WARNING! The analyzer cannot detect flammable vapors with Flash Points above the operating temperature of the analyzer or any portion of the sampling system. DO NOT ATTEMPT TO MONITOR A FLAMMABLE VAPOR WITH A FLASH POINT ABOVE THE ANALYZER'S OPERATING TEMPERATURE.

Some industrial processes can use a variety of solvents having different flash points. Each solvent to be monitored must have a flash point below the analyzer and sampling system operating temperatures. Before a new solvent is used, the flash point must be checked.

WARNING! The SNR671 analyzer cannot detect flammable vapors with Flash Points above 60ºC.

2.8.6. Condensation Limits

Hot vapors condense when cooled below the dew point. The dew point of water and other non-flammable vapors in the sample should be lower than the entire sampling system. Condensation can result in flow system fouling, erratic flow, and other sampling problems. The combination of condensing water and water-soluble solvents might cause false low readings.

WARNING! Condensation of flammable vapors in the sampling system may delay or disable alarms.

2.8.7. Ambient Temperature Effects

The analyzer reading drifts a small amount from ambient temperature changes. This error can be removed by recalibration. Recalibrate if the ambient temperature changes more than 50°C. Removal of the analyzer cover can also cause small errors. Calibrate by remote controls to prevent this error.

2.8.8. Flow Effects

Changes to the sample flow rate can affect accuracy, especially for air dilution types. During calibration, the flow rate must be observed to verify that it matches the flow rate during sampling, and the LOW FLOW setting should be set within 0.4 LPM of the flow rate during calibration.

2.8.9. Sample Pressure Effects

When sampling from a process at increased or decreased pressures, a small amount of error is created. This error can be removed by recalibrating. The use of a pressure regulator in the sample line is not recommended. During calibration, excess calibration gases must flow freely out the sample inlet. A pressure regulator in the sample line can interfere with the flow of calibration gases and reduce accuracy or cause faults.

2.8.10. Halogens

Halogens and halogen-containing substances such as chlorine, fluorine, bromine, hydrogen chloride, trichloroethylene, dichlororethylene, vinyl chloride, and freons will produce halogen acids when oxidized in the sensing flame. The analyzer is constructed of stainless steel and hard coated aluminum components with corrosion resistance. Under normal conditions, these substances do not affect performance. Some halogenated hydrocarbons that are relatively non-flammable in air produce a flammability reading at very high concentrations. Some mixtures of halogens and amines may form ammonium chloride upon contact with the heated analyzer. The process chemistry must be taken into account to ensure that a representative sample reaches the analyzer's flame cell. For example, halogens in the presence of amines can form solids upon contact with a hot analyzer.

2.8.11. Combustible Dusts, Aerosols and Mists

This analyzer cannot measure combustible dusts, aerosols and mists, which can form explosive mixtures in air, but are not in the vapor state, and may be trapped in the sample filter.

WARNING! The analyzer does not provide protection from the fire and explosion hazards of combustible dusts, aerosols and mists.

2.8.12. Silicones

Performance is generally unaffected by silicones. Extremely high silicone concentrations require extra maintenance to remove silicone dust on the burner and exhaust filter. An optional flow system that reduces silicone effects is available. Contact Control Instruments for recommendations in handling samples with extremely high silicone content.

2.8.13. Autoignition / Decomposition Temperature

Substances which auto ignite or decompose at or below the analyzer operating temperature will not be detected. For example, Carbon Disulfide (CS_2) has an approximate autoignition temperature of 90°C, and so will not be detected in an analyzer operated above that temperature.

WARNING! The analyzer cannot measure substances that thermally or chemically decompose from contact with the heated sampling system.

2.8.14. Analyzers used for control

If the analyzer signal controls a process, for example to vary process speed or ventilation rate, or to modulate some process control device, a "secondary safety" must ensure that analyzer faults cannot cause an unsafe condition. Industry standards, for example "Safety Instrumented Systems" require safety devices to be independent of process control. Otherwise, a fault in the analyzer that produces false low readings could cause an unsafe condition in the process (reduced ventilation, increased speed, etc.) without warning or alarm.

WARNING! Analyzers used for process control purposes require a secondary means of safety. A redundant analyzer, or an independent physical limit on the flammable gas concentration, must be used.

Low fuel pressure can cause false low readings. Analyzers that control a process require the correct fuel pressure at all times. If the fuel pressure is below the minimum the controls must be forced to a safe state.

WARNING! Analyzers used for control purposes require continuous monitoring of fuel pressure, and an automatic alarm that performs a safety shutdown when the fuel is below the minimum.

3. Specifications

Measurement range	0 to 100% LFL display range. 0 to 80% LFL range for stated accuracy. Display blinks when reading exceeds 80% LFL to indicate readings outside of accuracy range.
Flame Cell Temperature	SNR671: 60°C SNR672: 120°C SNR674: 200°C SNR675: 250°C
Accuracy	± 3% of full scale, or 10% of applied gas concentration, whichever is greater[12]
Repeatability	± 1% of measurement range
Zero Stability	± 1% in 30 days
Span Stability	± 5% per year
Response Time	As tested and approved:

Factory Mutual/FMc	CENELEC/ATEX							
	Dilution TYPEs “D” & “K”				All other types			
T90 less then 1 second to 90% of final reading, plus sample transport of 1 second. One second for every 6 feet of ¼ inch OD additional sample tubing, if used.	HSG TEMP [°C]	SPEED	T50 [s]	T90 [s]	HSG TEMP [°C]	SPEED	T50 [s]	T90 [s]
	100	MED	3,0	3,8	60	LOW	2,6	3,6
	270	LOW	3,0	3,8	60	MED	2,3	3,1
	270	MED	2,7	3,3	60	HIGH	2,0	3,0
	270	HIGH	2,3	3,0	200	LOW	2,2	2,6
					200	MED	2,0	2,4
	270	OFF	10,5	29,0	200	HIGH	1,7	2,1

Sample Transport Time	0.5 seconds per meter of ¼ inch OD tubing. 1.0 second per meter for air dilution option.
Stabilization Time	Calibration gas should be applied for at least 60 seconds
Sample Pressure Effect	Increase in pressure decreases the reading slightly. Air dilution types (D, K) have twice as much sample pressure effect.

TYPE	Factory Mutual/FMc %LFL per inch of water	CENELEC/ATEX %LFL per millibar	Air Dilution Types D,K
SNR671	-0.20	-0.08	-0.16
SNR672	-0.14	-0.06	-0.12
SNR674	-0.10	-0.04	-0.08
SNR675	-0.10	-0.04	-0.08

[12] Air dilution types (D and K) are accurate in the range from 0 to 60% LFL.

Sample Pressure Limit	CENELEC Accuracy limit. Maximum deviation in pressure relative to nominal (point of calibration):

TYPE	+/- Pressure change from calibration	
	Standard Types	Air Dilution Types D, K
SNR671	50hPa	25hPa
SNR672	67 hPa	33hPa
SNR674	100 hPa	50hPa
SNR675	100 hPa	50hPa

Ambient Temperature Range — As tested and approved:

Model#	Factory Mutual	FMc	CENELEC/ATEX
SNR671	–25°C to 60°C	0°C to 40°C	–10°C to 60°C
SNR672	–25°C to 65°C	0°C to 40°C	–10°C to 60°C
SNR674	–25°C to 65°C	0°C to 40°C	–20°C to 60°C
SNR675	–25°C to 65°C	0°C to 40°C	–20°C to 55°C

LCD Visibility Range: –20°C to 45°C ambient range

Extended range, factory specification, not tested nor approved:

Model#	Range
SNR672	–40°C to 65°C
SNR674	–40°C to 65°C

Recommended range of operation, factory specification

Model#	Range
SNR671	0°C to 50°C (indoor)
SNR675	0°C to 50°C (indoor)

Range for stated accuracy is 50°C, or within +/-25°C of temperature at which calibration was performed.

Sample Flow Rate	Typical range: 2.5 ±0.5 liters per minute[13] Low Flow: Less than 1.4 liters per minute
Sample Flow Rate Effect	The reading increases approximately 1% LFL for a 0.1 liter per minute decrease in the sample flow rate.
Sample Flow Rate Limit	CENELEC accuracy limit - maximum deviation relative to nominal (point of calibration) 0.4 liters per minute change in flow rate. The LOW FLOW setting should therefore be set within 0.4 LPM of the flow rate during calibration. For air dilution types (D, K) this limit is 0.2 LPM.
Calibration Test Gas	1.15% by volume Ethylene in air or 0.91% Propane in air. Tolerance should be within +/-2% of specified concentration.
Calibration Gas Pressure	20 PSIG (1.4 bar) inlet pressure
Calibration Gas Consumption	Approximately 7 SCFH (3.5 liters per minute) during calibration
Calibration Hardware Kit	Part# PRV022 set to 20 PSIG delivery pressure at span inlet

[13] Air dilution units draw less than half their total flow rate from the sample - the "sample" flow is half that indicated by the "FLOW" register. The balance of flow into the flame cell is dilution air.

SPECIFICATIONS

Oxygen Limitation	0 to 21% oxygen with air dilution option and hydrogen fuel 12 to 21% oxygen with hydrogen fuel 19 to 21% oxygen with propane fuel
Oxygen Effect	Using hydrogen fuel, the reading increases 1% LFL for each one percent (1%) decrease in oxygen concentration. The effect for propane fuel is approximately three times higher. For air dilution types the reading increases 0.7% LFL for each 1% decrease in oxygen concentration.
Dimensions	16"H x 12.1"W x 8.5"D (41cm H x 31cm W x 22cm D)
Storage Temperature Range	As tested and approved:

Model#	Factory Mutual	FMc	CENELEC/ATEX
SNR671	–40°C to 65°C	-40°C to 65°C	–40°C to 60°C

Ambient Humidity	0 to 100% Relative Humidity (non-condensing)
Ambient Pressure Range	800 to 1100 hPa (millibar). Air dilution types are within stated accuracy when pressure range is within +/- 50 hPa of the ambient pressure at the time of calibration; All other types are within stated accuracy when pressure range is within +/- 100 hPa of the ambient pressure at the time of calibration.
Dew Point / Flash Point	Must not exceed lowest temperature found in any part of sampling system and flame cell. To reach maximum Flash Point requires increase of HSG TEMP setting and recalibration.

Type	Factory Setting	Maximum
SNR671	60°C	60°C
SNR672	120°C	153°C
SNR674	200°C	210°C
SNR675	250°C	280°C

Fuel Required	Fuel Type:	Hydrogen, prepurified 99.99% minimum
	Inlet pressure:	40 to 45 PSIG (2.7 to 3.1 bar)
	Consumption:	58 Liters per day
	or	
	Fuel Type:	Propane, 99% minimum purity
	Inlet pressure:	30 to 35 PSIG (2.0 to 2.4 bar)
	Consumption:	1 Pound per month

Fuel Pressure Limit	CENELEC hydrogen fuel pressure limit 3.1 bar.
Sample Inlet	1/4" outside diameter (OD) tubing standard, except 3/8" OD for HTR075 concentric probe and MTG058 dual tube mounting.
Exhaust Outlet	3/8" OD tubing for wall mount (MTG053) and dual tube (MTG054, MTG058) types, 3/4” OD for concentric sample probes (HTR063, HTR075)
Compressed Air	3/8" OD tubing or larger for main lines. Reduce to 1/4" OD tube connection at analyzer inlet.
Fuel Inlet Connection	Requires 1/4" OD tubing
Span Gas Inlet	Requires 1/4" OD tubing
Electrical Connections	Two 3/4 " NPT (pipe), for independent AC and DC connections

Compressed Air Required	Inlet pressure:	20 ±1 PSIG (140 kPa), regulated
	Consumption:	42 SCFH, 21 Liters per minute
	Quality:	Per ANSI/ISA-7.0.01-1996 or equal Must be clean, dry, and oil-free.
	Dew Point:	At least 10°C below ambient
	Particulate:	Less than 40 micrometer
	Lubricant:	Less than 1 part per million
Electrical Power Required	Voltage:	Either 120 VAC or 230 VAC Factory built to accept only one range. Must use rated sensor voltage
	Tolerance:	+10%, -15% of rated voltage
	Frequency:	50 to 60 Hertz
	Power:	400 Watts maximum
Warm Up Time	30 to 90 minutes varying with sensor type and ambient conditions.	
Materials	Stainless Steel (300 series) and corrosion-resistant, hard-coat aluminum. Brass fittings on SNR671.	
Hazardous location Rating	See section 1.4. Refer to serial plate for rating and approval marks.	
NEMA Rating	NEMA 12 (HSG228) standard, NEMA 4X (HSG229) optional	
4-20mA Output	Self-powered, non-isolated output signal. Delivers 4mA at 0%LFL, 20ma full-scale to a passive load. Maximum load resistance is 275 Ohms total, which allows 250 Ohms non-inductive load plus 25 Ohms line resistance.	
Milliamp Output Range	4 to 20 milliamps for 0 to 100% LFL, full range 2.5 to 22.7 milliamps.	
Milliamp Output Notice	In order to signal a special state such as faults or the flooded condition, the MA FAULT and MA CAL settings should be configured outside the normal range of the milliamp output.	
Rate of rise notice	This function is outside the scope of CENELEC norms and was not examined during ATEX approval testing.	
Special state notice	For special state “Flooded,” refer to “Flameout from Flammable Mixtures - Flooded” under “Theory of Operation.”	
Relay rating	60 Watts (VA) non-inductive 0.5 Amp at 125 VAC 0.2 Amp at 230 VAC 2.0 Amp at 30 VDC	
O-Ring Storage	O-ring storage is five to ten years under clean, dry conditions. For best results: Temperature 0°C to 50°C, and Humidity 10 to 90 %RH. Avoid strong light, direct sunlight, ozone and oxidizers. Use sealed polyethylene bags.	
Weight	35 to 40 lbs. (16 to 18 kg.) - Depending on options	
Vibration	Frequency less than 25 Hz with amplitude less than 0.15mm	
Orientation	Install upright only: less than 15º deviation from vertical. 0º degrees is preferred. CENELEC accuracy limit allows maximum deviation 2.5° relative to nominal (point of calibration).	

4. Installation

WARNING! The accuracy and reliability of the analyzer depends completely on proper installation.

4.1. Unpacking

Check the packing list and contents of the shipment. Look for additional components: mounting gaskets, regulators, and sample probes. Retain shipping materials through installation and startup.

4.2. Equipment, materials, and utilities

AC electrical power, at 400 Watts (VA) maximum per analyzer, at a voltage matching the serial plate. The analyzer is factory-set for either 120 VAC or 230 VAC, but not both.

Fuel gas cylinder or generator, and pressure regulator. The analyzer is factory-set for only one fuel type, either hydrogen or propane, but not both. Pressure at the fuel inlet must match the pressure rating on the serial plate. Hydrogen is typically 45 PSIG (310 kPa), propane 35 PSIG (240 kPa).

Calibration span gas cylinder and pressure regulator, typically 1.15% Ethylene in Air with 20 ±1 PSIG (140 kPa) delivery pressure at the span inlet.

Calibration zero gas cylinder or compressor, and pressure regulator for clean, dry compressed air with 20 ±1 PSIG (140 kPa) delivery pressure at the zero inlet. If a compressor is used in place of the zero gas cylinder, include a shutoff valve.

Clean, dry, regulated compressed air. Delivery pressure to the air inlet is 20 ± 1 PSIG (140 kPa). A properly sized air filter and regulator must be used.

Either **Stainless steel sample and exhaust tubing** or **Sample probe**. Optional sample probes or sample tubes may be supplied with the analyzer. Otherwise, use ¼ inch OD stainless steel tubing for the sample and 3/8 inch for the exhaust.

Copper or stainless steel tubing for utilities, for connecting the fuel, air and calibration gases.

Shutoff valves for fuel, air and calibration gases, so that the sensor can be disconnected for service or maintenance procedures without affecting other equipment using the same utilities.

Switch for AC power, so that analyzer can be serviced safely.

Mounting bolts, washers and nuts. Size 3/8 inch mounting bolts or their metric equivalent.

Either **Conduit seals** or **cable glands**, to seal electrical connections at the enclosure entrance.

Mounting supports, saddles and/or flanges as needed, depending on the particular application. Mount analyzer upright, at zero degrees around X and Z-axis.

Size AWG 14 wire (1,3mm to 1,6mm diameter) for AC power, or the metric equivalent.

Size AWG 14 to AWG 24 wire (0,5mm to 1,6mm diameters) for relays and outputs. The terminals accept these wire gauges. The wire size depends on the relay or output function and current-carrying capacities of the circuit. Stranded wire is preferred.

Size AWG 22 (0,6mm dia.) **shielded three-conductor wire for RS 485 serial communications**.

Tools required: Tube fittings are fractional inches: 9/16 inch, etc. Flame cell bolts are metric.

Purge and pressurization system. The analyzer is rated by Factory Mutual Research for Class I, Division 2, Groups A, B, C & D. Use of an optional TYPE Y AIR PURGE improves the rating to Class I, Division 1, Groups A, B, C & D hazardous areas. The flame cell is always rated for sampling from Division 1 or Zone 1 hazardous areas. The rating must meet or exceed the hazardous area rating requirements for its location.

4.3. Location and Mounting

Obtain a representative sample. Position the probe for a reliable and accurate sample. This requires an understanding of the behavior of the gases and vapors being monitored, and the process itself. Consider the effects of fans and dampers in normal and upset conditions.

Install as close as possible. For good sampling and a fast response, the sample and exhaust tubes must be short.

Keep sensor upright. Do not tilt more than 15° from the vertical axis (at 0° about the X and Z axes).

Maintain the hazardous location rating. Install in an area suitable for the analyzer's rating.

Avoid Pressure Spikes. Keep away from fans, dampers, tees and elbows. For best performance, position the probe where the duct pressure remains near atmospheric pressure.

Provide access for service. Allow for safe and effective routine maintenance. Keep clearance space around the analyzer. If necessary, catwalks, railings or ladders may be required.

Ensure easy probe removal for cleaning. The sample and exhaust lines must be removable for periodic cleaning, especially in processes having high levels of particulate. If a pipe is installed between the oven's or duct's inner and outer walls, this pipe should be large enough to allow installation of the sample and exhaust lines, including all bends in those lines.

Insulate duct-mounted sensors using a gasket. The gasket allows mounting on surfaces up to 75°C. The sensor can sample from process ducts having much higher interior temperatures, limited mainly by the materials of the sample probe.

Seal duct entry holes. Prevent leaks that cause cooling or dilution of the sample, or allow process gases to leak into the analyzer housing. If used, fully weld flanges or mounting saddles.

Use inlet restrictor fittings. The fuel inlet fitting, and zero and span inlet fittings, contain sintered metal restrictors to control flow rates. These must be used to make the tubing connections. They can only be replaced with identical restrictor fittings.

Remove the shipping bracket. Some shipment methods use a steel bracket to support the flame cell in transit. The bracket is tagged, indicating that it must be removed before the analyzer is operated.

4.4. Sample and Exhaust Tubing

Use suitable materials. Stainless steel is the minimum material for the sample and exhaust tubes. High temperature processes may require other materials. Copper is generally unacceptable.

Keep tubes short. Short tubes give the fastest response and require the least maintenance. Long tubes can greatly delay the sensor response and affect the safety of the gas alarm system. Sample transport time is approximately 6 feet (2 meters) per seconds through standard ¼ inch tubing.

Keep sample-tubing volumes low. Filters and large diameter tubes cause sampling delays. Use ¼ inch 0.035 inch wall thickness tubing. Do not add bowl filters to the sample line.

Keep tubes hot. Prevent condensation and clogging. Never expose sample or exhaust tubing to room temperature, even for a very short distance. All tubes must be kept above the dew point(s) and flash point(s). If the sensor is not mounted directly on the process duct, the sample and exhaust tubes must be heat-traced to a temperature above the flash point(s) and dew point(s) of all substances in the sample stream. In cases where duct mounting is not possible, please contact Control Instruments Corporation for guidance in heat-tracing sample and exhaust lines.

Avoid short radius bends. This can cause clogging and make service difficult.

Keep tube openings perpendicular to the duct flow. Prevent sampling problems from a pitot effect. Do not aim the sample or exhaust tube openings directly into the process flow.

Position the sample probe properly, near the center of the duct where it can obtain a representative sample. Profiling of the duct might be necessary.

Position exhaust tube correctly. The exhaust should be at the same duct pressure as the sample, positioned where it cannot dilute the sample.

Install tube at or below the horizontal. If some condensation of water vapors is unavoidable, the sample and exhaust tubes must slope downward to carry condensate away from the analyzer. Sample tube diameter of 3/8 inch may be needed to avoid plugging by water droplets.

Keep lines leak-tight. Avoid unnecessary joints or couplings. Leaks cause false low readings.

Provide access for service. Cleaning or replacement may be required. If necessary, install a tube union to allow removal of the tubes.

Seal duct openings. Access holes in the duct wall must be sealed to prevent leaks that might dilute the sample, or cool the sample tubing and cause condensation.

Tube installation/removal. There are several mounting options:

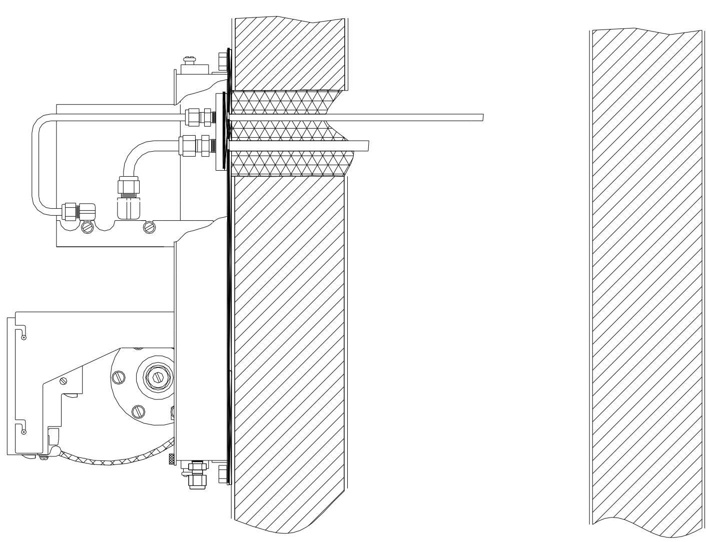
Type	Reference part #	Description	Section
Dual tube	MTG054 or MTG058	Duct mount, dual tube	4.4.1
Concentric	HTR063 or HTR075	Duct mount, concentric probe	4.4.2
Wall mount	MTG053	Wall mount, dual tube	4.4.3

4.4.1. Dual Tube Duct Mount

Reference part numbers MTG054 and MTG058

The sample tube and exhaust tube each pass through their respective bulkhead fittings. The exhaust tube is cut to a length that just penetrates the duct. The sample tube is cut to positions it at the center of the duct. For MTG054, the sample tubing is ¼ inch OD, for MTG058 it is 3/8 inch OD. All parts of the sample tube must be protected from exposure to cold surfaces or cold air. The analyzer is sealed and insulated with a gasket. The entry into the duct must also be sealed so that a cold spot does not form when room air enters the duct opening adjacent to the probe.

If the maximum temperature inside the duct exceeds 250°C, insulation must be packed into the space between the rear of the analyzer and the inside wall of the duct, as shown.

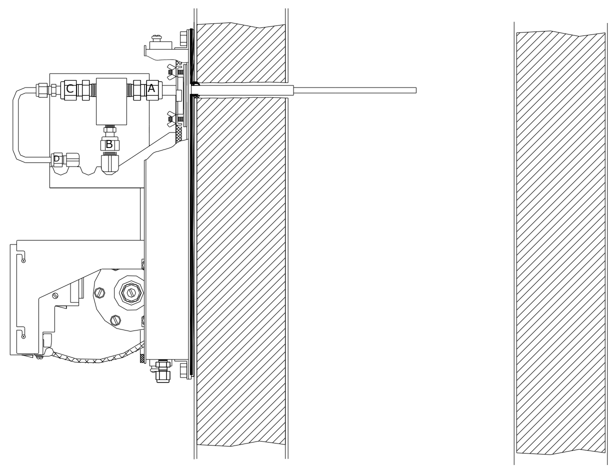


4.4.2. Concentric Sample Probe

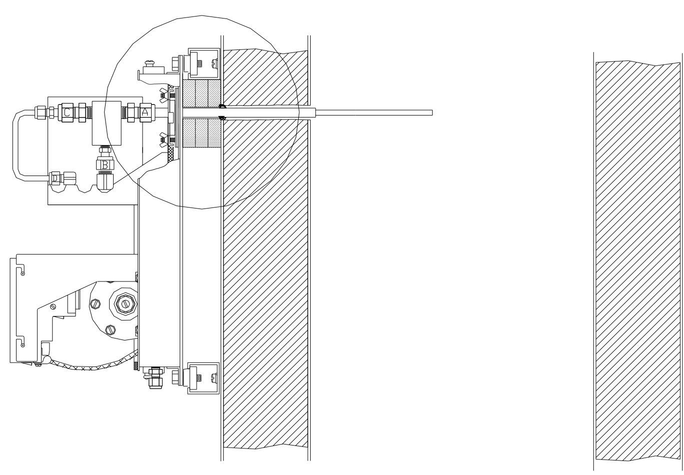
Reference part number HTR063 or HTR075

The exhaust tube surrounds the sample tube to protect it from heat losses. The exhaust is cut to length and de-burred. It just penetrates the duct. The sample is positioned to obtain a representative sample, usually at the center of the duct. If possible, the analyzer is mounted flush to the duct surface, using a gasket to seal and insulate.

For the standard probe, part number HTR063, the sample tubing is ¼ inch OD. An optional probe, part number HTR075 is similar, except the sample tubing is 3/8 inch OD. HTR075 is useful where condense water vapors might occasionally form from mists in the duct. Its larger sample tubing diameter is not easily obstructed by a water droplet.



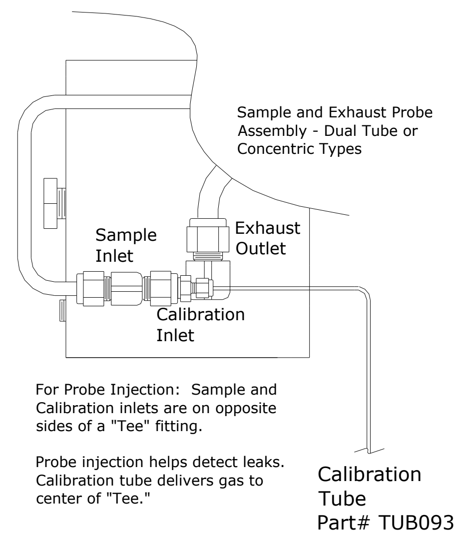
<u>When the duct surface is above 75ºC</u>, or if the duct is circular, the analyzer is not flush with the surface of the duct. The analyzer should be one or two inches (3 to 5 cm) from the duct. The concentric probe is insulated so that no part is exposed. <u>The entry into the duct is sealed</u> so a cold spot does not form at the duct opening adjacent to the probe.



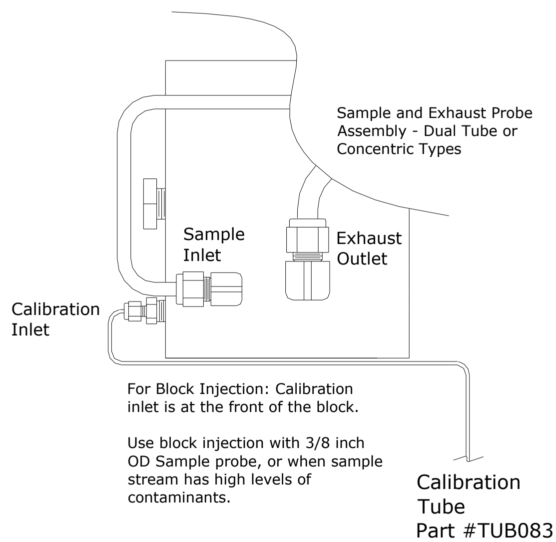
4.4.3. Calibration Injection Methods

The standard method of injecting calibration gas directly opposite the incoming sample stream, shown at left, below, helps detect leaks in the flame cell. Applications with high levels of contaminants use the block injection method, below right, to protect the calibration tube nozzle.

Calibration Probe Injection

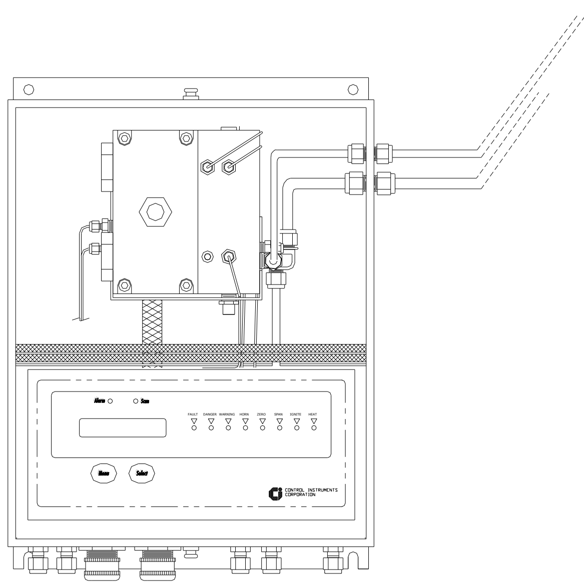


Calibration Block Injection



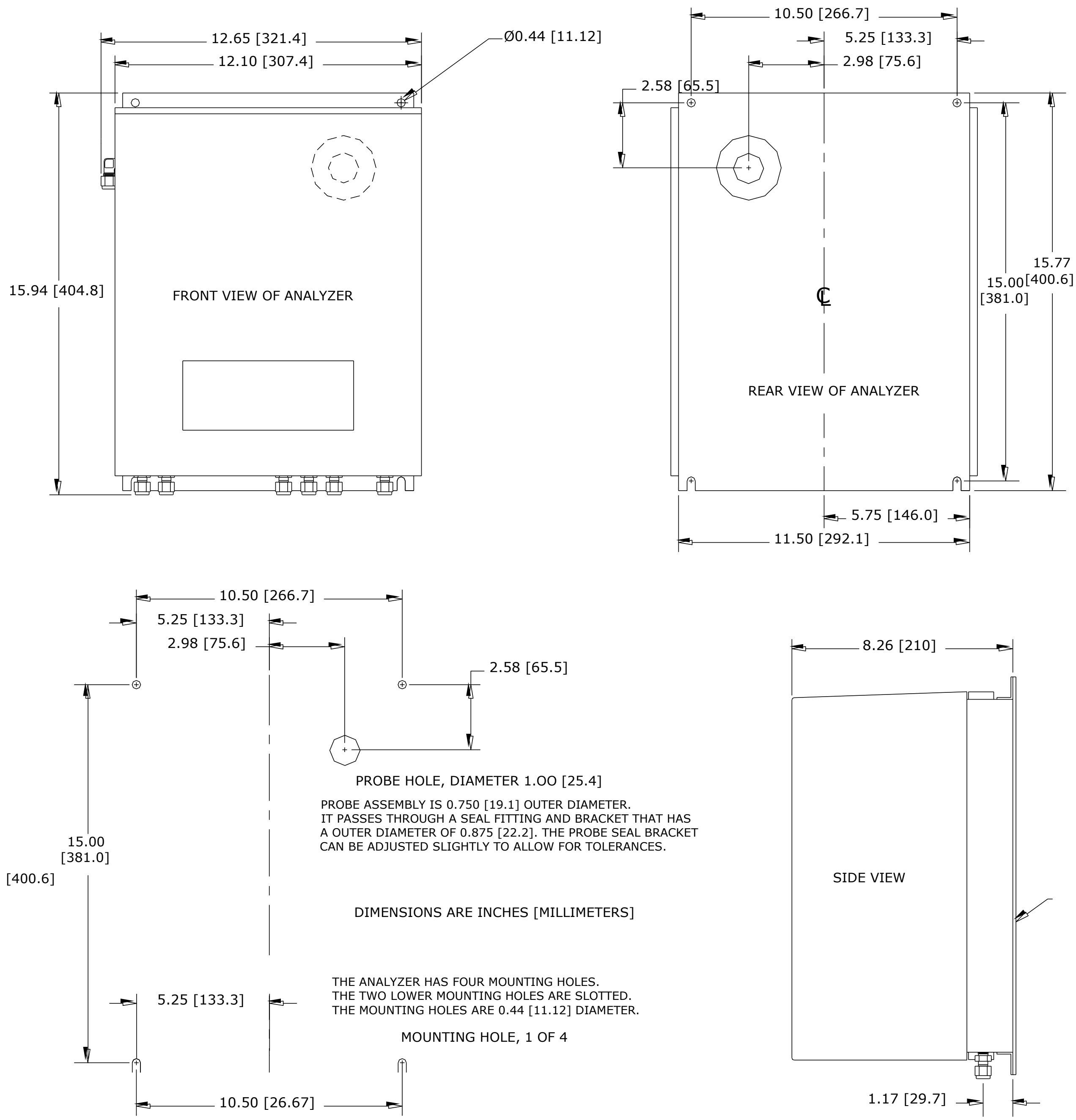
4.4.4. Wall Mount

Reference part number MTG053. Both the ¼ inch OD sample tube and 3/8 inch OD exhaust tube connect to fittings on the sidewall of the analyzer. The sample tube is positioned to obtain a representative sample and is cut to length and deburred. The exhaust tube is positioned at a point in the duct slightly downstream and/or at a distance from the sample inlet, so that the exhaust cannot dilute the sample. Cut tubes to length and debur.



4.4.5. Mounting Dimensions

Use four mounting bolts. For the optional Wall Mount SNR671 type (MTG053) sample and exhaust tubes connect to the side of the analyzer. For all others, sample probes connect through the rear of the analyzer's upper right corner. Leave 6 to 10 inches (15 to 25 cm) clearance on all sides. Some analyzers need room for a purge/pressurization system at the upper left.



4.5. Utilities

Electrical power, fuel and compressed air must be supplied continuously without interruption. Turning off the analyzer at night or on weekends can result in startup delays and operating problems.

Compressed air is used to prevent an accumulation of fuel within the enclosure in case of a leak. If compressed air is temporarily unavailable, turn off the fuel supply as a precaution.

Sampling into an unheated sensor can result in condensation and clogging. During installation, keep sample and exhaust tubing disconnected until startup. If the analyzer is to be left unheated for some time, and if the process being monitored contains substances that might condense when cooled, then the analyzer should be locked out and the sample and exhaust tubing should be disconnected.

4.6. Compressed air supply

Use clean, dry compressed air. The analyzer requires clean, dry "instrument grade[14]" compressed air that is free of oil and water. Water or oil in the air source can cause damage or affect accuracy.

Filter and regulate the compressed air. Install an external air pressure regulator and filter. Set the pressure on this regulator to 20 PSIG (1,4 bar). Allow for a maximum air consumption rate of 1 standard cubic foot per minute (28 liters per minute) for each analyzer.

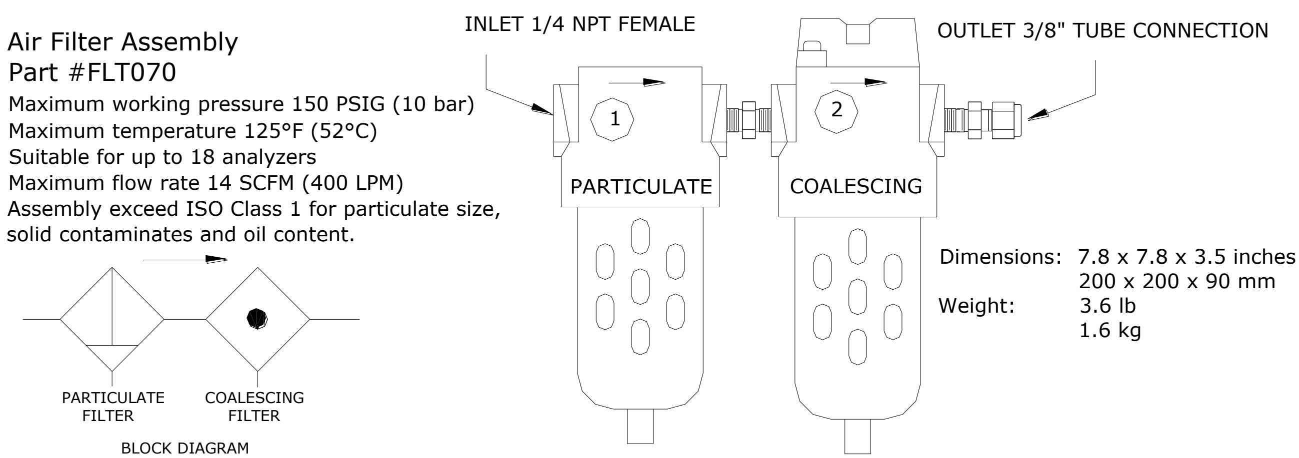
Use 3/8" OD copper tubing or better. Refer to flow diagrams for correct tubing diameters, lengths and quantity of analyzers.

Install a manual "shut off" valve near the Compressed Air inlet, to simplify service and maintenance routines. Use ¼" OD copper tubing to connect the "shut off" valve to the air inlet.

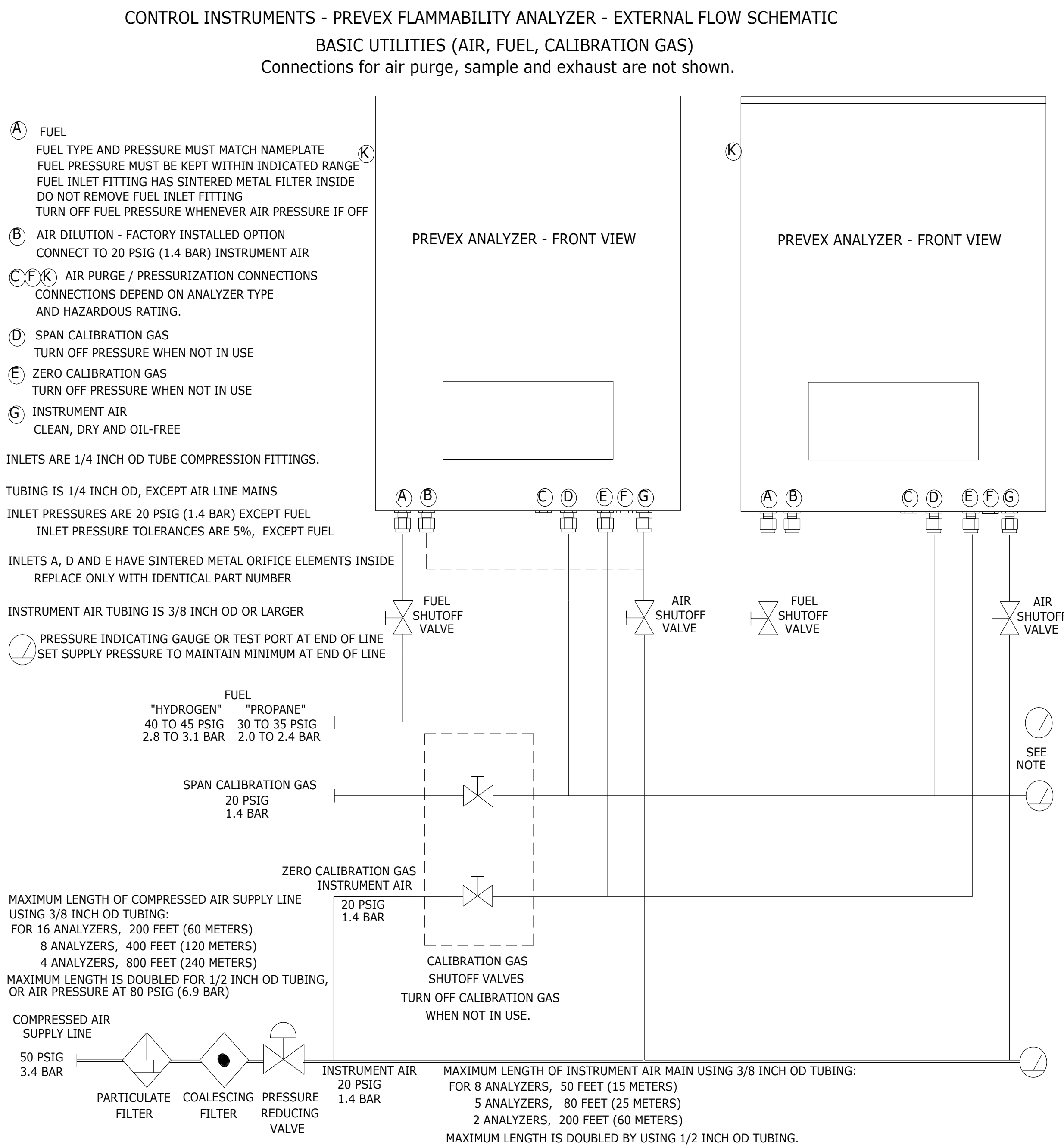
Keep the compressed air dew point well below the coldest expected temperature. Failure to do so may result in frozen compressed air lines. Outdoor compressed air lines require special care.

Protect inerted processes from air in the exhaust. The analyzer's exhaust contains compressed air and dilution air. 100% nitrogen may be used as the compressed "air" source, but the dilution must still use air. Make certain that this volume of air will not adversely affect an inerted process, or take special precautions to plan an alternate exhaust method.

Connect the compressed air to the (optional) air dilution inlet. If this factory-installed option is used, it requires 20 PSIG (140 kPa) at the dilution air inlet.



[14] Refer to ISA-7.0.01-1996 for specifications of instrument grade air.



Typical installation of pneumatic utilities for a PrevEx analyzer.

4.7. Fuel supply cylinders

Observe precautions and regulations for safe storage and handling. The fuel supply system should conform to all applicable codes[15].

Use only the specified fuel. The sensor is factory built to accept only one type of fuel.

Use inlet restrictor fittings. The fuel inlet requires a special fitting with a factory-installed restrictor. Do not remove or replace this fitting. It is necessary for controlling the flow of fuel.

Separate fuel cylinders from calibration cylinders. Calibration cylinders are equivalent to compressed air and should be separated from fuel cylinders by a safe distance or rated barrier.

Install warning sign and post operating instructions.

Use an approved cylinder rack or mounting system.

Install a pressure relief device vented to a safe outdoor location.

Limit the number of sensors on a common fuel line, to allow use of a safer excess flow limit.

Install an excess flow valve or flow restrictor. Allow a flow rate of at least 50 cubic centimeters per minute per analyzer for hydrogen fuel, and 10 cc/min per analyzer for propane fuel.

Install a low-pressure switch and alarm. Low fuel pressure causes false low readings. Especially for process control, monitor the fuel line with a pressure switch that alarms if the pressure falls below the minimum.

Install a flexible tubing loop at the cylinder, to facilitate cylinder changes.

Use ¼ inch OD stainless steel or copper tubing. Do not use flexible tubing. Keep tubing clean to prevent contamination. Do not use flux and solder, black pipe and pipe dope, or sealant. Use leak check solutions only on the outside of the tubing. Fuel flow and pressure drops are insignificant as long as leaks are prevented. **¼ inch OD tubing is the correct size**. **Do not use large diameter fuel lines or headers.**

Use compression fittings. Soldered or threaded connections that use flux or sealant will contaminate the fuel line, and cause reading drift or clogging of the fuel inlet restrictor. Fuel purity is important.

Install a shutoff valve at the fuel inlet for use during maintenance.

Test fuel lines for leaks. Eliminate all fuel line leaks.

Set the fuel regulator at the cylinder to deliver the correct pressure. Do not over- or under-pressurize the fuel line.

Set backup cylinder pressure lower than the primary. For systems with two cylinders, the pressure of the primary regulator should be slightly higher than the secondary regulator. In this way, fuel is drawn from the primary cylinder until it is nearly empty. Then the pressure drops slightly to the pressure of the secondary cylinder. This gives an indication that the primary cylinder is empty and needs replacement.

Wait for fuel lines to purge before startup. It may be necessary to wait one hour or more for fuel lines to purge themselves of trapped air. The reading drifts slowly upscale until all air is removed.

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[15] For example, in the USA, these may include: 29CFR chapter XVII, Paragraphs 1910.101(b) and 1910.103(a)(2)(i)(b) *Hydrogen Systems less than 400 cubic feet,* Compressed Gas Association, Pamphlet CGA P-1-1984 *Safe Handling of Compressed Gases in Containers, or* National Fire Protection Association - NFPA 50A *Standard for Gaseous Hydrogen Systems at Consumer Sites - Safe Handling of Compressed Gases in Containers.*

4.8. Zero and Span Test Gases

Use inlet restrictor fittings supplied with analyzer. The zero and span inlet fittings contain sintered metal restrictors that control the calibration flow rate. Do not remove these fittings. Do not replace them with other fitting types.

Supply "Zero Air" at 20 PSIG (140 kPa) to the zero inlet during calibration. If the compressed air supply is used for zero air, it must be clean, dry, oil-free, and regulated to 20 PSIG.

Supply "Span Gas," 1.15% Ethylene in Air, at 20 PSIG (140 kPa) to the span inlet during calibration. Cylinder part number CYL018 or equal. See calibration instructions for requirements.

Shut zero and span gas off at the cylinder valve when not in use. This prevents loss of gas from minor leaks, and prevents unintentional or accidental injection of test gases. When compressed air is used in place of a zero gas cylinder, **provide a zero gas shutoff valve**, to turn off air pressure to the zero inlet when not in use.

4.9. AC Power

Observe proper precautions for handling AC power. Do not open covers when circuits are live.

Allow 400 Watts (VA) per sensor peak power. Average power consumption is lower.

Supply correct voltage. Voltage is factory configured to either 120VAC or 230VAC—but NOT BOTH. Input voltage is marked on the serial plate on the side of the analyzer.

Supply power continuously. Electric heaters stabilize readings and prevent condensation. Loss of power can cause condensation that requires cleaning before the analyzer can be put into use.

Supply multiple analyzers from same main circuit. Prevent ground loops and electrical problems by properly grounding all analyzers at the same point. This is required for serial communications.

Use proper grounding. Connect the AC main ground wire to the ground lug on the chassis. A green ground wire with yellow stripe connects the controller to the ground lug.

If power is off for some time, turn off the air and fuel supply.

Install a power switch near the sensor. The sensor uses non-incendive circuits, and therefore does not have a power switch. A suitable power switch should be installed so that power can be easily disconnected for servicing the analyzer.

Use conduit seals or cable glands to seal wiring entrances. These are required if an air purge system is connected.

Use size 14 AWG wire (or equal) for power. Do not exceed the maximum recommended length of AC power wires for different wire gauges as indicated in the table below.

Access to wiring terminals is at the rear of the controller. Terminals plug in to the controller. Access terminals by lifting the controller up, and swinging the top down, leaving two bottom pins in place. Unplug terminals to remove controller.

Install a small service loop in wire leads. Prevent strain on the terminals, and allow free movement of the controller for access during service.

Maximum Length of AC Power Leads
Maximum length of wire from AC source to single analyzer

AWG	Metric (diameter)	Feet	Meters
12	2,0mm	1000	305
14	1,6mm	600	183
16	1,3mm	350	107

4.10. RS-485 Serial Communications

Serial communications enables remote monitoring for improved service and troubleshooting.

Observe correct grounding and AC wiring. Damage can occur if common-mode voltages are exceeded. Devices, which share the RS-485 connection, must all be grounded to the same common grounding point. If a DC powered master device is used, connect the (-) DC power common to earth ground.

Use shielded 22 AWG (metric 0,6mm) **three-conductor wire** such as “Belden 3106A” or equal. Use foil inner shielding with an overall braided shield. Installation of a spare is recommended.

Keep RS485 wiring separate from AC wires in metallic conduit to minimize RFI and EMI.

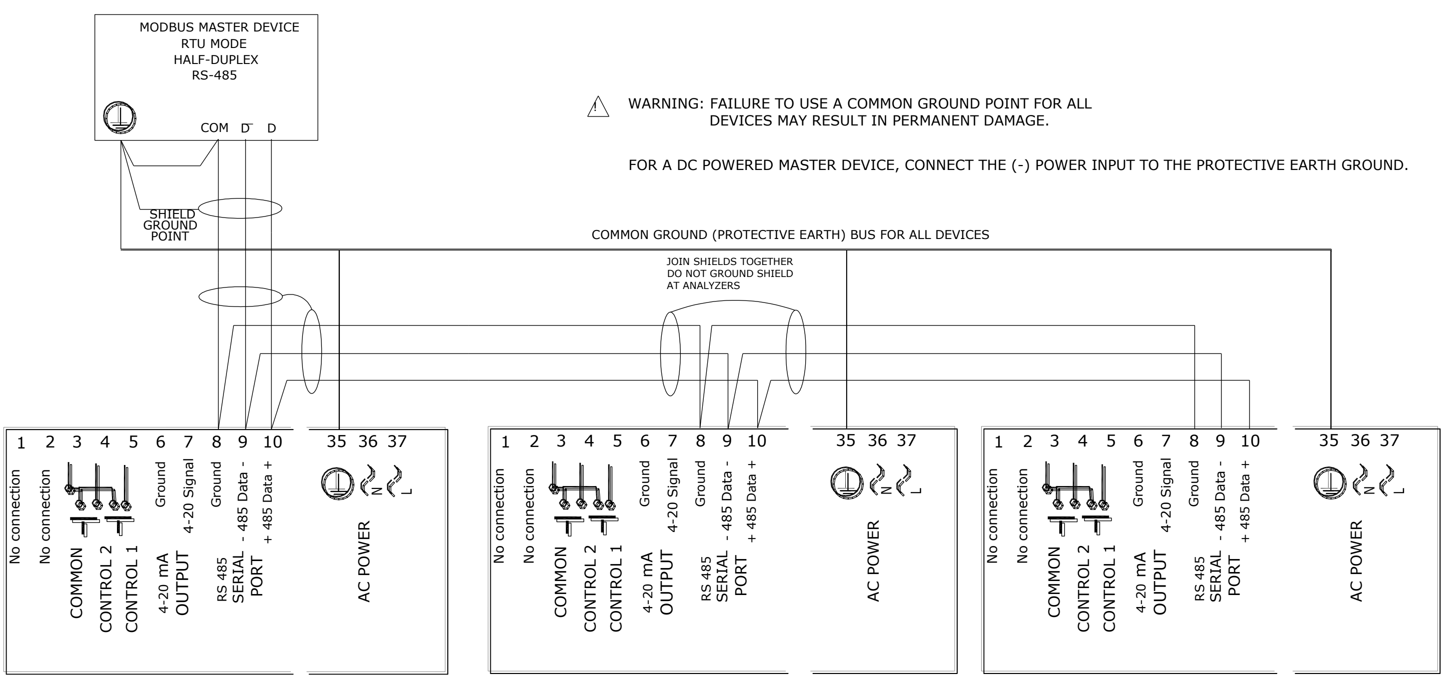
Protect RS-485 wires from excessive temperature and humidity, to avoid wire damage, aging, shorting and signal loss.

The maximum line length of the RS-485 three-conductor is 4,000 feet. For greater distances a repeater is required.

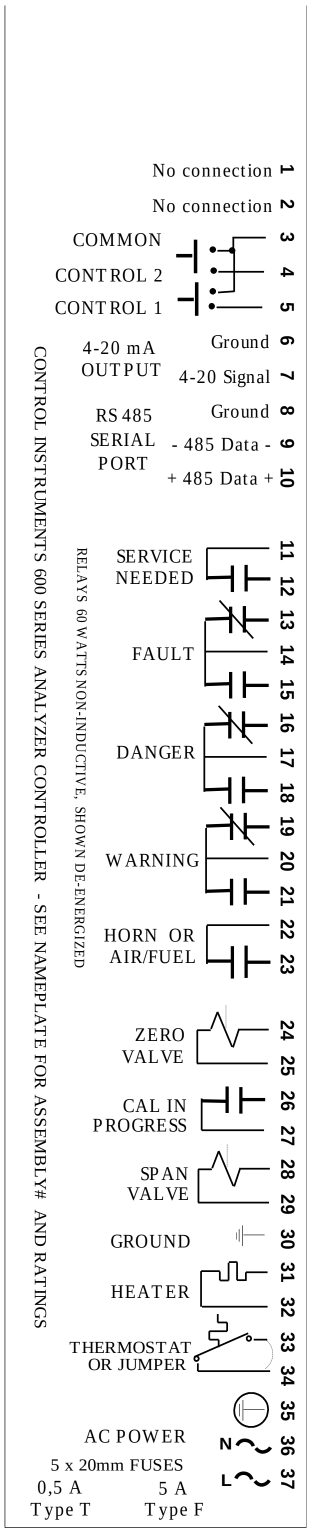
Connect wires in parallel. For multiple sensors, join all (+) connections, join all (-) connections, and join all common (grounds). Use a “daisy-chain” configuration. The maximum recommended “stub length” (length of branch circuit) is ten feet.

Ground the shield drain wire at a single point. Keep the shield and drain wire insulated from conduit and junction boxes. Interconnect the shields on each segment of cable, but attach the shield to ground only at a single ground point.

Install wire with a small service loop to prevent strain on the terminals and to allow access to the terminals for service procedures.



4.11. Relays and Outputs



4.11.1. 4-20mA Signal Output

1. **The sensor non-isolated 4-20mA output can drive a maximum load of 275 ohms**, non-inductive, including line length.
2. **Use shielded 22 AWG** (metric 0,6mm) **shielded twisted-pair wire** such as Belden 83319E or Alpha 2824/2 or equal.
3. **The 4-20 milliamp signal is self-powered.** It is not loop-powered, and should not be connected to a power source.

4.11.2. Relays

1. **Do not exceed the 60-Watt relay contact ratings.** All contacts are rated for 60 Watts, non-inductive loads. Exceeding the rated power or voltage will damage the controller.

2. **Use the FAULT and DANGER relays.** The fault and danger relays should be used in the safety shutdown system.

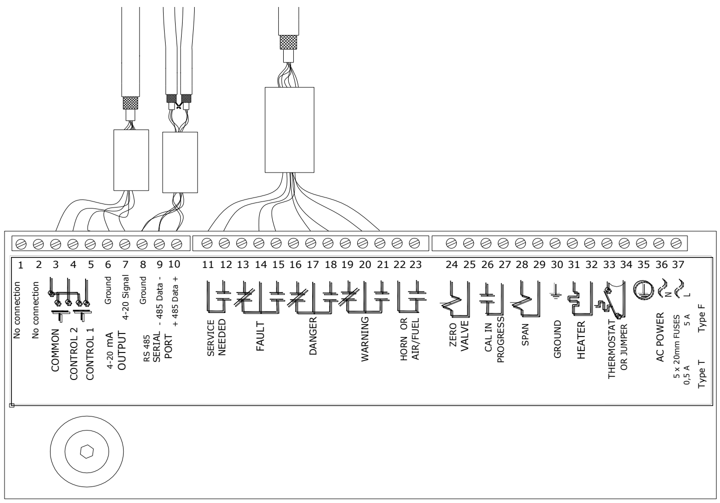
3. **The label shows each relay in its de-energized state**.
ND - normally de-energized relay. “Energize to trip.”
NE - normally energized relay. “De-energize to trip.”

Name	Form	Normal State	Function
SERVICE NEEDED	A	ND	Operating properly, but service needed soon to prevent fault.
FAULT	C	NE	Fault. Analyzer cannot make a valid readings or alarms.
DANGER	C	NE	Reading above DANGER setting in the ALARMS menu
WARNING	C	NE	Reading above WARNING setting in the ALARMS menu
HORN OR AIR/FUEL CUTOFF	A	ND	HORN Activates whenever FAULT, WARNING or DANGER first occurs. Is silenced by the acknowledge command. HORN can be made NE using FAILSAFE setting in ALARMS menu. Can be configured as AIR/FUEL cutoff using RLY/CNFG setting in the OUTPUTS menu
CALIBRATION IN PROGRESS	A	ND	Activates when ZERO or SPAN are on to indicate that analyzer is exposed to test gases and cannot make valid process readings or initiate a WARNING or DANGER alarm.

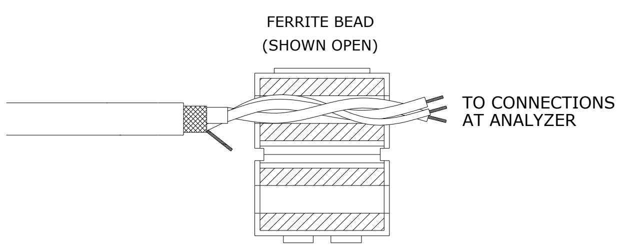
4. **Use failsafe relay wiring for WARNING, DANGER and FAULT.** These are “normally energized.” They de-energize for an alarm or power loss. Use a normally open contact that closes when energized, so that a disconnected wire is detected.

4.12. **Wiring for EMC (Electromagnetic Compatibility)**

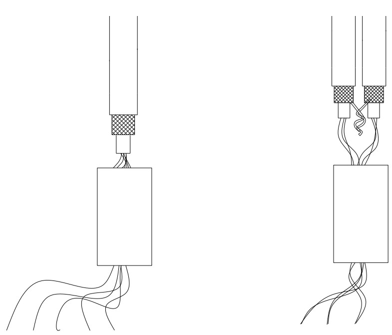
Shielded control cables, surge suppressors, and installation of ferrite beads, are required to suppress electromagnetic interference. Control cables for the 4-20 milliamp signal, RS-485 communications link, relays, and CONTROL inputs shall be shielded with an inner foil shield and an overall braided shield. Ferrite beads (250 Ohms at 100 Megahertz) shall be placed near the controller's terminals. Shields and ferrite beads are not required for the internal wiring or the AC power wiring on terminals #24 to #37.



Controller wiring with shielded cables and ferrites on control cables.



Installation of ferrite bead on control wiring. Remove outer insulation and shields. Fit wires into center and snap shut. Keep wires short. A tight fit is best.



"Star" (left), and "Ring" or "Daisy-chain" (right) configurations

For "star" configuration wiring, cut off the drain wire. For "daisy-chain" wiring, in which a single terminal has both an incoming and outgoing wire, join the drain wires together as shown.

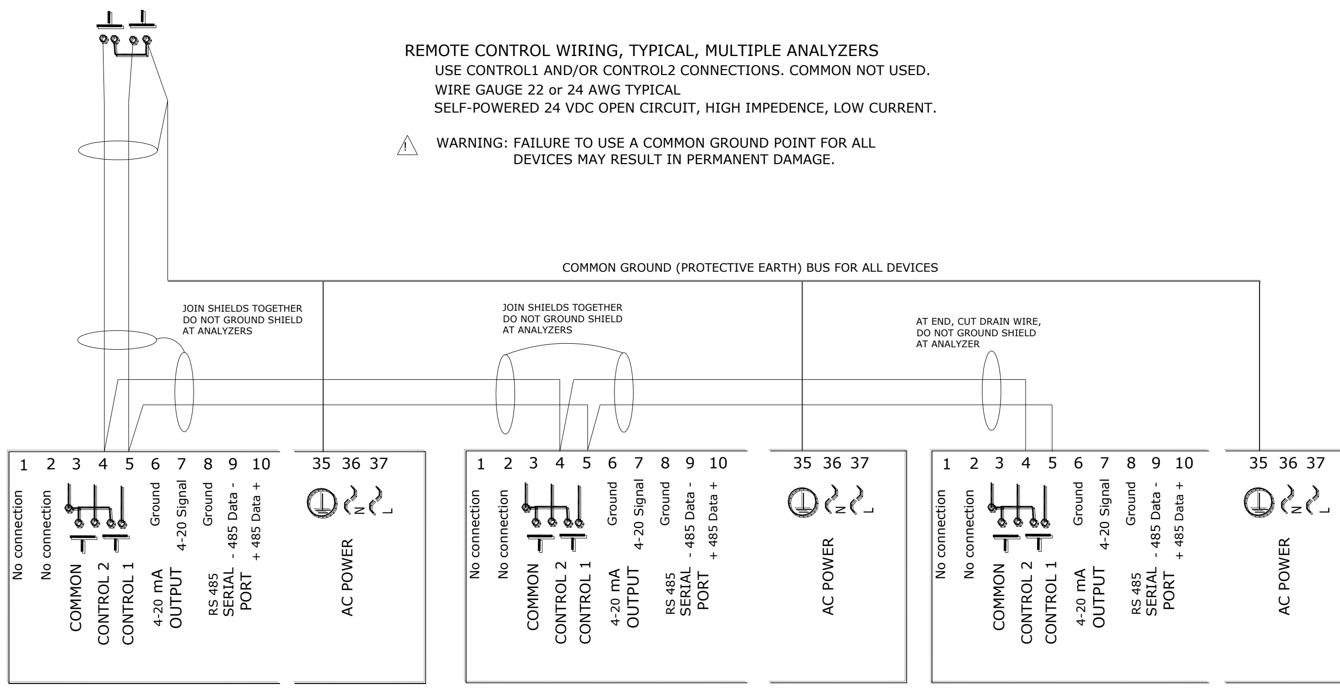
4.13. Remote Control Inputs

Two inputs are provided. They are programmed as CONTROL1 and CONTROL2 in the OUTPUTS menu. Each can perform one of the commands in the COMMANDS menu.

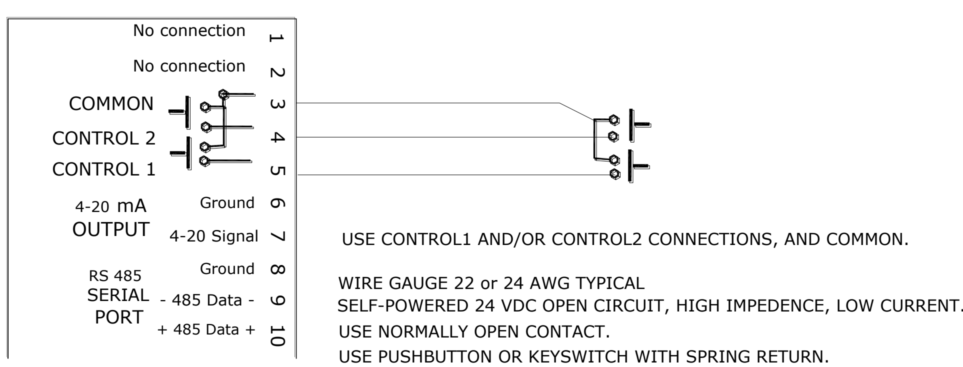
- Manual RESET and ACKNOWLEDGE pushbuttons for alarms.
- Local MENU and SELECT pushbuttons to allow access without removing the cover.
- Key switch or PLC control to initiate calibration.
- Prevent unauthorized calibrations and phototransducer access using LOCK CAL.

See sections 5.4 and 12.4 for descriptions of the available commands.

1. Three terminal block positions are available for CONTROL1, CONTROL2, and a ground wire.
2. Use a normally open, momentary contact, dry circuit, relay or switch.
3. Use 22 or 24 AWG wire (metric 0,5mm to 0,6mm) with a braided shield.
4. **Activate with a contact closure, 250 milliseconds or more**, from control input to common.
5. Controls are self-powered. **Do not attach AC or DC powered control signals** to controls.



REMOTE CONTROL WIRING, TYPICAL, SINGLE ANALYZER



4.14. Visual and Audible Alarms and Indicators

Install audible and visual devices to alert personnel in the vicinity of the analyzer. At a safe distance from the process, install a display that gives the reading and alarm status of the analyzer.

The analyzer reading (%LFL) should be displayed at the control panel where adjustments to the process are made that might affect the concentration of flammable gases. The operators should understand the meaning of the analyzer reading, and how it relates to the process under control.

A large, distinctive visual and audible alarm, easily observed and heard from all working locations, should be used to alert personnel to the presence of an alarm.

The danger and fault alarms should be used for an immediate safety shutdown to bring the concentration of flammable gases in the process safely down to 0%LFL. The warning alarm can be used to slow down or stop the process in an orderly manner, so that a danger alarm is avoided. But in any case, the danger alarm must safely bring the process to a halt.

The analyzer is installed close to the atmosphere being sampled. During alarms, the atmosphere may become flammable or explosive. Avoid the area near the analyzer during alarms, until it is known that the concentration of flammable gas has been brought to 0%LFL.

WARNING! During alarms, keep at a safe distance until the cause is found and corrected.

4.15. Security

Prevent accidental or unauthorized calibration or other changes to the settings and alarms.

WARNING! The enclosure should be locked to secure the analyzer against tampering.

Secure the analyzer from unintentional or unauthorized changes:
Lock the outer cover to prevent access to the MENU and SELECT pushbuttons. The cover latches allow the use of a padlock. The cover also requires a tool to open; this tool-operated safety feature should not be removed.

Secure the analyzer from unintentional or unauthorized calibration:
The calibration procedure must not interfere with the analyzer's safety function. The person responsible for overall process safety must implement an effective design. Several methods are available to prevent the start of calibration or to signal that calibration is in progress.

Hardware lock
Use the OUTPUTS menu to configure the remote control input CONTROL1 or CONTROL2 with the command LOCK CAL, and interlock this control to the process or machine controls so that calibrations are prevented except when the machinery or process is in a safe condition.

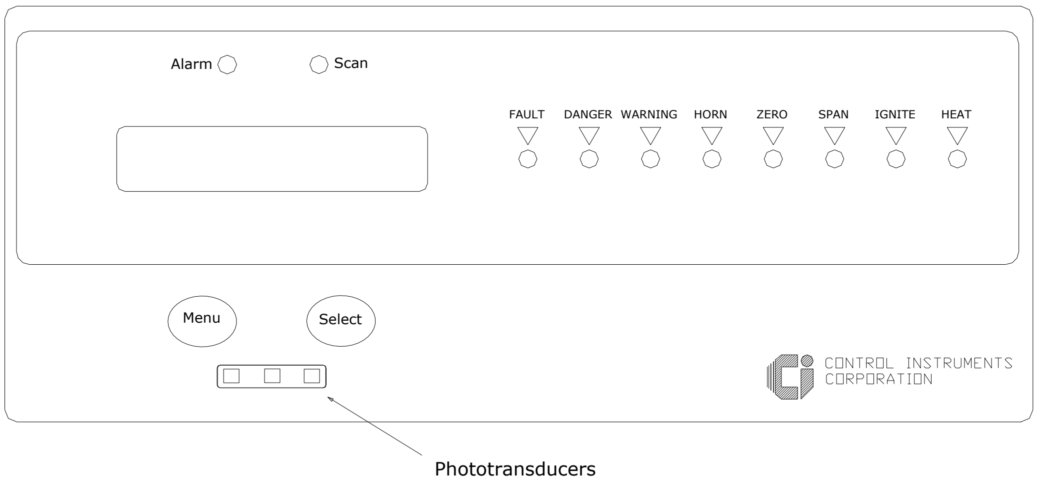
Hardware relay output
Interlock the CAL IN PROGRESS relay with an appropriate machine control so that an inadvertent activation of calibration immediately initiates a safety shutdown or some other safe state.

Hardware milliamp output
The MA CAL register can force the milliamp output to a special state during calibration, so that the control or supervisory system can detect that a calibration has begun and force the process to a safe state.

Software lock
Lock out phototransducer access by using LOCK CAL on the COMMANDS menu or with serial communications. It will prevent the initiation of calibration until the UNLOCK command is given. The CAL LOCK register (read-only) indicates LOCKED or UNLOCKED status.

5. Display, Indicators, Controls

The controller has an alphanumeric LCD display with 10 status indicators. The display is controlled by MENU and SELECT pushbuttons, or by phototransducers that allow access with the cover in place. When the menus are not in use, the flammability reading is displayed. Messages for alarms and faults are displayed once every ten seconds.



5.1. Indicators

Indicator	Color	Meaning
ALARM	Red	Flashes when a Fault, Danger, or Warning alarm first occurs. On steady after alarm is acknowledged. Flashed again if RESET fails to clear the alarm.
SCAN	Green	Flashes at least twice per second during normal operation. “Winks” briefly after completing a serial communication reply.
FAULT	Yellow	On when a fault is present. Flashes once each ten seconds if “service needed.”
DANGER	Red	Indicates a high high level alarm.
WARNING	Red	Indicates a high level alarm.
HORN	Red	The Horn LED is activated by new alarms.
ZERO	Green	On when the zero gas solenoid valve is energized during calibration.
SPAN	Green	On when the span gas solenoid valve is energized during calibration.
IGNITE	Green	On during two-second ignition pulse of the high voltage spark igniter.
HEAT	Green	Turns on when the flame cell heater is on. Once the operating temperature is reached, the heater and LED slowly cycles on and off.

5.2. Menu and Select Pushbuttons

The MENU pushbutton displays a list of menus. SELECT a menu to display its registers. Within a menu, SELECT a register to display its value, or press MENU to go to the next register. When finished viewing registers, press SELECT when EXIT is displayed to leave the menu and return to a scan of the reading and status. Or, simply wait: menus are displayed for several seconds, and register values for three minutes, after which, without pressing any pushbutton, the display will time out and exit automatically. Some registers can be changed. Pressing SELECT while its value is displayed increments the value to the next available setting. Once the desired value is displayed using SELECT, wait a few seconds until the display begins to flash. Continue to wait until the flashing stops. As the flashing stops, the new setting is entered and saved in EEPROM. To abort the change without saving it, press MENU at some point before the flashing stops. The old value will be restored.

5.3. Navigation: Menus and Registers

To move through menus,		*To display registers*		*... and modify registers ...*	
Show menu	**Enter menu**	**Show Register**	**Display Register**	**Modify Register**	***Flashes .... then completes***
"MENU"	**"SELECT"**	**"MENU"**	**"SELECT"**	**"SELECT"**	***To accept/activate wait for flashing to stop. To escape/cancel, press "MENU"***

COMMANDS

RESET	*Clear alarms, reignite, adjust chk flow*
ACKNWLDG	*Silence horn, clear "service needed", adjust chk flow*
ZERO CAL	*Calibrate to 0% with air, adjust* RAW ZERO
SPAN CAL	*Calibrate to* CAL RDNG *with test gas, adjust* RAW SPAN
FULL CAL	*Calibrate both zero and span*
ZERO TEST	*Inject air to check 0% LFL reading - no adjustment*
SPAN TEST	*Inject span test gas to check reading - no adjustment*
FULL TEST	*Test both zero and span*
SAVE ALL	*Write settings to EEPROM*
LOCK CAL	*Prevent activation of calibrations and tests*
EXIT	

GAUGES

READING	*%LFL Reading*
STATUS	*Device status*
PEAK HI	*Highest reading since last RESET*
PEAK LOW	*Lowest reading since last RESET*
HSG TEMP	*Temperature of flame cell*
SET TEMP	*Temperature setting for flame cell*
FLOW	*Sample flow rate*
LOW FLOW	*Flow rate below which LOW FLOW occurs*
CHK FLOW	*Flow rate below which CHK FLOW occurs*
FLAME	*Flame temperature*
EXIT	

CAL MENU

RAW ZERO	*Flame temperature of zero (0% LFL)*
RAW SPAN	*Flame temperature rise from span test gas*
CAL TIME	*Duration of calibration in minutes*
CAL RDNG	*Span calibration reading, %LFL*
SPAN °C	*Expected RAW SPAN flame temperature rise from span gas*
SPEED	*LOW* / *MED* / *HIGH*
CAL LOCK	*ON* / *OFF*
EXIT	

ALARMS

WARNING	*%LFL above which WARNING is given*
DANGER	*%LFL above which DANGER is given*
RATE	*Rate-of-rise alarm enable: ON or OFF*
LATCHES	*----HFDW Relay latch until RESET*
FAILSAFE	*----HFDW Relay normally energized*
AUTO IGN	*0 (off), 1, 2, ...*
VERSION	*5.11*
TYPE	*SNR67x*
SERIAL	*05-xxx*
LANGUAGE	*Display language selection*
EXIT	

OUTPUTS

RLY TEST	----HFDW *Force relays to activate*
MA TEST	*Force milliamp output to increase*
4 MA ADJ	*Fine tune output so 0%LFL = 4.0 mA*
20 MA ADJ	*Fine tune output so 100%LFL = 20.0 mA*
MA CAL	*Force output during calibrations and test*
MA FAULT	*Force output during faults*
CONTROL 1 / CONTROL 2	*RESET* / *ACKNWLDG* / *ZERO CAL* / *SPAN CAL* / *FULL CAL* / *ZERO TEST* / *SPAN TEST* / *FULL TEST* / *SAVE ALL* / *COLDSTRT* / *MENU* / *SELECT* / *LIGHT ON* / *LOCK CAL*
RLY CNFG	*HORN* / *AIR/FUEL* / *OVERRIDE*
EXIT	

COM PORT

SET BAUD / BAUD RATE	*300* / *600* / *1200* / *2400* / *4800* / *9600* / *19200*
AUTO BAUD	*ON* / *OFF*
ADDRESS	*1,2 ...255*
ID NBR	*0,1,2 ... 99*
EXIT	

EXIT

5.4. COMMANDS

RESET and ACKNWLDG are the only commands used by the operator. They are accessible with the CAL LOCK active. All other commands are for calibration and maintenance, and should be secured against unauthorized or unintentional activation with a software or hardware lock.

RESET	The RESET command deactivates latched warning or danger alarms or faults if the condition that caused the alarm or fault has been corrected. If the status is a FLAMEOUT fault, RESET initiates re-ignition. The IGNITE indicator momentarily activates as a high voltage spark discharge is generated in the flame cell. RESET also adjusts the flow rate for the CHK FLOW, SERVICE NEEDED message.
ACKNWLDG	The ACKNOWLEDGE command deactivates the HORN indicator and relay[16], and stops the flashing of the ALARM indicator. ACKNWLDG deactivates the SERVICE NEEDED relay and message. If a CHK FLOW, SERVICE NEEDED message was active, it adjusts CHK FLOW so another message occurs if the flow rate continues to fall.

Calibration (CAL)commands initiate calibration. Solenoid valves inject calibration gases to the analyzer. If the response is acceptable, the readings are adjusted; else a calibration fault is activated. Hardware faults, which might make calibration inaccurate, cause the calibration to abort.

ZERO CAL	Injects Zero Gas and updates RAW ZERO to give a 0%LFL reading. If the response is bad, a ZERO FAIL fault occurs.
SPAN CAL	Injects Span Gas and updates RAW SPAN to give a %LFL reading equal to CAL RDNG. If the response is bad, a SPAN FAIL fault occurs.
FULL CAL	Performs a zero calibration, followed by a span calibration.

TEST commands do not calibrate, they only inject calibration gases. They do not adjust readings, and do not generate faults. They are permitted when a fault exists. Use TEST commands for troubleshooting only.

ZERO TEST	Injects Zero Gas, so the response can be observed.
SPAN TEST	Injects Span Gas, so the response can be observed.
FULL TEST	A combined zero and span test.
SAVE ALL	Saves all settings to nonvolatile EEPROM. Calibration automatically saves all.

The commands LOCK CAL and UNLOCK are for security. One or the other appears as appropriate.

LOCK CAL	Prevents calibration and test commands from being activated until the UNLOCK command is given. With the lock on, only the “RESET, ACKNOWLEDGE and EXIT” are available.
UNLOCK	Enables calibration and test commands. Does not override a hardware lock on the CONTROL1 or CONTROL2 input.

Section 12.4 includes COMMANDS that are accessed through serial communications only.

[16] Acknowledge deactivates the relay only if the RLY CNFG setting is “HORN.” See section 2.6.11for details.

5.5. GAUGES

The GAUGES menu has registers for the reading, status and operation. All are read-only, except for SET TEMP and LOW FLOW, which can be adjusted, but normally require none.

READING	The flammability reading in %LFL.
STATUS	The device status.
PEAK HI	The highest reading since last reset, excluding warm-up and calibration.
PEAK LOW	The lowest reading since last reset, excluding warm-up and calibration.
HSG TEMP	The flame cell temperature in °C. It should be equal to SET TEMP.
SET TEMP	Sets the flame cell temperature in °C. The controller turns the heater on and off in order to keep the HSG TEMP equal to SET TEMP, typically, within ±2°C.
FLOW	The sample flow rate in standard liters per minute, (SLPM).
LOW FLOW	The sample flow rate below which a FAULT is activated.
CHK FLOW	The sample flow rate below which a CHK FLOW message is activated.
FLAME	The flame temperature in °C. At 0%LFL, the typical flame temperature is 500°C.

5.6. CAL MENU

The CAL MENU contains registers that control calibration.

RAW ZERO — The flame temperature taken during the last successful zero calibration.

RAW SPAN — Rise in flame temperature above the zero, from the last successful span.

CAL TIME — Sets the number of minutes that the zero and span gases are injected during calibrations and tests.

CAL RDNG — Sets the reading for span calibration. It is the flammability of the span gas including the response factor and temperature correction.

SPAN °C — Sets the expected temperature rise for the span gas response during span calibration. If the response of the sensor is not close to this value, a CHK SPAN message or SPAN FAIL fault will be given.

SPEED — Sets the speed of response for the sensor. The HIGH setting gives the fastest response; the LOW setting has an additional delay that can reduce the rate of rise of the reading. The speed register controls a digital noise filter, which introduces a small time delay, but increases noise immunity. Some Model types allow the speed to be turned OFF, which delays the response about ten seconds.

LOW	Slowest setting. Adds up to 0.25 seconds to the response time.
MED	Default setting.
HIGH	Fastest possible response time. Reduces response time by 0.25 seconds.

CAL LOCK — Indicates the state of CAL LOCK. Either LOCKED or UNLOCKED.

The setting LINEAR appeared in prior versions, but is no longer included in the CAL MENU:

LINEAR — LINEAR sets the linear range for the air dilution option. When air dilution is uninstalled or OFF, and/or the sensor operating in the standard configuration, this setting should be 40% LFL. With air dilution ON, this setting should be 80% LFL.

5.7. ALARMS

The ALARMS menu contains registers related to the warning and danger alarms, and the device identification. These registers are for configuration only, and do not normally require adjustment.

WARNING	Sets the WARNING alarm level. When the flammability reading exceeds the warning level, the warning LED indicator and relay are activated. If configured to be a latching alarm, the warning remains active until the flammability reading goes back below the warning level and the reset command is given. Otherwise, the warning LED indicator and relay are deactivated once the flammability reading goes back below the warning level. The WARNING alarm is automatically activated whenever the DANGER alarm is active.
DANGER	Sets the DANGER alarm level. When the flammability reading exceeds the danger level, the warning and danger indicators and relays are activated. These remain active until the flammability reading goes back below the danger level and the reset command is given, or an auto reset occurs.
RATE	Enables or disables the RATE alarm. If the rate of rise of the flammability reading is such that it will soon exceed the danger alarm level, the danger alarm is activated.
LATCHES	Configures the warning, danger, fault and horn to latch. A latching alarm is kept active, even if the condition that caused the alarm is corrected, until it is cleared by the reset command. The value of the LATCHES register is displayed as the first letter of each alarm. The display ----HFDW means that the HORN, FAULT, DANGER and WARNING are latching. When the DANGER alarm is not latching, an external device must be provided to perform the latching function. When the HORN is configured to latch, a RESET that does not result in a NORMAL status causes the HORN to re-activate. When the horn is configured to auto reset, only a new alarm, and not a reset attempt, re-activates the horn. An AUTO IGN setting of 1 or more can override the LATCHES setting for flameout faults that successfully re-ignite.
FAILSAFE	Failsafe relays are normally energized; they de-energize when the alarm activates. If power is lost, or another fault de-energizes the relay, the relay contacts switch. WARNING, DANGER and FAULT relays are failsafe. The HORN, if not essential to the safety system, can be made non-failsafe so that it is silent during maintenance procedures. FAILSAFE displays the first letter of each failsafe alarm. -----FDW means the horn is not failsafe, ----HFDW means the horn is failsafe.
AUTO IGN	Configures automatic re-ignition of the sensing flame. When set to 0, this feature is turned off, and there is a single attempt to ignite the sensing flame. When 1 or more, up to a limit of 120, there are additional re-ignition attempts at 15-second intervals. If re-ignition is successful, and there are no fault conditions, normal operation resumes as if an alarm reset had occurred, regardless of the setting of the LATCHES.
VERSION	Displays software version.
TYPE	Displays the analyzer type and matches the device software to the model number on the serial plate, for example SNR671.
SERIAL	Displays the serial number that was programmed at the factory during assembly.
LANGUAGE	Configures language, for example ENGLISH/DEUTSCH (German).

5.8. OUTPUTS

This menu contains registers for configuring and testing the relays, controls and analog output.

RLY TEST	Test relay activation. Only accessible through the menu. Not accessible through serial communications. The relay test register allows the relays to be tested by activating them. The register is displayed as the first letter of each relay, - - - - HFDW means the HORN, FAULT, DANGER and WARNING relays are activated. When the OUTPUTS menu is exited, the test ends, and relays activated by the test are deactivated. It is not possible to deactivate relays using the test register.
MA TEST	Test milliamp output. Only accessible through the menu. Not accessible through the serial communications. The test register allows the milliamp output to be increased to a higher level. In order to make the test failsafe, it is not possible to decrease the milliamp output. When the OUTPUTS menu is exited, the test ends, and the milliamp output is decreased to the correct value.
4 MA ADJ	Adjusts the milliamp output circuit so that 4 milliamps = 0%LFL. The 4 MA ADJ value is added to the output. For example, if the actual output is 3.9 milliamps at 0%LFL, set 4 MA ADJ to 0.1 milliamps to obtain 4.0 milliamps at 0%LFL.
20 MA ADJ	Adjusts the milliamp output circuit so that 20 milliamps = 100%LFL. The 20 MA ADJ value is added to the output. For example, if the actual output is 19.0 milliamps at 100%LFL, set 20 MA ADJ to 1.0 milliamps to obtain 20.0 milliamps. To adjust, use MA TEST to get a 20.0 milliamp output, then measure the actual output, and make 20 MA ADJ equal to the difference between the actual and 20.0 milliamps.
MA CAL	Sets the milliamp output during calibration. May be adjusted from 2.5 to 22.7 milliamps. If "OFF" is displayed, the register is not used, and the output equals the flammability reading during calibration. If any other value is used, then the milliamp output is forced to the MA CAL value during calibration.
MA FAULT	Sets the milliamp output during faults. May be adjusted from 2.5 to 22.7 milliamps. If "OFF" is displayed, the register is not used, and the output equals the flammability reading during faults, even if the flammability reading is inaccurate. If any other value is used, faults force the milliamp output to the MA FAULT value.
CONTROL1	Configures the remote control #1 to execute a command. This register allows one of the commands to be assigned to CONTROL1. When the CONTROL1 input is activated, the command is executed. See the COMMANDS menu in section 5.4 and the COMMANDS register in section 12.4 for a list of commands.
CONTROL2	Configures the remote control #2 to execute a command.
RLY CNFG	Reconfigures the HORN relay for use as an AIR/FUELcontrol. See section 2.6.11.

HORN	Default operation, relay performs HORN function.
AIR/FUEL	Configuration for controlling solenoid valves to automatically turn off air and fuel to the analyzer. The relay energizes (contact is closed) at the proper operating temperature. The relay de-energizes (contact is open) if temperature is too low, or if flame remains unlit after re-ignition attempts are unsuccessful.
OVERRIDE	The relay is forced to energize (contact is closed) to manually override the AIR/FUEL CONTROL function.

The setting MA SCALE appeared in prior versions but is no longer included in the OUTPUTS menu:

MA SCALE	MA SCALE displays the reading equal to 20 milliamps, typically 100 %LFL.

5.9. COM PORT

This menu configures the serial communications port. The character length is always 8 bits with one stop bit and no parity. The baud rate is adjustable, and can be made automatic.

SET BAUD — Sets the default baud rate between 300 and 19,200 baud. If AUTOBAUD is OFF, the default baud rate is used.

BAUDRATE — The baud rate actually in use by the device. If AUTOBAUD is OFF, BAUDRATE equals SET BAUD. If AUTOBAUD is ON, BAUDRATE slowly searches from 300 and 19200 baud until successful communications occur.

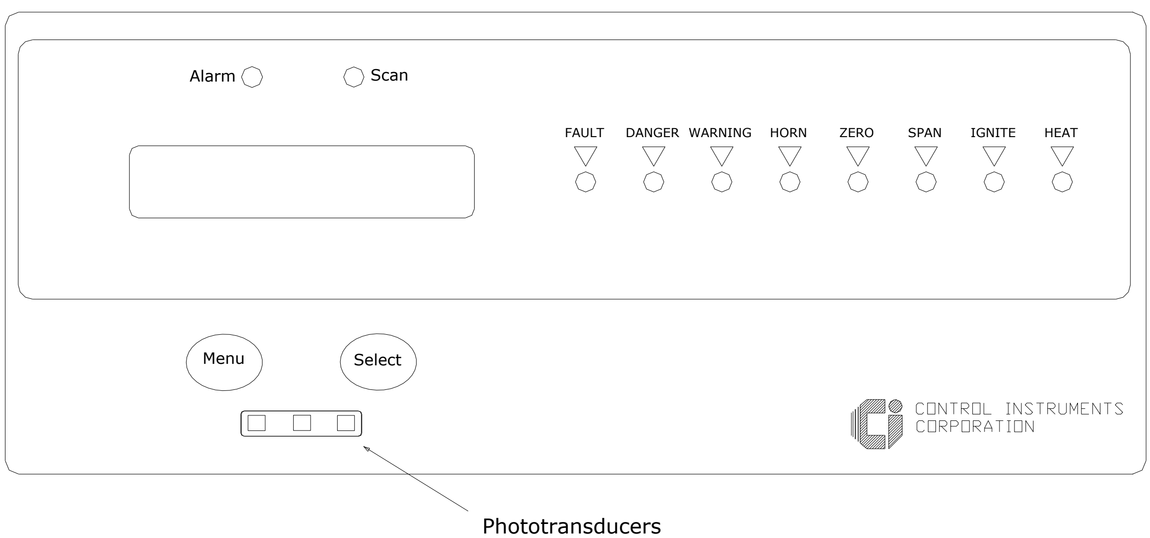
AUTOBAUD — Activates automatic baud rate detection. After several consecutive unsuccessful attempts to communicate, the baud rate is changed, until communications are established.

ADDRESS — Sets the devices address to a number from 1 to 255. Each device that is connected to the same serial communications wire must have its own unique address.

ID NBR — Allows an identification tag number between 0 and 99 to be assigned by the user.

5.10. Flashlight-activated Commands

Phototransducers located just below the MENU and SELECT pushbuttons allow access to COMMANDS when the enclosure cover is on.



1. Cover the left and right phototransducers with fingertips.
2. Shine a flashlight on the center phototransducer.
3. Commands will appear in the display, one at a time, every few seconds. Only RESET and ACKNOWLEDGE commands appear when the CAL LOCK is active.
4. When the desired command appears, remove the flashlight and uncover the left and right phototransducers. To exit without executing a command, use the EXIT command.
5. The selected command flashes for several seconds before activating.
6. Once the command activates, flashing stops, and the reading and status is displayed.

6. Startup Procedure

To be performed by qualified persons only.

6.1. Initial conditions

Before starting, AC power, fuel pressure, air pressure and calibration pressure are all OFF. To be safe, turn utilities on in the correct sequence as shown below.

6.2. Air

Apply compressed air to the analyzers. Remember that the compressed air allows the analyzer to use fuel safely. Keep the fuel and power off until the air is on and checked.

1. Temporarily disconnect air connections from analyzer(s)
2. Turn air supply pressure to a minimum value, (a few PSIG).
3. Turn air on to blow air lines clean of anything that might have accumulated.
4. Reattach air lines to each analyzer
5. Set air pressure to deliver 20 PSIG to each and every analyzer.
6. Check pressure at each analyzer.

6.3. Fuel

Once the compressed air is on, the fuel supply can be turned on. It will take some time for the fuel lines to purge before the fuel reaches the analyzer.

1. Visually check fuel connection.
2. Turn fuel supply regulator to low pressure.
3. Turn on fuel supply main valve.
4. Turn fuel supply regulator up to pressure indicated on serial plate.
5. Check for leaks: Shut off fuel cylinder valve and observe outlet pressure. If pressure holds steady more than 5 minutes, there are no significant leaks. If pressure drops suddenly there are leaks. If pressure does not hold for at least 30 seconds, the main valve must be left off until all connections are checked and the leak is found and fixed, or else the fuel cylinder will empty itself.
6. Turn on main fuel valve.

The fuel supply will begin to purge trapped air from the lines. This can take ½ to a few hours, depending on the fuel system design.

6.4. Power

Carefully check the wiring before turning power on.

1. Check wiring for misconnections and short.
2. Look for loose strands on terminals.
3. Measure from AC input to ground, should be open circuit
4. Check relay connections for compatibility. If in doubt unplug relay connections until they can be proven.
5. Turn power on.

Analyzer has "TEMP LOW" fault. Heater is on. Fault indicator on. Alarm on, or flashing.

Analyzer begins to heat up. Depending on the starting temperature and operating temperature, after ½ hour to 1½ hour, the analyzer reaches operating temperature, and the heater cycles on/off. Analyzer may still be in fault condition "FLAMEOUT."

6.5. Ignition

Once fuel lines have purged so fuel reaches the analyzers, and the analyzer is up to its operating temperature, and there are no other faults except "FLAMEOUT," the sensing flame can be lit.

1. The analyzer may automatically ignite itself. If not, use RESET on the COMMANDS menu to start the ignition process.
2. Use the FLAME register to see if the flame is lit.
3. Check the settings and reading on the GAUGES menu.
4. To repeat the ignition attempt, use RESET on the COMMANDS menu again.

AUTOIGN on the ALARMS menu can be configured to automatically make re-ignition attempts.

REGISTER	Description
READING	Until flame is lit, reading is negative, usually below -35% LFL, typically -99 %LFL or less. Once flame is lit, reading is higher, usually above -35% LFL, and climbs up slowly as fuel lines purge and analyzer stabilizes. It finally settles out near 0%LFL.
STATUS	When power is first applied, STATUS is TEMP LOW until analyzer heats up. With air on and the analyzer up to temperature, STATUS will be FLAMEOUT.
HSG TEMP	When up to temperature, is equal to SET TEMP
SET TEMP	Depends on TYPE.
FLOW	Should be higher than LOW FLOW or else a fault exists.
LOW FLOW	Factory set, usually 1.4 LPM.
FLAME	Until the flame it lit, the reading is about the same as HSG TEMP. Once the flame is lit, FLAME is much higher than HSG TEMP, and it continues to rise as the fuel lines purge and the analyzer"s temperature stabilizes. The controller indicates FLAMEOUT until the FLAME is above 450°C. It eventually settles near 500°C.

Avoid adjusting the fuel regulator to try to bring the flame up. Wait for fuel lines to purge completely, until then the flame will be smaller than normal. Wait for the fuel system and analyzer to stabilize before making any adjustments.

6.6. Preliminary Calibration

Check calibration line for leaks. Perform a preliminary calibration and check results.

1. Briefly turn calibration cylinder main valve on and then immediately off to pressurize the calibration lines.
2. Observe the calibration cylinder tank pressure. It should hold constant for at least 5 minutes. If not there is a leak that must be eliminated or else the calibration cylinder will empty itself. Check all connections and repair any leaks before proceeding.
3. Turn calibration cylinder(s) on.
4. Use FULL CAL on COMMANDS menu to initiate the automatic calibration sequence.
5. For each analyzer, observe the reading during the calibration process.
    - Zero indicator is on.
    - After about one minute (CAL TIME on CAL MENU) reading is near 0%LFL.
    - Zero is off. Span comes on.
    - Reading climbs up to near CAL RDNG, typically about 60%LFL.
    - Within one minute reading is very near CAL RDNG.
    - Span LED off. Zero LED back on for about 30 seconds to purge. Reading falls back toward 0%LFL.

6.7. Inputs and outputs

Check the 4 - 20 milliamp output and set up its "special states." Configure the controls. Check the alarm levels, Test the relays. Verify the E-Stop.

6.7.1. 4 - 20 milliamp output

The 4 MA ADJ AND 20 MA ADJ *settings or the 4 - 20 milliamp output do not normally require adjustment. Prior to adjustment, record the settings for future reference.*

1. Use MA TEST on OUTPUTS menu.
2. Output 4 ma. Only if necessary adjust 4 MA ADJ on OUTPUTS menu.
3. Output 20 ma. Only if necessary adjust 20 MA ADJ on OUTPUTS menu.
4. When adjustments have been made check at 4, 12, and 20 milliamps.
5. Set MA FAULT, the milliamp output during faults, for desired effect.
6. Set MA CAL, the milliamp out during calibration, for desired effect.

6.7.2. Controls

1. Configure CONTROL1 and CONTROL2 on outputs menu for desired effect.
2. Configure security for CAL LOCK or CAL IN PROGRESS.

6.7.3. Alarms and Relays

1. Check relay wiring for misconnections and shorts.
2. Check WARNING and DANGER levels in ALARMS menu.
3. Use RLY TEST in OUTPUTS menu to activate relays.
4. Verify that actions of each relay produce the desired overall result.
5. Verify that the **F**AULT and **D**ANGER relays activate the E-Stop (safety shutdown).

6.8. Records

For future reference, create a permanent written record of all settings and values.

6.9. Stability test

After the first 24 to 72 hours of operation the analyzer and all its utilities should be stable. Test accuracy with calibration gases and check results. If the zero and span values have not drifted significantly, the analyzer and its utilities have stabilized, and are ready for a complete calibration, see section 7.

FLAME on the GAUGES menu should be between 495°C and 505°C. The zero and span should be within +/-1%LFL of the correct values. If the drift is greater than 1%, perform a recalibration, and repeat the stability test once more, after another 24-hour period has passed.

1. Turn calibration cylinder(s) on.
2. Use FULL TEST on COMMANDS menu to initiate the automatic test sequence.
3. For each analyzer, observe the reading during the calibration process.
   - Zero indicator is on.
   - After about one minute (CAL TIME on CAL MENU) reading is near 0%LFL.
   - Zero is off. Span comes on.
   - Reading climbs up to near CAL RDNG, typically about 60%LFL.
   - After about one minute reading is near CAL RDNG.
   - Span LED off. Zero LED back on for about 30 seconds to purge. Reading falls back toward 0%LFL.

7. Calibration

To be performed by qualified persons only.

WARNING! The accuracy of the analyzer, and its ability to make alarms, depends completely upon proper calibration. Follow all calibration instructions carefully.

Calibration adjusts the analyzer for accurate %LFL readings. First, an initial calibration verifies important aspects of the calibration and its configuration, and determines the correct calibration reading[17] - CAL RDNG. Thereafter, routine recalibrations are performed on a regular basis to maintain accuracy and to verify the response. If any fact affecting the initial calibration changes, the initial calibration process should be repeated.

7.1. Initial calibration

Perform the initial calibration before the analyzer is put into service, and whenever process changes are made, especially changes to the types of flammable gases being measured, the span calibration gas, or the process temperature. Maintain a permanent record of all calibration information.

Review of limitations

Prior to putting the analyzer into service, review the “Theory of Operation” section for limitations to its effective operation. Include all foreseeable changes. Any limitation that might adversely affect the reliability of the analyzer should preclude its use until a correction can be found.

Identification of all flammable gases to be measured

List all flammable gases to be measured, now or in the future, in the record of initial calibration. Include the name, the LFL value, the Flash Point, and the response factor.

Response factors for different flammable gases

A response factor compares a particular gas to the standard calibration[18]. If the standard calibration is completely accurate for the gas of interest its response factor is 1.0. A low response factor means low readings: the calibration reading should be increased to make readings accurate. A high response factor means a gas has an exaggerated response compared to the standard - a “safe side” error[19]. The sensing flame has uniform response factors for many gases. Most solvent vapors have response factors between 0.9 and 1.1. They can be measured within the analyzer’s specified accuracy using the standard calibration, so correction for different solvents is often unnecessary.

Flash Point verification

Make certain the Flash Points of any and all flammable gases to be monitored are less than the operating temperature of the analyzer and all parts of the sampling system. The Flash Point of each individual flammable gas is important, not only the Flash Point for the complete mixture.

[17] The calibration reading is determined according to code requirements. There is one method for FMc and FM approved types, and another for ATEX/CENELEC types. The results are similar but not identical.

[18] Response factors are not based on the LFL value of the calibration gas itself. The calibration gas is only used to create a known, predictable increase in the flame temperature. Do not change the calibration reading when the local authority publishes a different LFL value of the calibration gas itself.

[19] The error due to response factor variation is the actual %LFL reading times (R_{gas} - R_{cal}), where R_{cal} is the response factor used for the calibration (typically 1.0 for the standard calibration), and R_{gas} is the response factor of the gas that is actually present. If more than one gas is actually present, R_{gas} is the weighted average of all response factors, where the weighing factor is each gas’s percentage of the total %LFL reading.

7.1.1. Calibration reading for FM and FMc type analyzers

Standard calibrations

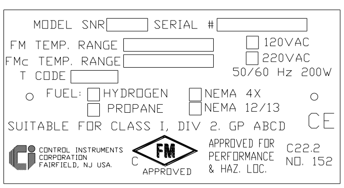
approved for FM and FMc type analyzers
with 7.84% per 100°C temperature correction factor per NFPA-86, suitable for the standard solvents

FM and FMc approved models are calibrated with *1.15% by volume ethylene in air* within a 2% tolerance. Ethylene in air between 1.13% and 1.17% by volume is an acceptable calibration span gas.

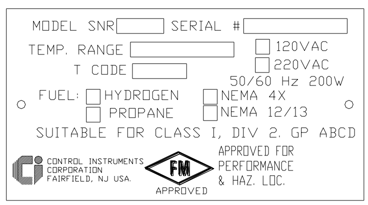
The calibration reading is adjusted for higher temperatures per the NFPA-86 code, which requires a 7.84% increase in **CAL RDNG** for each 100°C increase in process temperature.

CAL RDNG	Process temperature
1.15% Ethylene in Air = **50%** LFL of standard solvent vapors at	**77°F** (25°C)
1.15% Ethylene in Air = **56%** LFL of standard solvent vapors at	**250°F** (120°C) per NFPA-86
1.15% Ethylene in Air = **60%** LFL of standard solvent vapors at	**400°F** (200°C) per NFPA-86 (factory default)
1.15% Ethylene in Air = **64%** LFL of standard solvent vapors at	**600°F** (315°C) per NFPA-86

Canadian Standards Association (FMc)

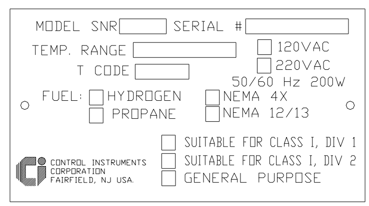


Factory Mutual Research (FM)



Generic Label

Models with generic labels have options not tested and approved by a third party.



Adjusting FMc and FM type analyzers for other substances

The standard calibration is accurate for flammable gases with response factors between 0.9 and 1.1. Response factors above 1.1 produce “safe-side” error and can be ignored. Response factors below 0.9 may require correction of the calibration reading.

For mixtures of several solvents, where one has a much lower response factor than the others, $\mathbf{R_{min}}$, it is safest to divide the standard calibration reading by $\mathbf{R_{min}}$. The higher calibration reading will give readings for all gases in the mixture at or above their actual flammability[20].

To remove some of the “safe-side error,” the response factors for “minor components” in the mixture may be ignored. A minor component is a flammable gas with a low response factor, that nevertheless is present in such small amounts in the mixture that the resulting error[21] can be ignored.

If all gases being monitored have response factors greater than 1.0, it is permitted, but not necessary, to divide the calibration reading by $\mathbf{R_{min}}$, the lowest response factor of all the gases, to lower the calibration reading and remove the “safe side” error.

[20] Refer to National Fire Protection Association, NFPA-86 “Ovens and Furnaces” for this requirement.

[21] NFPA-86 indicates an error of not more than 3% of the reading. This means flammable gases with response factors above 0.7 that are always less than 10% of the total flammable gas mixture are minor constituents. The rated accuracy of the analyzer is 10% of the reading, which corresponds to a response factor of 0.7 that is less than one-third of the mixture.

7.1.2. Calibration reading for ATEX type analyzers

Standard calibration

approved for ATEX / CENELEC types

Models SNR67x-Ty carry the ATEX and CE marks. To conform to CENELEC norms, start with the standard calibration "1.15% Ethylene in Air = 50% LFL." Then correct for response factor(s), calibration gas type and concentration, alternate LFL values (if any), and temperature correction (if any).

CAL RDNG **Process temperature**

1.15% Ethylene in Air = **50%** LFL of standard solvent vapors at **20°C**

II 2 G EEx p II T**x** -20°C ≤ Tamb ≤ 60°C		0344	Control Instruments Corporation Fairfield, New Jersey, USA		
Model	SNR67**XXXX**		Free volume	18 l	Freies Volumen
Year of manufacture	**XXXX**		Minimum overpressure	0,5 mbar	Mindest- Überdruck
Serial number	**XX-XXXX**		Maximum overpressure	25 mbar	Maximaler Überdruck
Certificate number	DMT 03 ATEX G 001 X		Minimum purge volume	240 l	Mindest-Vorspülmenge
Voltage	☐ 230 VAC	☐ 120 VAC	Minimum initial purge flow	24 l/min	Mindest-Vorspül-Volumenstrom
Fuel type	☒ Hydrogen	☐ Propane	Minimum continuous dilution flow	14 l/min	Mindest-Volumenstrom

Adjusting ATEX / CENELEC type analyzers for other substances

To measure a particular flammable gas with maximum accuracy, divide the calibration reading by the response factor **R** from the table in section 7.1.3.

For mixtures of several solvents, where one has a much lower response factor than the others, $\mathbf{R_{min}}$, it is safest to divide the standard calibration reading by $\mathbf{R_{min}}$. The higher calibration reading will give readings for all gases in the mixture at or above their actual flammability.

To remove some of the "safe-side error," the response factors for "minor components" in the mixture may be ignored. A minor component is a flammable gas with a low response factor, that nevertheless is present in such small amounts in the mixture that the resulting error is insignificant. For example, a substance with **R** = 0.7 at a concentration below 10% LFL causes an error less than 3% LFL using the standard calibration.

If all gases being monitored have response factors greater than 1.0, it is permitted, but not necessary, to divide the calibration reading by $\mathbf{R_{min}}$, the lowest response factor of all the gases, to lower the calibration reading and remove the "safe side" error.

Alternate calibration gases and concentration for ATEX / CENELEC type analyzers

If calibration gas is not available in concentration C^0, a different concentration C_C may be used within an acceptable range. The calibration reading is multiplied by $(P * C_C) / C^0$.

For ethylene, C^0 is 1.15% by volume, C_C must be between 1.0% and 1.2%, and P =1.
For propane, C^0 is 0.91% by volume, C_C may be between 0.8% and 0.95%, and P = 0.93.

Alternate Lower Flammable Limit values

Each flammable gas has its own LFL value, the percent by volume concentration in air at which that particular gas becomes flammable. The response factors in section 7.1.3 use LFL values from several sources. If traceability to a particular code or authority is required, compare the LFL value in section 7.1.3 with the value published by the local authority. If the values are the same, the response factor remains valid. If the **LFL_A** value recognized by the local authority is different than the **LFL_R** value in the response factor table, multiply the response factor by the ratio (**LFL_A / LFL_R**).

Temperature correction for ATEX / CENELEC type analyzers
To reflect the increase in flammability at higher temperatures, there are two methods.

Increased calibration reading - for ATEX temperature correction
To correct the calibration reading for temperature, multiply CAL RDNG by [1/ (1-K_T*(T_A – T^0))].
Once corrected, the analyzer readings will be accurate for the temperature **T_A**.
T_A is the temperature of mixture to be monitored, in °C.
T^0 is the temperature at which the LFL value was determined, in °C, usually 20°C.
K_T is a (gas-specific) factor for the temperature dependency, usually from 0,000784 to 0,00140.
A typical value of **K_T** is 0,0014, which corresponds to 14% per 100°C. **K_T** should be obtained from the relevant standards or the local authority having jurisdiction.

Reduced or limited alarm levels - for ATEX temperature correction
If the calibration reading is not corrected for temperature, the analyzer reading means "%LFL at 20°C." In this case, the alarm levels must be set to prevent operation above the maximum %LFL concentrations permitted by code, and must still have an acceptable margin of safety for the actual process temperature. Refer to the relevant CENELEC norm, for example, EN1539.

Calibration reading formula for ATEX type analyzers

A formula for the calibration reading for ATEX type analyzers combines all the corrections described above:

CAL RDNG = 50%LFL * [C_C/C^0] * [1/R] * [P] * [LFL_R / LFL_A] * [1/ (1-K_T*(T_A – T^0))]

Note concerning SPAN°C - the expected span temperature
The known, predictable increase in the flame temperature during the span phase of calibration is the setting SPAN°C. It is the RAW SPAN, the amount of temperature rise, expected from the standard calibration gas. PrevEx analyzers have very little individual variation in sensitivity[22] - the RAW SPAN is normally between 115°C and 135°C. During calibration, RAW SPAN is compared to the SPAN °C setting. A large deviation causes "service needed" message, or fault. "Service needed" occurs for deviations greater than 13% of SPAN °C (~ 15°C). A fault occurs for deviations greater than 25% (~ 30°C). If this occurs, do not adjust SPAN °C. Instead, find and fix the cause of the deviation, which could be incorrect calibration gas concentration or pressure, incorrect alignment between the burner and thermocouple, accumulation of debris on the thermocouple, or a leak in the sampling system. The benefit of SPAN °C is the ability to detect a problem with the analyzer or the calibration procedure that might otherwise go undetected.

[22] Air dilution is an exception. The air dilution option decreases the calibration gas concentration in the flame cell by about half, so the RAW SPAN and SPAN °C are approximately half their usual values.

7.1.3. Response Factor Table

Response factors **R** marked (*) were determined by DMT - Deutsche Montan Technologie GmbH - using the **LFL_R** value given in the table and temperature basis $T^0 = 20°C$. All others are by Control Instruments Corporation with temperature basis $T^0 = 25°C$. Substances marked “>” are standard. **FP** = °C Flash Point.

	LFL_R	R	Substance	CAS#	FP °C
>	4.00	1.00	acetaldehyde	75-07-0	-27
	4.00	0.82	acetic acid	64-19-7	39
>	2.70	1.06	acetic anhydride	108-24-7	52
>	2.50	1.01	acetone (*)	67-64-1	-20
	3.00	0.83	acetonitrile	75-05-8	2
	16.00	1.74	ammonia	7664-41-7	-78
	1.10	1.14	amyl acetate	628-63-7	23
>	1.20	0.90	amyl alcohol	71-41-0	33
>	1.20	0.94	benzol (*) / benzene	71-43-2	-11
>	1.30	0.94	benzyl alcohol	100-51-6	93
>	1.50	1.10	butadiene	106-99-0	-
>	1.80	1.01	butanone (*)	78-93-3	-7
>	1.40	1.00	n-butane	106-97-8	-60
>	1.60	1.06	butene	25167-67-3	-
>	1.70	1.00	butyl acetate	123-86-4	22
	1.50	0.88	n-butyl acrylate	141-32-2	29
>	1.70	1.00	n-butyl alcohol	71-36-3	37
	1.10	0.78	butyl cellosolve	111-76-2	-5
	1.40	0.76	butyraldehyde	123-72-8	-12
	2.40	1.00	butyrolactone	96-48-0	98
	1.30	0.83	carbon disulfide	75-15-0	-30
	12.50	1.22	carbon monoxide	630-08-0	-205
>	1.70	1.02	cellosolve acetate	110-80-5	60
	1.30	0.81	chlorobenzene	108-90-7	30
>	14.00	1.00	chloroform / trichloromethane	67-66-3	-
	8.10	1.43	chloromethane / monochloromethane	74-87-3	0
>	1.33	1.00	cyclohexane	110-82-7	-20
	1.10	0.84	cyclohexanone	108-94-1	43
	1.00	0.93	cyclohexene	110-83-8	-12

	LFL_R	R	Substance	CAS#	FP °C
	0.70	0.77	decalin	91-17-8	57
>	0.80	1.02	decane	124-18-5	46
	1.80	0.91	diacetone alcohol	123-42-2	56
	2.2	1.17	1,2-dichlorobenzene	95-50-1	65
>	6.20	0.91	dichloroethane / 1,2-dichloroethylene	107-06-2	13
>	0.80	0.96	diisobutyl ketone / DIBK	108-83-8	49
	1.00	0.60	(dimethylamino) acetonitrile	926-64-7	36
	2.00	1.14	dimethyl acetamide	127-19-5	70
	0.85	0.88	dimethyl adipate	627-93-0	107
	3.00	1.18	dimethyl ether	115-10-6	-41
>	2.20	0.95	dimethyl formamide	68-12-2	58
>	1.20	1.02	dimethyl glutarate	1119-40-0	103
>	1.35	0.96	dimethyl succinate	106-65-0	85
	2.20	1.19	dimethyl sulfide	75-18-3	-
	2.60	1.44	dimethyl sulfoxide	67-68-5	95
	1.10	1.08	dipropylene glycol methyl ether acetate	88917-22-0	86
	2.00	1.11	1,4-dioxane	123-91-1	12
	2.30	0.88	1,3-dioxolane	646-06-6	2
>	0.60	1.00	dodecane	112-40-3	71
	3.00	1.28	ethane	74-84-0	-135
>	3.30	1.08	ethanol / ethyl alcohol (*)	64-17-5	17
>	0.95	0.98	1-ethoxy -2-propyl acetate	54839-24-6	42
	1.30	0.82	1-ethoxy-2-propanol	1569-02-4	42
	1.70	1.14	2-ethoxyethylacetate	111-15-9	52
>	2.00	1.00	ethyl acetate (*)	141-78-6	-4
>	1.80	1.04	ethyl acrylate	140-88-5	9
	1.00	1.08	ethyl benzene	100-41-4	27
>	3.70	0.93	ethyl chloroformate	541-41-3	16

	LFL_R	R	Substance	CAS#	FP °C
>	1.90	1.10	ethyl ether	60-29-7	-45
	1.05	0.92	ethyl-3-ethoxypropionate	763-69-9	58
	0.88	0.90	2-ethyl hexanol	104-76-7	81
	1.50	0.71	ethyl L-lactate	687-47-8	49
	1.19	0.88	1-ethyl-2-pyrrolidinone (NEP)	2687-91-4	76
>	2.30	1.00	ethylene (*)	74-585-1	-135
	6.20	1.16	ethylene dichloride	107-06-2	13
	1.10	0.86	ethylene glycol monobutyl ether 2-butoxyethanol	111-76-2	60
>	1.75	0.90	ethylene glycol monoethyl ether ethyl cellosolve	110-80-5	43
>	n/a	0.90	formaldehyde and methanol aqueous	-	60
	18.00	0.89	formic acid	64-18-6	69
	2.30	1.37	furan	110-00-9	-35
>	1.80	0.96	furfural alcohol	98-00-0	75
>	1.00	1.02	heptane (*)	142-82-5	-4
>	1.10	1.00	hexane (*)	110-54-3	-22
	1.20	1.11	1-hexene	592-41-6	-25
	4.00	0.72	hydrogen	1333-74-0	-
>	4.30	1.02	hydrogen sulfide	7783-06-4	-
>	1.10	0.91	isoamyl acetate	123-92-2	25
	1.80	1.14	isobutane	75-28-5	-88
>	1.80	1.08	isobutylene	115-11-7	-76
	1.00	1.00	isooctane	540-84-1	-12
	0.70	0.80	Isopar G	64742-48-9	104
	0.70	0.81	Isopar H	90622-57-4	49
>	0.60	1.07	Isopar K	64742-48-9	50
>	0.60	0.94	Isopar M	64742-47-8	71
>	0.80	0.94	isophorone	78-59-1	84
	1.50	1.04	isoprene	78-79-5	-53
>	1.80	0.98	isopropyl acetate	108-21-4	2
>	2.20	0.99	isopropyl alcohol	67-63-0	12

	LFL_R	R	Substance	CAS#	FP °C
>	1.40	1.02	isopropyl ether	108-20-3	-18
	4.40	1.20	methane	74-82-8	-188
>	6.00	1.06	methanol	67-56-1	12
	1.30	0.88	1-methoxy-2-propylacetate	108-65-6	43
>	1.20	0.98	2-methoxyethylamine	109-85-3	12
	2.7	1.02	methyl acrylate	96-33-3	-3
>	1.00	1.10	methyl amyl ketone	110-43-0	39
	1.20	0.82	2-methyl-2-butanol	75-85-4	21
	8.10	1.41	methyl chloride / chloromethane	74-87-3	0
>	12.00	1.10	methylene chloride / dichloromethane	75-09-2	-
	1.00	1.19	3-methylheptane, 95%	589-81-1	7
>	1.80	1.01	methyl ethyl ketone / MEK / 2-butanone (*)	78-93-3	-7
	4.00	0.81	methyl formate	107-31-3	-19
>	1.20	0.98	methyl isobutyl ketone / MIBK	108-10-1	17
	1.20	1.09	2-methylpentane	107-83-5	-12
	2.30	0.98	methyl methacrylate	80-62-6	13
	2.50	1.39	methyl proprionate	554-12-1	
>	1.60	0.90	methyl tert-butyl ether MTBE	1634-04-4	-40
>	0.80	0.94	mineral spirits RM-19	-	
>	0.80	0.92	mineral spirits Shell 140	-	60
>	0.90	1.00	mineral spirits Varsol	8052-41-3	40
	4.90	1.11	monomethylamine	74-89-5	-18
>	0.90	1.07	naptha, vm&p regular	8032-32-4	20
>	2.60	1.04	nitropropane	79-46-9	33
>	1.30	0.93	n-methyl pyrrolidone NMP	872-50-4	93
	0.70	0.71	octene	25377-83-7	21
	2.40	1.17	2,4-pentanedione	123-54-6	34
	1.60	1.22	3-pentanone, 99%	96-22-0	13
>	0.80	1.00	pinene	-	32

	LFL_R	R	Substance	CAS#	FP °C
>	1.70	0.93	propane	74-98-6	-104
>	1.30	0.96	proprionic anhydride	123-62-6	63
>	1.80	0.96	propyl acetate	109-60-4	14
>	2.20	0.99	propyl alcohol / propanol (*)	71-23-8	15
>	2.00	1.04	propylene	115-07-1	-108
	2.40	0.93	propylene carbonate	108-32-7	135
>	2.20	0.97	propylene glycol	57-55-6	99
>	1.60	0.90	propylene glycol mono methyl ether / PGME	107-98-2	32
	1.3	0.89	propylene glycol mono methyl ether acetate	108-65-6	43
>	1.70	0.94	pyridine	110-86-1	17
	0.60	0.93	Shellsol T	90622-57-4	56
>	1.80	1.02	styrene	100-42-5	31
	2.35	1.19	tert-butyl alcohol	75-65-0	4
>	0.43	0.95	tetradecane	629-59-4	100
>	2.00	0.94	tetrahydrofuran	109-99-9	-14
>	1.20	1.03	toluene / toluol (*)	108-88-3	4
	7.00	2.09	trichloroethane	71-55-6	-
	8.00	1.66	trichloroethylene	79-01-6	-
>	0.47	1.03	tridecane	629-50-5	79
>	1.20	1.00	triethylamine	121-44-8	16
	1.40	0.79	trimethyl orthoformate	149-73-5	15
	2.00	2.29	trimethylamine	121-44-8	< 3
>	0.80	1.00	turpentine	8006-64-2	95
>	0.58	1.05	undecane	1120-21-4	61
	3.00	1.01	vinyl acetate	108-05-4	-8
>	1.10	1.04	xylene / xylol (*)	1330-20-7	27

7.2. Recalibration Procedure

To be performed by qualified persons only. Perform at routine intervals as part of normal maintenance. If changes to the types of flammable gases, the span calibration gas, the process temperature, or process controls have been made, the initial calibration procedure in section 7.1 should be repeated.

WARNING! During calibration, the analyzer alarms are bypassed. Calibration should only be performed when it cannot interfere with the safe operation of the process being monitored.

Verify normal operation. The calibration will not proceed if any fault except DOWNSCALE exists. If a fault occurs during calibration, the calibration process will terminate. Make sure the temperature is stable, with the insulating covers in place, for at least twenty minutes before starting. Accuracy is maintained over a range of temperatures spanning not more than 50°C (122°F). Therefore, where the analyzer is to be exposed to changing temperatures in excess of this range, the accuracy must be restored by recalibration.

UNLOCK to allow calibration.

Record the RAW ZERO, RAW SPAN and CAL RDNG registers in the CAL MENU.

Open the Zero and Span Gas[23] supply valves. Verify that the pressure is 20 ±1 PSIG.

Use the FULL CAL command to initiate calibration. **Then observe:**

> *The ZERO solenoid valve is energized and the* ZERO *indicator comes on. Zero air enters the flame cell from the zero inlet. The* ZERO *remains on for the* CAL TIME *setting in minutes.*
>
> ZERO *ends. If the* FLAME *temperature is unacceptable (below 450°C or above 550°C), a* ZERO FAIL *fault is activated and calibration terminates.*
>
> *If the* FLAME *temperature is acceptable, it is taken as the* RAW ZERO*, which causes the reading to display 0%LFL for a few seconds.*
>
> *The SPAN solenoid valve is energized and the* SPAN *indicator comes on. Span calibration gas enters the flame cell from the span inlet.*
>
> *The SPAN remains on for the* CAL TIME *setting in minutes. The reading during the SPAN phase should quickly come close to the CAL RDNG setting.*
>
> *Observe the* FLOW *in the* GAUGES *menu. It will be compared to the sample* FLOW *after calibration to make sure the calibration was valid.*
>
> *At the end of the* SPAN *phase, if the* FLAME *temperature is unacceptable, a* SPAN FAIL *fault is activated and the calibration process terminates.*
>
> *If the* FLAME *temperature during the* SPAN *was acceptable,* FLAME *minus* RAW ZERO *is taken as the* RAW SPAN*, which causes the reading to display the* CAL RDNG *for a few seconds.*
>
> *The* ZERO *valve is turned on for one half the* CAL TIME *to purge out the span gas.*
>
> *After the calibration ends the alarms are enabled.*
>
> *If the* RAW ZERO *or the* RAW SPAN *values have drifted, a* CHK ZERO *or* CHK SPAN *message, and the fault indicator, will appear intermittently. The* SERVICE NEEDED *relay activates. Refer to section 9.3 for a description of* SERVICE NEEDED *messages.*

Record the new RAW ZERO and RAW SPAN and compare them to the old values. Investigate any significant changes. Verify that CHK ZERO, CHK SPAN, ZERO FAIL or SPAN FAIL did not occur.

Compare the FLOW while sampling with the FLOW observed during span calibration. If they are not the same, service the flow system (see maintenance section 9.12), and repeat the calibration.

Turn off the Zero Gas and Span Gas supply valves.

LOCK to secure from unauthorized or unintentional calibrations.

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[23] Before using a new cylinder of calibration gas, its contents should be analyzed to ensure the correct gas type and concentration. Observe the first calibration with a new calibration cylinder carefully to verify the gas type and concentration.

8. Operation

Operators must read and understand this instruction manual. They must understand that the device is for early warning of a potential fire or explosion. They must understand the meaning of the readings and alarms. Alarm relays should be hard wired to the safety shutdown system as part of the overall system design and in conformance to all applicable safety codes. They must not tamper with, or otherwise defeat the intended protection of the alarms and relays.

Calibration, testing, maintenance and repair are beyond the scope of the operating instructions and are to be performed by qualified persons only.

WARNING! Only the ACKNOWLEDGE and RESET controls should be accessible during operation.

8.1. Reading and status.

Operators should be alert to abnormal readings or changes in the alarm indicators. Familiarity with the normal range of readings under various process conditions will help operators detect abnormally high or low readings. Unusually low readings might indicate analyzer failure that must be corrected immediately. Unusually high readings might indicate the beginning of a serious problem with the atmosphere or process. All alarms, service needed messages, and abnormal reading should be recorded in a log and reported for correction.

WARNING! During alarms, the area near the analyzer may be explosive: keep a safe distance until the cause has been found and corrected.

Install remote indicators, and acknowledge and reset controls, in a safe location where operators can easily view the %LFL reading and the alarm status, preferably near a main control panel.

8.2. Acknowledge Command.

The acknowledge command has two uses. It deactivates the horn relay. It also deactivates the service needed relay. Acknowledge alarms first. Then investigate and correct the cause before attempting to reset the alarm.

8.2.1. How to acknowledge the Horn

When an alarm first occurs, the red ALARM LED flashes, and the HORN relay activates. As a convenience to the operator, the HORN relay is deactivated by pressing either the MENU or SELECT pushbutton. The ACKNWLDG command from the COMMANDS menu may also be used. Or the photo transducer command ACKNWLDG can also be used.

- For WARNING and DANGER alarms, use the remote acknowledge control to safely acknowledge the alarm from a distance. See section 4.13.
- Press the SELECT button. This will acknowledge the alarm and “silence” the HORN relay. The red ALARM indicator stops flashing. This method does not affect SERVICE NEEDED messages.

8.2.2. How to acknowledge the SERVICE NEEDED message

Before acknowledging, record the Service Needed message.

- Press the MENU pushbutton until the word COMMANDS appears in the display. Press SELECT. Press the MENU button until ACKNWLDG appears. With ACKNWLDG in the display, press the SELECT button. The display will flash for a few moments as the command executes. Wait for the flashing to stop. This will deactivate SERVICE NEEDED messages, except CHK RDNG, which is active whenever the reading is below -7%.
- Or, shine a flashlight on the center phototransducer while covering the two outer phototransducers. Remove the light when the ACKNWLDG command appears on the display. The

display will flash for a few seconds, and then stop. It will acknowledge the alarm and “silence” the HORN relay. The red ALARM indicator stops flashing. It will also deactivate SERVICE NEEDED messages, except CHK RDNG, which is active whenever the reading is below -7%.

SERVICE NEEDED messages activate about half way towards the point of a fault. Left uncorrected, it is likely that a fault will occur. SERVICE NEEDED messages give maintenance personnel the chance to correct problems before they disrupt the operation of the analyzer. Acknowledging the SERVICE NEEDED message does not correct the problem. After acknowledging the service needed message, perform maintenance to prevent a future fault.

- Acknowledging the CHK FLOW message means that another CHK FLOW message can occur when the flow rate drops even closer to causing a LOW FLOW fault.
- Acknowledging CHK ZERO or CHK SPAN clears them until another calibration is performed.
- Acknowledging a CHK DATA message clears it. It means that all settings should be checked.
- CHK RDNG means that the reading has drifted downscale. Recalibration may be needed. The CHK RDNG message will not clear unless the reading rises back up towards 0%LFL.

8.3. Reset Command

Alarms typically latch. They stay active until a reset command is performed. The RESET command clears latched alarms if the condition that caused the alarm is no longer valid.

8.3.1. How to reset alarms

Before resetting, make a record of the alarm, record the PEAK HI and PEAK LO readings, and investigate to determine the cause of the alarm.

- Press the MENU pushbutton until COMMANDS appears in the display. Press SELECT. Press the MENU button until RESET appears. With RESET in the display, press the SELECT button. The display will flash for a few moments as the command executes. Wait for the flashing to stop.
- Or, shine a flashlight on the center phototransducer while covering the two outer phototransducers. Remove the light when the RESET command appears on the display. The display will flash for a few seconds, and then stop.

If the RESET is successful, the red ALARM indicator will go out, and the corresponding relay will deactivate. If RESET is unsuccessful, the alarm will re-activate.

8.3.2. Reset the danger alarm.

DANGER alarms should only be reset after all corrective actions have been successfully completed. Flooding of the flame cell with explosive concentrations can extinguish the sensing flame. If reset of a DANGER alarm results in a FLAMEOUT fault, this could indicate a flammable concentration, especially if the sensing flame cannot be re-ignited.

8.3.3. Reset the flameout fault - Reignition.

A FLAMEOUT may require two RESET commands. The first re-ignites the sensing flame, and after a minute or so, a second RESET clears the FLAMEOUT fault after successful ignition. If RESET of a DANGER alarm results in a FLAMEOUT fault, this could indicate a flammable concentration, especially if the sensing flame cannot be re-ignited.

WARNING! Flameout may indicate the presence of an explosive atmosphere.

9. Maintenance

In addition to the operator instructions and calibration, the following maintenance procedures are to be performed semi-annually or as experience indicates they are required.

9.1. General information and precautions

WARNING! The following general precautions, and all warnings noted in this manual, must be observed during all operation and maintenance procedures.

WARNING! Do not perform service when flammable gas might be present, or when servicing might interfere with the safety and operation of the process or atmosphere being monitored.

WARNING! The analyzer uses hydrogen or propane fuel. Observe all proper precautions for handling compressed gases and flammable gases, including:

1. Turn fuel supply off whenever the air pressure is off. If necessary, an external automatic fuel shutoff should be installed.
2. Eliminate ALL fuel fitting leaks. Use a leak-check (soap) solution, or a leak detector that is sensitive to the particular fuel in use.
3. The sensor enclosure is sealed for purging. Air pressure must be maintained whenever fuel is present to prevent an accumulation of flammable gas.
4. All covers must be kept tight whenever circuits are energized.
5. The fuel inlet fitting has a sintered metal restrictor that limits incoming fuel flow. Do not remove the restrictor. Replace with a new restrictor fitting if clogged or damaged.
6. Keep sampling system clean and leak-tight. Check for leaks after all maintenance work.
7. Non-incendive circuits are used to prevent ignition of fuel leaks, sample leaks, or of the external atmosphere. Do not modify the analyzer circuits, or add ignition-capable devices to the analyzer.

WARNING! The analyzer is electrically heated. Observe proper precautions for working with electricity and hot surfaces, including:

8. Prevent electric shock. Turn off electrical power before performing maintenance.
9. Prevent burns from contact with the heated flame cell components. Use insulated gloves. If necessary allow parts to cool just enough to allow maintenance.
10. Prevent overheating of the flame cell. Always keep the insulated flame cell cover in place during operation.

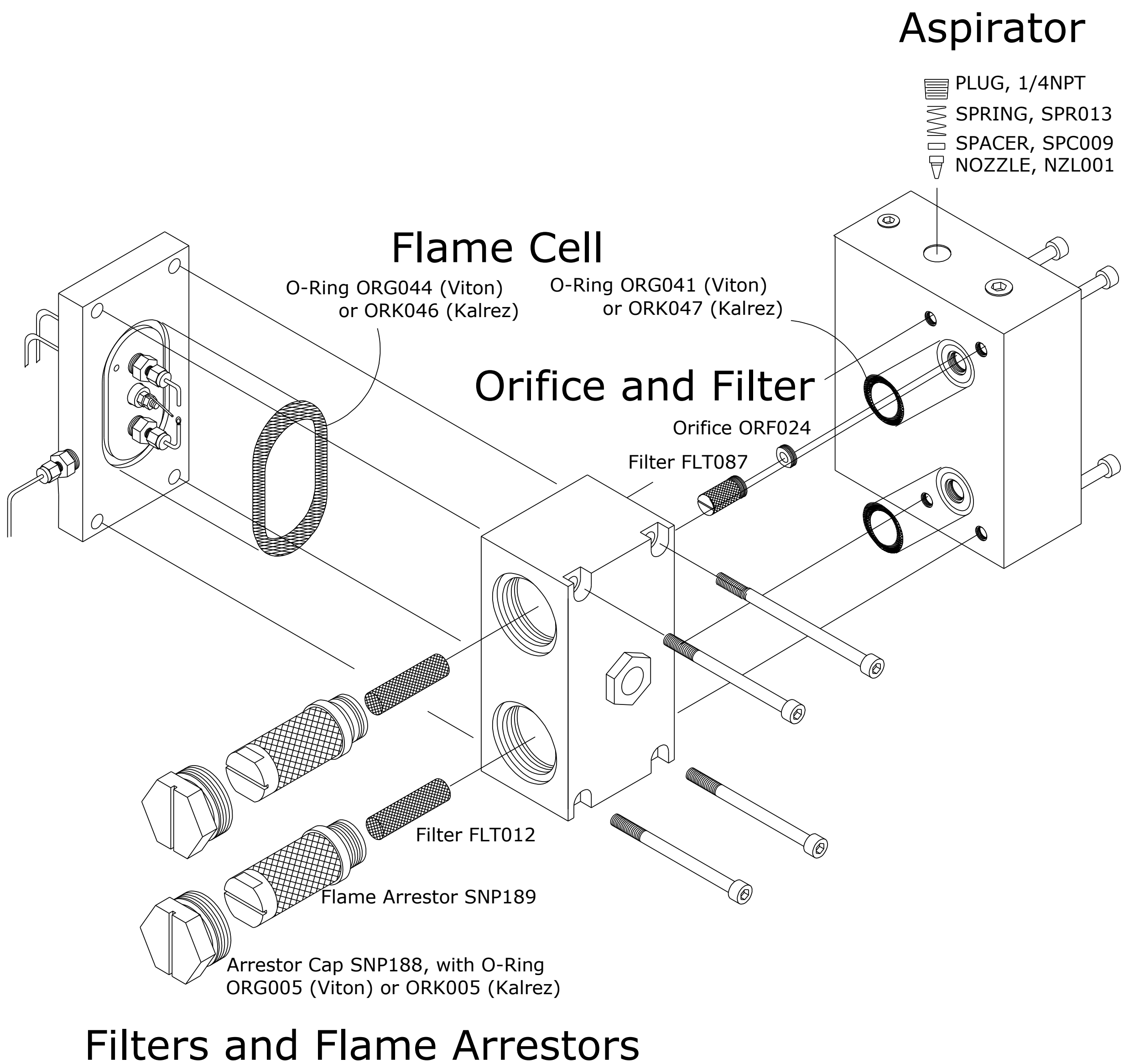
WARNING! The analyzer has a low-power high-voltage ignition transformer. When operating the controller with the ignition cable detached, attach a shorting clip from the ignition cable connection of the controller to the chassis ground.

WARNING! The sensor uses inlet and exhaust flame arrestors to protect the atmosphere being monitored. Observe precautions for hazardous locations, including:

11. Keep flame arrestors clean and installed at all times.
12. Flameproof joints and threads must be kept clean and free from any mechanical damage that can degrade the protection they provide.
13. Replace any components that show mechanical deformation, abrasion, or damage to the flameproof joints, threads or surfaces.
14. Test alarms regularly.

WARNING! Analyzers monitoring pressurized or hazardous atmospheres should not be disassembled until the atmosphere being monitored is safe and free of excess pressure, hazardous gases, or other substances or conditions that may be released during maintenance.

15. Make a record of analyzer maintenance. Use the form in section 9.2, or equal.


Aspirator
PLUG, 1/4NPT
SPRING, SPR013
SPACER, SPC009
NOZZLE, NZL001
Flame Cell
O-Ring ORG044 (Viton)
or ORK046 (Kalrez)
O-Ring ORG041 (Viton)
or ORK047 (Kalrez)
Orifice and Filter
Orifice ORF024
Filter FLT087
Filter FLT012
Flame Arrestor SNP189
Arrestor Cap SNP188, with O-Ring
ORG005 (Viton) or ORK005 (Kalrez)
Filters and Flame Arrestors

9.2. Analyzer Maintenance Record

Name		Date	Time
Equipment Serial Number	Location		Tag# / ID#

DESCRIPTION(S):

☐STARTUP ☐CALIBRATION ☐PREVENTATIVE MAINTENANCE ☐TESTING ☐REPAIR
☐LEAK CHECK ☐FILTER CHANGE ☐O-RING CHANGE ☐CLEANING ☐ALARM TEST
☐OTHER/DETAILS:

Record of values from PrevEx controller. If value has changed, mark "as found" and "as left"

GAUGES	CAL MENU	ALARMS	OUTPUTS	COM PORT
READING	**RAW ZERO**	WARNING	RLY TEST	SET BAUD
STATUS	**RAW SPAN**	DANGER	MA TEST	BAUD RATE
PEAK HI	CAL TIME	LATCHES	4MA ADJ	AUTO BAUD
PEAK LOW	CAL RDNG	FAIL SAFE	20MA ADJ	ADDRESS
HSG TEMP	SPAN DEG. C	VERSION	MA CAL	IDNBR
SET TEMP	SPEED	TYPE	MA FAULT	
FLOW		SERIAL	CONTROL 1	
LOW FLOW			CONTROL 2	
CHK FLOW			RLY CONFIG	
FLAME				

Record the state of the indicators: OFF= ○ ON= ● FLASHING= ∅

Alarm	Scan	Fault	Danger	Warning	Horn	Zero	Span	Ignite	Heat
○	○	○	○	○	○	○	○	○	○

Utility	Measurement "As found" /	"As left"	Units	Notes
Fuel inlet			☐PSIG ☐BAR	*Measure the pressure of each inlet and check off units. Show measurement as found prior to service, and as left after adjustment, if any.*
Zero inlet			☐PSIG ☐BAR	
Span inlet			☐PSIG ☐BAR	
Compressed air			☐PSIG ☐BAR	
Air dilution inlet			☐PSIG ☐BAR	*If unused, this must be capped*
Span cal gas	☐ 1.15% Ethylene in air +/-0.02 ☐ Other:			*Identify type and concentration, including analysis / tolerance.*

9.3. "Service Needed" Messages

When a condition exists that might lead to a fault, the SERVICE NEEDED relay activates. If there is no alarm at the time, a message is displayed, and the yellow FAULT indicator blinks. The ACKNWLDG command deactivates the Service Needed relay and message, but does not fix the problem.

9.3.1. SERVICE NEEDED - CHK FLOW – Check sample flow rate

A sample flow rate more than half way towards LOW FLOW for more than fifteen seconds displays a CHK FLOW message. The ACKNWLDG command moves the level at which the next CHK FLOW message will be given to a level half way between the present flow rate and the LOW FLOW level. If the flow continues to fall, eventually another CHK FLOW message should occur. Without maintenance, a LOW FLOW fault can occur.

1. Record the FLOW rate from the GAUGES menu.
2. At the earliest convenient time, ACKNWLDG the message and troubleshoot the flow system to isolate the problem to the air pressure, sample tubing, filters, o-rings, orifice, or aspirator.
3. Verify that the FLOW has been restored +0.5 LPM or more above the LOW FLOW level.
4. After correcting the problem, use the RESET command. It will adjust the level at which CHK FLOW is given half way back up towards the present flow rate.

If CHK FLOW "service needed" message is active, the ACKNOWLEDGE command level will move CHK_FLOW downwards half way between FLOW and the LOW FLOW level, but only if the result would be a lower CHK_FLOW level. The RESET command will move CHK_FLOW to a level half way between the present FLOW rate and the LOW_FLOW level, but only if the result would be an increase in the CHK_FLOW level.

The LOW FLOW level can be adjusted using the GAUGES menu. Normally, the default value of 1.4 liters per minute is acceptable and should not be changed. Higher settings can be used to give earlier warning of a loss of flow, and are recommended where possible. Accuracy is maintained over a range of sample flow rates that varies less than +/-0.3 liters per minute from the flow rate during calibration. The LOW FLOW setting should be set to give a SERVICE NEEDED indication or a FAULT indication if the flow rate decreases more than this amount below the flow rate during calibration.

9.3.2. SERVICE NEEDED - CHK RDNG – Check downscale reading

If the reading is below -7%LFL for more than fifteen seconds, a CHK RDNG message is given and the SERVICE NEEDED relay is activated. The Acknowledge command does not clear this message until the reading goes above -7%LFL. If the drift is not corrected, a DOWNSCALE FAULT will occur below -10%LFL.

1. Immediately verify that the fuel supply pressure is above the minimum and is not running out.
2. Record the FLAME temperature from the GAUGES menu.
3. At the earliest convenient time, recalibrate the analyzer.
4. If the calibration fails, or if a CHK ZERO message occurs after calibration, readjust the fuel regulator to get a FLAME temperature of 500°C.
5. After correcting the problem, use the ACKNWLDG command to clear the SERVICE NEEDED message.
6. If the fuel regulator has been adjusted, recalibrate the analyzer.
7. Check for leaks in the fuel system. Tighten the fuel fitting located at the side of the flame cell.

9.3.3. SERVICE NEEDED - CHK ZERO - Check zero calibration

If the flame temperature during zero calibration is less than 475 °C, or greater than 525 °C, the CHK ZERO message is given and the SERVICE NEEDED relay is activated. Although the calibration is acceptable, the zero has drifted from the ideal value, and eventually might need readjustment of the fuel regulator pressure. If the drift continues, the FLAME temperature may go below 450 °C and activate a FLAMEOUT fault. Attempting to zero calibrate with the FLAME temperature below 450°C or above 550°C will give a ZERO FAIL fault.

1. Immediately verify that the fuel supply pressure is above the minimum and the fuel supply is not running out.
2. Immediately verify that the air pressure to the zero calibration inlet is correct.
3. Record the RAW ZERO temperature from the CAL MENU.
4. At the earliest convenient time, ACKNWLDG the message, and adjust the fuel regulator for a FLAME temperature of 500°C per section 9.14.
5. Recalibrate the sensor and verify that the RAW ZERO is near 500°C.

The expected rate of drift in the RAW ZERO is less than 25°C per year. Higher rates may indicate a problem with the fuel regulator, or the fuel itself.

9.3.4. SERVICE NEEDED - CHK SPAN Check span calibration

During span calibration, the difference between the FLAME temperature and the RAW ZERO is the RAW SPAN. This is the temperature rise above zero caused by the test gas. The RAW SPAN temperature rise is tested against the expected temperature rise in the register SPAN °C. There are three possibilities:

1. RAW SPAN is within ±12.5% of SPAN °C	Calibration is successful.
2. RAW SPAN outside ± 12.5%, within ± 25%	Calibration is successful, but a CHK SPAN message given
3. RAW SPAN outside ± 25% of SPAN °C	Calibration fails, RAW SPAN not updated, old calibration is restored, SPAN FAIL fault is given, and a CHK SPAN message is given.

For the standard test gas, 1.15% by volume Ethylene in Air, the expected temperature rise is approximately 125°C (60°C in air dilution types). A few degrees variation can occur due to slight mechanical differences between individual analyzers. A 5°C to 10°C effect can come from the effect of the HSG TEMP. A higher operating temperature means a slightly lower RAW SPAN.

Using the standard calibration span gas, the SPAN °C should never require readjustment.

1. Record the RAW SPAN temperature from the CAL MENU.
2. Immediately verify the concentration and type of the calibration span gas.
3. At the earliest convenient time, ACKNWLDG the message, and service the flow system.
4. Recalibrate the sensor and verify that the RAW ZERO is near 500°C.

Use the ACKNOWLEDGE command to clear the message and relay. Record the RAW SPAN value from the GAUGES menu. At the earliest convenient time, check the span gas supply and pressure, the thermocouple cleanliness, and check the analyzer for leaks. Following service, recalibrate the analyzer.

9.3.5. SERVICE NEEDED - CHK DATA Check for data loss

Settings are stored in RAM memory and are also saved in EEPROM. When power is turned off, the settings in RAM are lost but the settings in EEPROM are preserved. When power is turned on, the settings are copied from EEPROM into RAM. When a setting is changed intentionally through a menu or through the serial port, it is changed first in RAM and then is copied to EEPROM within one minute. During operation, the settings in RAM are tested continuously to make sure that they stay within acceptable limits, and that they match the settings stored in EEPROM. This helps prevent an unintentional change in a setting in RAM from a momentary fault or power interruption.

If the controller's self-diagnostics detects a discrepancy in a setting, the CHK DATA message is given, and the SERVICE NEEDED relay is activated. The CHK DATA message means that there may have been an unintentional change in a setting. It is necessary to verify that the settings are correct.

Use the ACKNOWLEDGE command to clear the message and relay. Review all settings in the CAL MENU, ALARMS, OUTPUTS and COM PORT menus. If RAW ZERO or RAW SPAN settings are incorrect or have changed, recalibrate the analyzer. If this message is given repeatedly, investigate the analyzer power supply for power disturbances. Verify that the ignition spark discharges to the tip of the burner, and that the gap between the ignition electrode and burner tip is correct. If the problem remains, it is likely the EEPROM or RAM in the controller has a fault that requires factory repair.

9.4. Scheduled Maintenance

There is a wide variety of applications, industry codes, and operating conditions. Base the maintenance schedule on both design and experience. The initial maintenance schedule shown below should be adapted as needed.

Procedure	Section	Frequency
Readings	9.5	Daily
Utilities	9.6	Weekly or monthy
Gauges	9.7	Monthly or quarterly
Recalibration	9.8	Monthly
Leak test	9.9	After any disassembly. Otherwise quarterly or yearly.
Alarm test	9.10	Monthly. Yearly is minimum required by code.
System review	9.11	Semi-annual or when process or monitoring conditions change.
Flow system	9.12	Quarterly or yearly For CHK FLOW, or LOW FLOW status
Cleaning	9.13	As needed for CHK FLOW, or LOW FLOW status following flow system maintenance
Fuel regulator	9.14	Yearly, or for CHK ZERO or ZERO FAIL status *More frequent adjustment should not be required.*

9.5. Readings

Readings should be checked frequently. Operators should have access to a display of the reading near the control panel or operator station used to control or monitor the process or atmosphere being monitored. Abnormally low readings are as important as abnormally high readings, and should be investigated. They might indicate an analyzer leak, or another fault that the analyzer itself is unable to detect.

The PEAK HI and PEAK LOW readings can help with understanding the normal range of readings. Knowing the normal range of readings for a particular process or set of conditions can help identify a problem well before it might become a hazard. PEAK HI and PEAK LOW are cleared by the RESET command.

Knowledge of the normal range of readings helps set the alarm levels properly. The lowest WARNING and DANGER alarm levels that do not produce false alarms are the best. Information gathered over time can be used during the annual review to help choose the best alarm levels.

9.6. Utilities

Keep all utilities, power, air and fuel, on continuously, so that the analyzer gives the best performance and requires the least maintenance. On regular intervals, verify the air pressure. The air supply likely has a filter that might require cleaning or replacement. If it is necessary to adjust the air pressure, check the air supply filter. Check the fuel pressure, and the quantity of fuel remaining in the supply, often enough that the fuel cannot lose pressure or unexpectedly run out. Before and after calibration, check the supply of calibration gas and reorder if necessary.

9.7. Gauges

Make an analyzer maintenance record (see section 9.2) at regular intervals, especially before and after calibration or maintenance. Investigate significant changes, especially in FLOW, RAW ZERO and RAW SPAN.

The FLOW rate on the GAUGES menu should not change by more than a few tenths of a liter per minute per week. The FLOW rate observed during startup, when the analyzer was first put into service in clean condition, is a good reference point. Reduced flow rates indicate need for filter changes. Inability to restore flow near its startup value indicates the need for cleaning.

The HSG TEMP should be stable to within +/- 3°C of the SET TEMP value.

The FLAME temperature, measured as RAW ZERO and RAW SPAN in the CAL MENU, should also be stable to within several °C before and after calibration. The CHK ZERO and CHK SPAN messages help identify significant changes.

9.8. Recalibration

Calibrations and tests using known gas concentrations should be performed regularly. This is the best way to verify proper operation. Operating history will determine frequency of calibrations. Zero and Span tests can be performed to verify correct response and help determine the most appropriate calibration schedule. Some codes, for example NFPA-86 Ovens and Dryers, require a monthly calibration to verify proper sensor response.

9.9. Leak test

The analyzer can not detect some types of leaks in the sampling system that might dilute the sample and cause false low readings. A leak test should be performed regularly. It should also be performed after maintenance involving disassembly of any part of the sampling system.

1. Use the GAUGES menu to display FLOW.
2. Remove the sample probe fitting at the analyzer inlet.
3. Cap off or otherwise block the analyzer sample inlet.
4. For air dilution types, turn off pressure and block flow to the dilution air inlet B.
5. Verify that the FLOW drops below 0.01 LPM.

9.10. Alarm test

The alarm relays are used for corrective action. Immediate and effective corrective action is needed to prevent the possibility of a fire or explosion. At regular intervals, perform a complete test of the relays and the corrective action.

1. Verify that WARNING and DANGER levels in ALARMS menu are correct.
2. Use RLY TEST in OUTPUTS menu to activate relays.
3. Verify that actions of each relay produce the desired overall result.
4. Verify that the DANGER relay activates the safety shutdown.
5. Verify that the FAULT relay activates the safety shutdown.

9.11. System review

Semi-annually, or when process or monitoring conditions are changed, review the initial calibration information to ensure that the calibration remains valid, check maintenance records for potential problems and adjust the maintenance schedule as needed, and refresh training and education of operators and maintenance personnel. Some codes require an annual review by a factory-trained technician. Leak test failures and in some cases calibration failures or calibration check alarms may be an indication of an o-ring failure.

Unless guided elsewhere in this manual the table below indicates the expected life of the o-rings by model number and operating temperature.

Model #	**SET TEMP**	**Flame arrestor end caps o-rings**	**Interblock o-rings**
SNR671	60°C	ORG005 – 5 year replacement	ORG041, ORG044 – 5 year replacement
SNR672	120°C	ORG005 – 5 year replacement	ORG041, ORG044 – 5 year replacement
SNR674	200°C	ORG005 – 1 year replacement	ORG041, ORG044 – 1 year replacement
SNR675	250°C	ORK005 – 6 month replacement	ORK046, ORK047 – 1 year replacement

Over time the air purge restrictor on the manifold can be clogged with oil, water or debris from the compressed air supply to the analyzer. A clogged restrictor will not supply fresh air into the analyzer housing sweeping out any potential leaking fuel that may be present. Semi-annual checks of this restrictor can be easily done by placing a finger tip over the restrictor and listening/feeling for air escaping around your finger. If little or no air is detected the restrictor should be replaced with the instructions and part of an SRV153.

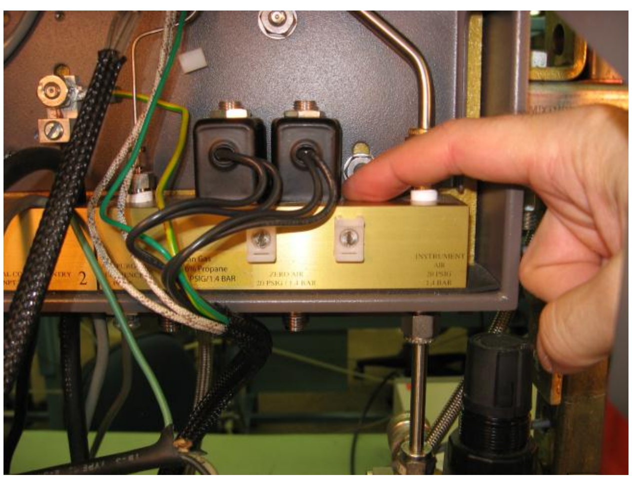


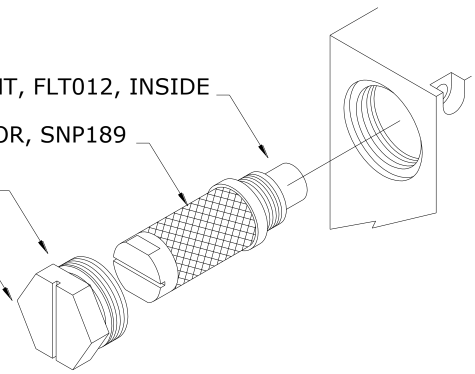
Photo 1

- Remove the outer cover of the analyzer when it is safe to do so.
- Locate the air purge restrictor on the manifold and test it for flow with your finger as shown in Photo 1. If air flow is low or not detected replace restrictor with SRV153.

9.12. Flow System Preventative Maintenance

Routine replacement of the disposable filter elements, and where needed, cleaning of flame arrestors, prevents loss of sample flow. Replacement of O-rings helps prevent leaks.

SNR671, SNR672 and SNR674 use Viton O-rings. These have good temperature and solvent resistance, and are inexpensive. They can be used up to 200°C. They should be replaced whenever they are disassembled during a service procedure. O-rings in SNR675 are Kalrez®. These are required for flame cell temperatures above 200°C. They are expensive, but have superior heat and solvent resistance, and so can be re-used if they are not damaged, deformed or shrunken. If the O-ring is elastic, has a uniform cross-section, has no abrasion, breaks or cuts, and no signs of shrinking or hardening, it can be re-used. When in doubt, replace the o-ring.



1. Remove outer cover.
2. Remove inner cover (except SNR671 types). Cover is retained by four mounting pins that fit into keyhole-shaped slots on the cover. Lift cover straight up ¼ inch, until all four mounting pins line up with slot openings, then slowly pull the cover straight out from flame cell. Do not force the cover, or the mounting pins may be damaged.
3. Unscrew the flame arrestor caps located on the left side of the flame cell block.
4. Unscrew the flame arrestors from the flame cell.
5. Remove filter elements from inside the flame arrestor.
6. Clean the flame arrestor with compressed air. If necessary, soak the flame arrestor in solvent and dry completely before reinstalling. Do not clean mechanically, such as by sanding or scraping the surface. Abrasive cleaning will cause damage.
7. Insert replacement filter element (Part Number FLT012) into flame arrestors.
8. Screw flame arrestor clockwise into flame cell until hand-tight, then back out counterclockwise 1/8 of a turn. ***Do not over tighten.***
9. Replace the o-rings on the flame arrestor caps. (Part Number ORG005, except for SNR675, which uses ORK005 Kalrez O-rings to operate above 200°C).
10. Screw flame arrestor caps into flame cell until o-rings seal and cap is hand-tight.
    Do not over tighten: The flame arrestor cap is sealed by the o-ring. When properly installed, there is a 1/32" (0.8 mm) gap between the arrestor cap and the flame cell surface. About half the O-ring width remains visible. Do not attempt to screw the arrestor cap completely into the flame cell until it bottoms out, because this can damage the threads.
11. Perform a leak test. Plug the sample inlet. Verify FLOW on GAUGES menu below 0.01 LPM.
12. After temperature stabilizes, perform a full calibration.

9.13. Cleaning

Purpose — Restore sample flow by removing contamination on aspirator or orifice. Increases aspirator suction, decreases flow resistance in orifice. Returns sample FLOW reading on GAUGES menu to a normal level.

Frequency — As needed, if Flow System Preventative Maintenance does not restore sample flow, and sample and exhaust tubing are not clogged.

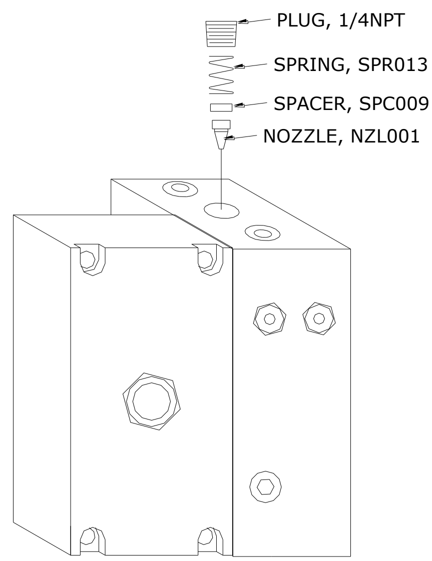
Clean flame cell if an accumulation forms on the burner, the thermocouple or the upper flame arrestors, causing a CHK ZERO or CHK SPAN message during calibration.

If a flow problem is not caused by a lack of air pressure, or a clog in the sample or exhaust tubing, the filters, or the flame arrestors, then the problem might be due to a lack of suction from the aspirator or a clog in the orifice. Over time, particles or condensate can accumulate. Some substances in the sample, such as silicones, may form dust when burned in the sensing flame. This dust can accumulate on the burner, thermocouple, or upper flame arrestor. The dust is removed to restore the sample flow, or to restore the RAW ZERO and RAW SPAN to normal values.

9.13.1. Aspirator cleaning or replacement

Parts Needed — Aspirator nozzle - if needed. Part number NZL001
Tool needed — 3/16 inch Allen key. Needle nose pliers.

1. Turn all utilities off.
2. Using a hex key, remove the ¼ NPT plug from the top of the heated block assembly. This is the middle plug on the top right hand side of the flame cell.
3. Remove the spring and spacer.
4. Use needle-nose pliers to remove the aspirator nozzle. Be careful not to damage the inside of the nozzle. If the nozzle is difficult to remove, you can also remove the ¼ NPT plug from the bottom of the block (directly below the aspirator) and use a soft wooden stick to push the nozzle from its seat.
5. Clean the bore and nozzle with a solvent such as acetone or alcohol, and let dry.
6. Replace nozzle with new if contamination cannot be removed.
7. Re-install the nozzle, spacer, and spring. Replace the ¼ NPT plug(s).
8. Restore utilities.
9. Re-ignite the analyzer
10. Allow analyzer time to stabilize.
11. Perform a full calibration.



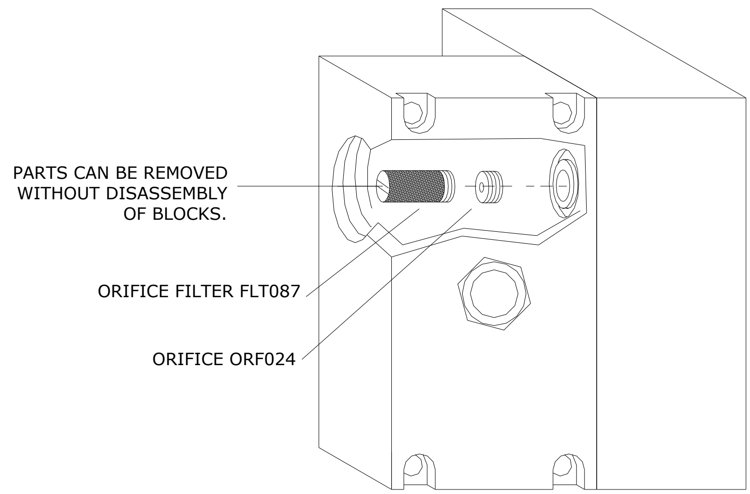
Oil or residue on the inside of the nozzle may indicate oil in the compressed air supply. Check the compressed air supply filters and replace if necessary.

9.13.2. **Orifice cleaning or replacement**

Parts Needed Orifice filter - if needed. Part number FLT087.
Orifice - if needed. Part number ORF024.
O-rings - if needed, quantity 1, part number ORG005 (Viton) or ORK005 (Kalrez)

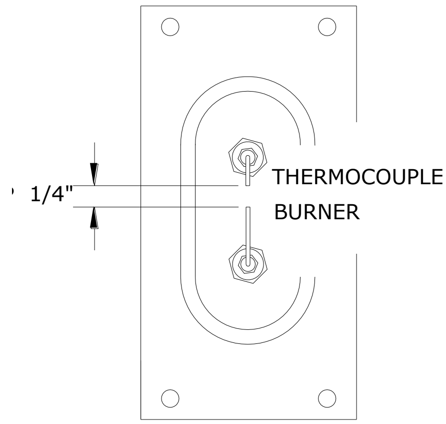
Tools needed Screwdriver
Locking screw driver- 10" quick wedge screwdriver, part number TOL044
1/8 inch Allen key (Part number TOL046 or equal)

1. Verify the compressed air pressure. Insufficient air pressure causes reduced flow that will not be corrected by cleaning.
2. Turn all utilities off.
3. Remove upper flame arrestor cap.
4. Remove upper flame arrestor.
5. Use locking screwdriver to remove the orifice filter through the upper flame arrestor block opening.
6. Use Allen key to remove orifice.
7. Clean the orifice and orifice filter with a solvent such as acetone or alcohol, and let dry. Do not drill out.
8. Replace orifice or orifice filter with new if contamination cannot be removed.
9. Re-install the orifice.
10. Re-install the orifice filter.
13. Re-install filter and flame arrestor. Screw flame arrestor clockwise into flame cell until hand-tight, then back out counterclockwise 1/8 of a turn. ***Do not over tighten.***
14. Check flame arrestor cap o-ring and replace if needed.
11. Re-install flame arrestor cap and o-ring. ***Do not over tighten:*** The flame arrestor cap is sealed by the o-ring. When properly installed, there is a 1/32" (0.8 mm) gap between the arrestor cap and the flame cell surface. About half the O-ring width remains visible. Do not screw the arrestor cap completely into the flame cell until it bottoms out, it will damage the threads.
12. Restore utilities.
13. Re-ignite the analyzer.
14. Allow analyzer time to stabilize.
15. Perform leak check of sampling system.
16. Perform a full calibration.



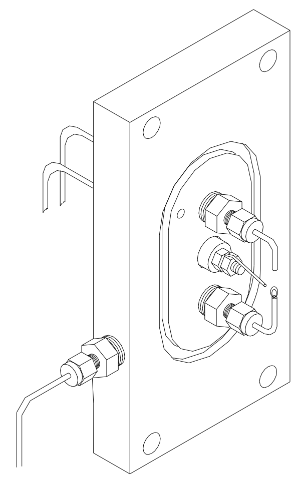
CUTAWAY VIEW OF ORIFICE AND FILTER INSIDE FLAME CELL. ACCESS IS THROUGH UPPER FLAME ARRESTOR CAP.

9.13.3. Flame cell cleaning



Parts Needed
Orifice filter - if needed. Part number FLT087.
Orifice - if needed. Part number ORF024.
O-rings - if needed:
Qty 1 of ORG044 (Viton) or ORK046 (Kalrez)
Qty 2 of ORG041 (Viton) or ORK047 (Kalrez)
Qty 2 of ORG005 (Viton) or ORK005 (Kalrez)

Tools needed
Screwdriver
Locking screw driver- 10” quick wedge screwdriver, part number TOL044
1/8 inch Allen key, part number TOL046 or equal.
5mm Allen key for flame cell bolts.
Alignment tool, part number TOL003 or TOL047.



1. Turn all utilities off.
2. Remove sample probe.
3. Remove flame arrestor caps, and remove flame arrestors.
4. Use locking screwdriver to remove the orifice filter.
5. Remove eight flame cell bolts. For best results, loosen bolts while blocks are warm.
6. Lift flame cell block straight out and away from burner plate, taking care not to bend the thermocouple or burner.
7. Clean flame cell parts as needed.
8. ***Align the thermocouple, burner and spark electrode.*** The thermocouple should be directly above the burner, with ¼ inch gap. The spark electrode is located 1/10 inch (2.5mm) behind, and just above, the rear of the burner. Use the alignment tool, part number TOL003 or TOL047. Avoid excessive bending of the thermocouple, which can cause damage.
9. Replace flame cell o-rings with new, if needed.
10. Re-install flame cell block, but **do not** bend the thermocouple or burner.
11. Re-install and tighten flame cell bolts.
12. Re-install the orifice filter.
13. Re-install filters and flame arrestors. Screw flame arrestor clockwise into flame cell until hand-tight, then back out counterclockwise 1/8 of a turn. ***Do not over tighten.***
14. Check flame arrestor cap o-ring and replace if needed.
15. Re-install flame arrestor cap and o-ring. ***Do not over tighten:*** The flame arrestor cap is sealed by the o-ring. Properly installed, there is a 1/32” (0.8 mm) gap between the arrestor cap and the flame cell surface. Half the O-ring width remains visible. Do not attempt to screw the arrestor cap completely into the flame cell until it bottoms out, because this can damage the threads.
16. Restore utilities.
17. Re-ignite the analyzer
18. Allow analyzer time to stabilize.
19. Perform leak check of sampling system.
20. Perform a full calibration.

9.14. Fuel Regulator Adjustment

Purpose: Adjust sensing flame until FLAME temperature on GAUGES menu is 500°C when no flammable gases are present in the sample.

Frequency: Every twelve months
Following a CHK ZERO Service Needed Message, when RAW ZERO is below 475°C or above 525°C
Following a ZERO FAIL fault, when FLAME is lit, but is below 450°C or above 550°C during a zero test.

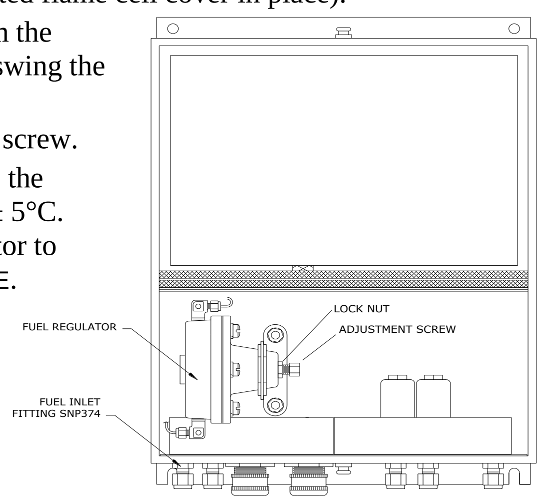
Parts Needed: Fuel inlet fitting, part number SNP374 - if needed.

The fuel regulator may exhibit a slow drift. Routine calibration will remove the error from this drift, but eventually the drift can accumulate over time, and a CHK ZERO SERVICE NEEDED message, or even a ZERO FAIL fault, might occur. Readjustment of the fuel regulator pressure can restore the sensing flame to its optimal size.

The fuel pressure should be above the minimum required pressure at the inlet to the analyzer.

There is a small sintered metal filter installed inside the fuel inlet fitting. This filter protects the fuel system from contamination. It should not normally require replacement if the fuel delivery system and fuel tubing is clean and free of contamination. In some cases, a contaminated fuel restrictor must be replaced in order to pass enough fuel through to the analyzer’s sensing flame.

1. Verify that the flame cell temperature is stable. Variations in flame cell temperature can cause drift in the flame temperature that will not be corrected by fuel regulator adjustment.
2. Verify that the fuel pressure at the inlet is correct. Incorrect fuel pressure can cause drift in the flame temperature that will not be corrected by fuel regulator adjustment.
3. Check fuel purity. Impure fuels, or impurities in fuels that respond to temperature changes, will not be corrected by fuel regulator adjustment.
4. Remove the outer enclosure cover. (Leave the insulated flame cell cover in place).
5. Lift the controller, slide the upper retaining pins from the bracket, leave the lower retaining pins in place, and swing the controller down to give access to the fuel regulator.
6. Loosen the lock nut on the fuel regulator adjustment screw.
7. Slowly turn the fuel regulator adjustment screw until the FLAME temperature on the GAUGES menu is 500°C ± 5°C. Turn the adjustment screw clockwise into the regulator to increase FLAME, counterclockwise to decrease FLAME. Increases occur quickly, but decreases occur slowly. Do not over adjust when decreasing.



8. Tighten the lock nut on the fuel regulator adjustment screw.
9. Re-install outer cover.
10. Perform a full calibration.
11. Test the regulation of the fuel system by increasing the fuel pressure at the analyzer inlet by a few PSIG. The reading should not change. When finished, set fuel pressure to correct setting.

10. Troubleshooting

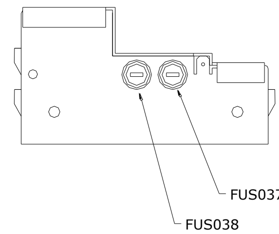
These requirements for proper operation are shown in their order of importance.

10.1. AC Power

All power and voltages for the analyzer's operation is derived from the AC power mains. Power must be supplied continuously within +10%/-15% of the rated voltage.

10.1.1. Fuse replacement

Parts Needed 5 Amp, Part number FUS037, for power to controller and heater.
½ Amp, Part number FUS038, for controller power.



1. Disconnect electrical power at the power switch or circuit breaker.
2. Remove the outer cover.
3. The controller is mounted by four pins that fit into slots on a bracket. Slide the controller up ¼ inch. Swing the top outwards so only the top pins come out of their slots. The lower pins must remain in their slots.
4. The fuses are on the right side of the controller. Use a screwdriver to turn the fuse holder cover counterclockwise 1/8th of a turn.
5. Remove and replace fuse with same rating and type as shown on label or fuse.
6. Re-mount the controller and replace the outer cover.

10.2. Flame Cell Temperature

The flame cell is heated by an AC-powered electric heater. Thermocouple TC2 in the flame cell block measures the HSG TEMP temperature. Heating is controlled by SET TEMP. A deviation more than a few degrees results in a fault. At startup, or after a change to the SET TEMP setting, a TEMP LOW or TEMP HIGH fault exists until the flame cell reaches the new temperature. The time can vary from 15 minutes at a SET TEMP of 60°C, to as much as 90 minutes at 250°C.

The sensing flame requires a stable flame cell temperature. Temperature changes cause drift. Low temperatures can also cause condensation, leading to false low readings, or clogging. Always keep the flame cell heated and insulated with its covers in place. If power is to be turned off for some time, the air pressure should be removed and the fuel should be turned off. In some cases the sample and exhaust tubing must be capped as well.

The TC2 thermocouple is 0 millivolts at 0°C, and increases about +1 millivolt for every 25°C.

10.3. Air Inlet Pressure

Compressed air is used for suction to draw the sample into the flame cell. It also purges the enclosure to prevent the accumulation of leaking fuel or flammable gases. The compressed air pressure must be regulated to 20 PSIG (1.4 bar). Low or high air pressure causes flow faults.

10.4. Fuel Inlet Pressure

The sensing flame uses hydrogen or propane fuel. Low fuel pressure causes downscale reading drift.

External fuel line leaks not only waste fuel they can cause low fuel line pressure and analyzer reading drift sufficient to cause a downscale fault to occur. Test for leaks by shutting off the fuel at the tanks and watch the line pressure. Quick drops in pressure indicate fuel line leaks. A leak tight system will hold pressure for minutes without a significant drop in pressure. Use a soap solution at all fittings to locate possible leaks.

Propane fuel should not be stored outdoors, exposed to large temperature changes. Low temperatures cause low propane pressure. Large temperature changes increase the effect of impurities.

The fuel inlet fitting has a sintered metal filter inside. It prevents contamination from reaching the analyzer. It also limits the fuel flow that can leak into the enclosure. A contaminated restrictor drops the fuel pressure and causes low readings and reading drift. Tubing or fitting leaks in the analyzer enclosure can cause the pressure to drop, resulting in low readings. Check internal fitting for leaks especially the fuel fitting at the side of the flamecell.

Test the fuel restrictor and regulator. Attach a pressure gauge to the fuel inlet. Increase pressure by +5 PSIG and observe the reading and FLAME measurement, it should remain the same. If the reading changes more than 2%, it means the fuel system is not regulating properly, and the analyzer readings will drift. Check for fuel leaks in the analyzer enclosure. Check or replace the fuel inlet fitting.

10.5. Spark

The sensing flame is ignited by a two-second spark discharge from a small electrode mounted to the spark plug in the flame cell to the grounded burner tube. The spark is generated by a high voltage (30 kV) transformer in the controller.

The spark electrode must be aligned about $1/10^{th}$ inch (2.5mm) behind, and slightly above, the rear of the burner tip. If the spark discharge strikes too low on the burner, the fuel will not ignite. If the spark discharge is too close or too far from the burner it can cause the controller to reset itself.

10.6. Flame

Flammable gases in the sample are burned in the sensing flame. This results in a temperature rise in the TC1 thermocouple located above the sensing flame. The sensing flame must be stable. The fuel supply pressure must be constant. The fuel, especially when propane is used, must be pure.

The TC1 thermocouple makes the FLAME temperature measurement. It must be properly aligned above the sensing flame, at the correct distance. The sensitivity is about 0.5%LFL per degree C. Use care when aligning the thermocouple. Excessive bending causes damage.

A propane sensing flame appears as a small round blue flame about the size of a match head. It may have a small yellow tip at the top. Hydrogen flames are not visible to the human eye. Solvents and other flammables burning in a hydrogen flame cause a faint blue glow. Explosive concentrations in the flame cell can emit an orange or yellow burst of flame. Sometimes the TC1 thermocouple that measures the FLAME temperature has a faint red glow when the flammability reading is high. A bright red thermocouple indicates very high flammability.

10.7. Sample Flow

The sample flow rate must be maintained to ensure that measurement is accurate and timely. If the flow rate decreases the measurement will become slower, especially if the sample tubing is long.

The sample orifice is used to measure the FLOW. It must be kept clean so that the measurement is accurate. In some cases, the orifice will require periodic cleaning. A sintered metal filter must be removed using a flat head holding screwdriver to get access to the sample orifice. The sample orifice can then be removed and cleaned.

A partially or completely clogged orifice may trigger a HI FLOW fault message. A partially clogged orifice may result in slow response to sample and calibration gas, FLAMEOUT faults, inability to ignite or stay lit after an ignition attempt or span calibration failure, SPANFAIL.

10.8. Calibration Flow

Zero gas must be clean, dry, instrument-grade air from a cylinder or properly filtered compressor. Oil in unfiltered compressed air can be vaporized in a high temperature analyzer, burn in the sensing flame, and cause a false zero reading.

Zero and span calibration gases are injected under 20 PSIG (1.4 bar) pressure through sintered metal restrictors located inside the inlet fittings. Each restrictor must be kept clean and in place. If the calibration flow is too low or too high, errors will occur. An excess of calibration flow must be free to flow out of the sample tubing.

Fuel pressure must be steady, within specification, and not running low for a successful calibration. Fuel line leaks that cause reading drift will be captured during calibrations resulting in reading error until a proper calibration is done.

Positive reading shifts after a zero calibration (when no combustibles are present) may be an indication of a partially clogged sample line. Compare FLOW in the GAUGES menu when sampling and during calibration. Increases in FLOW during calibration of more than 0.1 LPM is an indication of sample line clogging that restricts the free flow of excess calibration out through the sample line. Clean or replace the sample line to restore proper calibration accuracy.

10.9. Troubleshooting by status message

STATUS	Observations	Causes and/or Corrective Action
TEMP LOW	HEAT “on” continuously	• Proper voltage levels not present at terminal. • Insufficient warm-up time. Wait up to 45 to 90 minutes after power is turned on. • Heater failure • Heater relay failure in controller • Loose controller connections on Terminals 31-37. • Insulation and/or enclosure covers not in place. • Overtemperature thermostat activated – requires manual reset. • Overtemperature thermostat removed or not installed, and jumper not in place. • TC2 thermocouple measuring circuit failure.
TC2 FAIL	HEAT is “off” And HSG TEMP in GAUGES menu has negative temperature reading	TC2 thermocouple open circuit or loose connection Tighten all connections
TEMP HI	HEAT LED is “OFF” And HSG TEMP on GAUGES menu reading above SET TEMP by more than +5°C.	• Mis-wiring of AC power to heater terminals instead of AC input terminals. • Failure of controller circuit. • Failure of heater relay, or short circuit to AC heater. • TC2 thermocouple measuring circuit failure.

<table>
<tr><th>STATUS</th><th>Observations</th><th>Causes and/or Corrective Action</th></tr>
<tr><td>CHK FLOW

or

LOW FLOW</td><td>CHK FLOW message cycling
Service Needed Relay Activated
Fault LED cycling with message

Or

Fault LED indicator “on” and FLOW measurement in GAUGES menu less than LOW FLOW setting (1.4 LPM typical)</td><td>• Sample and/or Exhaust filters clogged. Change filter(s).
• Flame arrestors starting to clog. Remove, clean and reinstall.
• Low compressed air pressure. Verify/set to 20psi.
• Sample line starting to clog. Disconnect sample line at sensor. Clean line.
• Exhaust line starting to clog. Disconnect exhaust line at sensor. Clean line.
• Pressure transducer tubes loose or slightly leaking on back of electronics. Tighten and/or replace.
• Pressure transducer tubes reversed. Verify correct connections.
• Failure of measuring circuitry or pressure sensor. Call for service.
• Aspirator nozzle plugging, clean.
• Sample flow orifice loose, inspect and tighten.</td></tr>
<tr><td>DOWNSCLE</td><td>READING < -10% LFL</td><td>• Drift from low fuel supply pressure.
• Drift from impurities in propane fuel supply.
• External or internal fuel line leak, check and tighten.
• Improper zero calibration without zero gas. Zero on slight upscale reading.
• Contaminated zero gas, such as oil in compressed air line.
• Insufficient zero gas pressure.
• Contaminated thermocouple needs cleaning.</td></tr>
<tr><td>FLOW HIGH</td><td>Fault LED indicator “on” and FLOW measurement in GAUGES menu at or above the limit</td><td>• Air pressure too high, causing excessive suction in aspirator and too high a flow value:
SNR671 < 3.1 LPM
SNR672 < 2.9 LPM
SNR674 < 2.6 LPM
SNR675 < 2.4 LPM
• Process pressure too high, causing excessive sample flow.
• Differential pressure between sample inlet and exhaust too high, causing excessive sample flow.
• Clogged sample orifice, causing excessive pressure drop at normal flow rate.
• Flow Transducer failure, causing high electronic signal, call for service.</td></tr>
<tr><td>FLAMEOUT</td><td>GAUGES/FLAME ≈ GAUGES/HSG TEMP
Indication of a sensing flame failure – without which the sensor will not read sample.</td><td>• Low fuel, fuel leak, or insufficient fuel inlet pressure. Replace/set to specified value.
• Ignition circuit not lighting the flame. Repeat RESET.
• No visible spark during ignition. Call for service.
• Lack of oxygen in sample stream. Call for service.
• Air pressure low or not connected.
• Fuel regulator failure. Call for service.</td></tr>
</table>

STATUS	Observations	Causes and/or Corrective Action
CHK RDNG	-10% < READING < -7%	• Same as DOWNSCLE.
CHK ZERO Or ZEROFAIL	CHK ZERO message cycling Service Needed Relay Activated Fault LED cycling with message or Fault indicator “on”	• Zero calibration gas not connected. • Incorrect zero gas or incorrect pressure. • Zero gas oxygen concentration not 20.9%volume. Must use clean, dry compressed air. • Insufficient fuel pressure at fuel inlet. • Drift from fuel regulator requires readjustment until FLAME measurement is 500°C under zero conditions.
CHK SPAN Or SPANFAIL	CHK SPAN message cycling Service Needed Relay Activated Fault LED cycling with message or Message may appear at the end Fault LED indicator “on”.	• Span gas not connected to inlet. • Incorrect span gas type or concentration. • Insufficient span gas pressure. • Incorrect CAL RDNG setting. • CAL TIME too short to allow time to respond. • Incorrect alignment between thermocouple and burner. • Thermocouple requires cleaning to remove accumulated debris. • Sample line leaks in analyzer. Tighten fittings and/or replace o-rings.
CHK DATA	CHK DATA message cycling Service Needed Relay Activated Fault LED cycling with message	▪ Self-diagnostics has detected an unintentional change in a setting. See section 9.3.5. ▪ Check all register settings. Perform a calibration.
DATALOST	TYPE setting blank -------- Other settings may be wrong Fault LED and relay active.	▪ Self-diagnostics has detected an unintentional change in a setting that cannot be recovered. See section 10.10. ▪ Loss of power or power disturbance during power-on self test or during calibration. ▪ The setting TYPE must be correct and not blank. ▪ Enter TYPE in ALARMS menu. Enter SERIAL if necessary. Perform RESET. Check all other settings. Perform a calibration.
RAM FAIL or EE FAIL	Memory failure	▪ Controller failure or power interruption or power disturbance during power-on self test. Cycle power “off” and then “on,” if fault repeats controller may require factory repair to replace faulty RAM memory or EEPROM.
ROM FAIL	Memory failure	▪ Controller failure or extreme power line disturbance. Perform reset command, wait five minutes, if fault repeats controller may require factory repair to replace faulty ROM memory.

10.10. DATA LOST and COLD START

Settings are stored in RAM memory and are also saved in EEPROM. When power is turned off, the settings in RAM are lost but the settings in EEPROM are preserved. When power is turned on, the settings are copied from EEPROM into RAM. When a setting is changed intentionally through a menu or through the serial port, it is changed first in RAM and then is copied to EEPROM within one minute. During operation, the settings in RAM are tested continuously to make sure that they stay within acceptable limits, and that they match the settings stored in EEPROM. This helps prevent an unintentional change in a setting in RAM from a momentary fault or power interruption.

The acceptable limits for some settings depend on the TYPE setting (example: HSG TEMP). So if the self diagnostics detect that the TYPE setting itself is lost, a DATA LOST fault is given and the analyzer cannot operate until the TYPE is set. The TYPE (and also the SERIAL) setting are written once at the factory and ordinarily cannot be changed. But during a DATA LOST fault, these settings can be re-entered. After TYPE is set, a RESET command or a off/on power cycle will lock out changes to the TYPE and SERIAL registers.

The COLD START command allows the TYPE and SERIAL registers to be changed even if they have not been lost. It should only be used during factory repair procedures. The RESET command (or a power cycle) clears the COLD START condition, locking out further changes to the TYPE and SERIAL registers.

To recover from DATA LOST :

1. Enter the correct TYPE in the ALARMS menu.
2. If necessary, correct the SERIAL number in the ALARMS menu.
3. Check the SET TEMP in the GAUGES menu.
4. Use the RESET command to clear the COLD START condition.
5. Use the ACKNWLDG command to clear the CHK DATA service-needed message and relay.
6. Verify all settings.
7. Perform a FULL CALibration.

10.11. Drift

Most causes of drift are relatively minor, and do not cause error outside of the specified accuracy. The specifications for pressure, flow, temperature and oxygen effects should be reviewed to determine if the drift is due to one of these specified effects.

Some causes of drift are more significant, and can activate faults or service-needed messages.

10.11.1. Initial drift

Drift is sometimes observed during the first 24 to 48 hours after initial startup. It may be due to air trapped in the fuel line, or other causes. The analyzer then stabilizes and drift stops.

10.11.2. Fuel regulation

Loss of fuel regulation can cause a significant amount of drift, even flameout. The fuel pressure must be above the minimum at the fuel inlet. The fuel inlet fittings, which contains a sintered metal filter, must be clean. This problem is diagnosed when an increase in the fuel supply pressure of +10% or more causes more than +1% to +2% LFL increase in the reading.

10.11.3. Fuel purity

Impure fuels cause drift. The contamination may be in the fuel itself. Propane fuels are more likely to have purity problems than hydrogen, especially if the propane supply is subjected to temperature changes. Or the contamination may be residue of sealant, flux, oil, etc., in the fuel line. This contamination may be slowly released into the fuel, and can vary in magnitude over time from changes in temperature and pressure. Clean fuel tubing and pure fuels are essential.

10.11.4. Sample line contamination

An obstruction or clog in the sample tubing can cause drift.

Heated processes sometimes produce vapors from high boiling point substances that can condense in the sampling system, especially if the sample tubing is unheated or insufficiently heated. This contamination, when subjected to temperature changes, can release back into the sample stream and interfere with the readings. If this occurs, the sample tubing temperature must be increased.

During calibration, test gases exit through the sample tubing. A clog in the sample tubing can cause pressure in the flame cell that shifts the reading by several %LFL during calibration. This condition can be observed by comparing the FLOW in the GAUGES menu when sampling vs. when calibrating. FLOW increased of more than 0.1 LPM during calibration is an indication of partial sample line clogging than can result in sample reading shifts of several %LFL after a completed calibration.

10.11.5. Thermocouple or burner contamination

An accumulation of material on the thermocouple or burner, in particular silicones, can slightly insulate the thermocouple from the sensing flame and cause abnormally low zero readings. Such contamination usually presents itself as zero and span drift, and lower-then-expected readings.

11. Spare Parts

11.1. Parts for Preventative Maintenance

For maintaining the flow system of SNR671, SNR672 and SNR674:

FLT012	4 per year	Filter element, flame cell sample and exhaust
ORG005	4 per year	O-Ring, 1 3/16” ID, Viton, Flame arrestor cap

For maintaining the flow system of SNR675:

FLT012	4 per year	Filter element, flame cell sample and exhaust
ORK005	2 per year or as needed	O-Ring, 1 3/16” ID, Flame arrestor cap, Kalrez®

11.2. Parts for Routine Maintenance

Replacement O-rings for re-assembly of the SNR671, SNR672 or SNR674 flame cell:

ORG044	1	O-Ring, Viton, 2.484” ID, Flame cell
ORG041	2	O-Ring, Viton, 0.359” ID, Flame cell to aspirator block

Replacement O-rings for re-assembly of the SNR675 flame cell:

ORK046	1	O-Ring, 2.484” ID, Flame cell, Kalrez®
ORK047	2	O-Ring, 0.359” ID, Flame cell to aspirator block, Kalrez®

11.3. Parts for Maintenance and Repair

These parts are needed occasionally during maintenance and repair and should be kept on hand.

ORF024	Orifice, Sample flow measurement
FLT087	Sintered metal filter to protect orifice
NZL001	Nozzle, aspirator
SNP189	Flame arrestor
BRN006	Burner, with nuts
FUS037	Fuse, 5 amp, 5mm x 20mm, quick acting, IEC 127 code F
FUS038	Fuse, ½ amp, 5mm x 20mm, time lag, IEC 127 code T

11.4. Parts for Repair

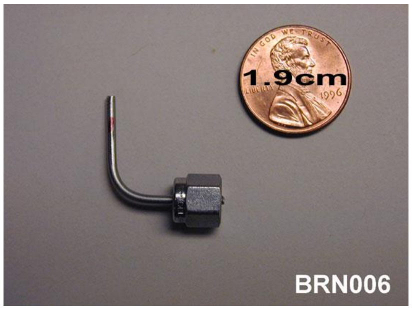
These parts may be needed to replace a failed component.

THC002R	Thermocouple, flame and block temperature
RSH001	Fuel Restrictor, Hydrogen, standard unit
RSH002	Fuel Restrictor, Hydrogen, air dilution type unit
RSP018	Fuel Restrictor, Propane
VLV079	Solenoid valve, zero or span, 120 VAC
VLV083	Solenoid valve, zero or span, 230 VAC
PRV058FR	Fuel Regulator
HTR077R	Heater, 385 watt, 120 VAC (was part number HTR057)
HTR078R	Heater, 385 watt, 230 VAC (was part number HTR058)
TOL003	Tool, flame thermocouple bending and alignment
TOL047	Tool, thermocouple alignment
TOL044	Quick-wedge locking screwdriver for orifice filter service
TOL046	1/8” Hex socket driver
HSG237R	Display/Controller assembly, include serial number when ordering.
CBL229	Ignition cable, replacement, SNR675 only
SPK031	Ignition cable, replacement, SNR671, SNR672 and SNR674
SPK021	Spark plug, flame ignition
SNP366	Calibration gas restrictor/filter
SNP374	Fuel inlet restrictor/filter

11.5. Spare Part Photos

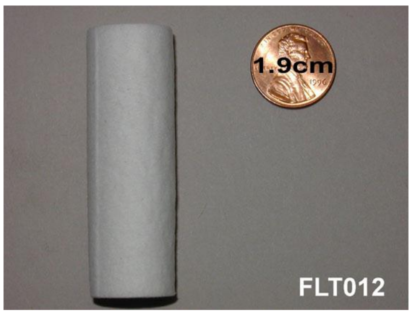
The coin in the photographs is approximately 2 centimeters, or 3/4 inch.

Burner assembly[24]: part # BRN006



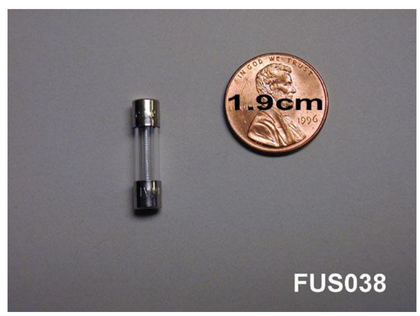
Ignitor cable: part # CBL229 for SNR675

Filter element: part # FLT012



Controller: part# HSG237R

Fuses: part#s FUS037 and FUS038



Heater elements - part#s HTR077R (120VAC) and HTR078R (220 VAC)

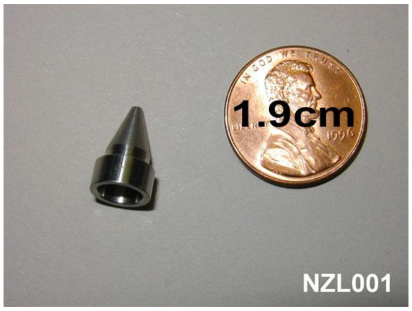
Use HTR077R to replace HTR057 heater

Use HTR078R to replace HTR058 heater

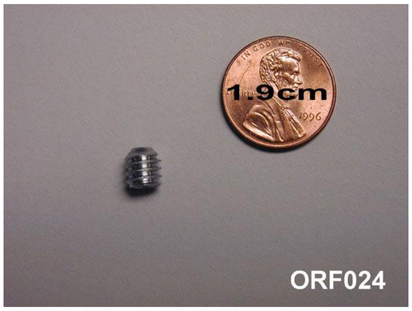
[24] Air dilution types (D, K) use a shorter burner, part# BRN050, having a 0.5 inch (1.3 cm) gap.

SPARE PARTS

Aspirator nozzle: part# NZL001



Sample flow orifice: part# ORF024
Orifice inner diameter is 0.025 inches (#72 drill).

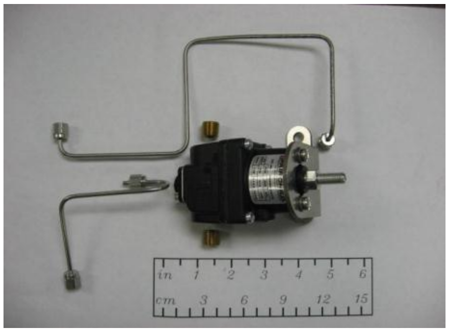


O-Ring, Flame Arrestor Cap, viton: part# ORG005 and Kalrez: part#ORK005
Viton O-Rings (ORG) are for lower temperatures. Kalrez (ORK) is required for high temperatures.

O-Ring, block seals, viton: part# ORG041 and Kalrez: part# ORK047

O-Ring, flame cell seal, viton: part# ORG044 and Kalrez: part# ORK046

Fuel Regulator: part# PRV058FR

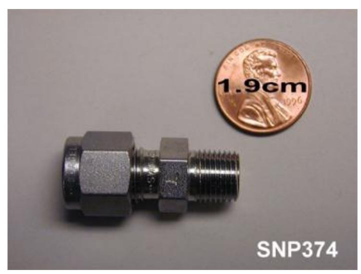


Flame Arrestor: part# SNP189

Fuel Restrictor, hydrogen[25]: part# RSH001 (or RSH002) and propane: part# RSP018

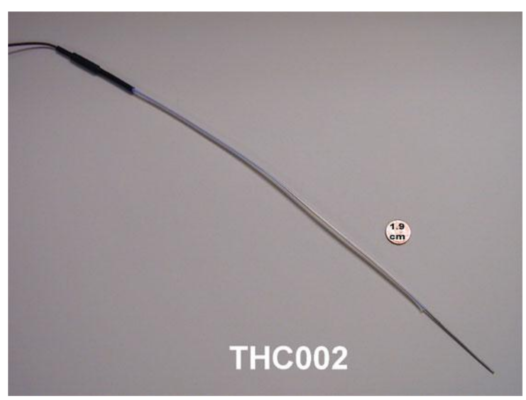
Calibration Gas Inlet Restrictor: part# SNP366

Fuel Inlet Restrictor / Filter: part# SNP374



Spark Plug Assembly: part# SPK021

Thermocouple assembly: part# THC002

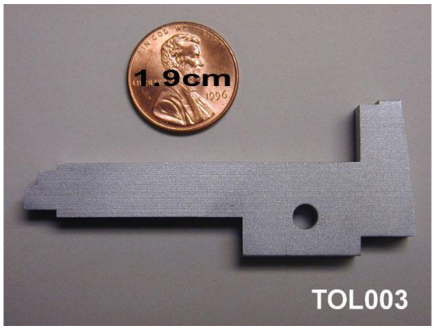


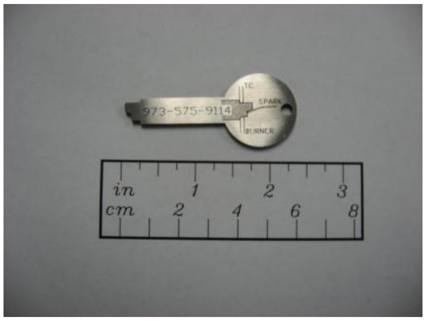
[25] Air dilution type analyzers use hydrogen fuel restrictor part number RSH002.

SPARE PARTS

Tool: part# TOL003 Tool: part# TOL047

Used to set the standard burner-thermocouple gap,[26] and spark gap





Solenoid valve, calibration: part#s VLV079 (120 VAC) and VLV083 (230 VAC)

Air Regulator, Part# PRV069,

for Air-dilution Types only

Ignitor cable: part # SPK031

for SNR671, SNR672 & SNR674 only

[26] Air dilution types (D, K) use a shorter burner, part# BRN050, having a 0.5 inch (1.3 cm) gap.

12. Serial Communications

Data can be transferred between one or more analyzers, and a single host device, using the Modbus Remote Terminal Unit (RTU) protocol. The host device sends polls, to which the analyzer replies.

12.1. Serial Communications Specifications

Specification	Description	
Supported commands	Command 3	"Read Output (Holding) Registers"
	Command 6	"Preset Single Register"
	Command 16	"Preset Multiple Registers."
Command 16 limit	Limited to one register in length (special case).	
Command 3 limit	Limited to 127 registers in length.	
Broadcast mode	Supported for commands 6 and 16.	
Serial port hardware	Half-duplex RS485	
Data format	8 bits, no parity, 1 stop bit	
Baud rates	Baud rates from 300 to 19,200 are supported	
Standard baud rate	9600	
Maximum poll rate	Eight per second at 9600 Baud, sixteen per second at 19200 Baud	
Receive-transmit delay	Minimum: 5 characters between receipt of poll and reply.	
	Maximum: 250 milliseconds, if maximum poll rate is reached	
Error handling	Invalid start register address	Command ignored, no reply
	Read more than 127 registers	Command ignored, no reply
	CRC error, poll corrupted	Command ignored, no reply
	Read over page boundary	Command ignored, no reply
	Read invalid page	Command ignored, no reply
	Data written outside valid limits	Reply is made but data is ignored
	Read of unsupported register	00H Data returned in reply

12.2. Serial Communications Notes

The modbus master should be secured from unauthorized or unintentional changes. Networked access is not recommended.

WARNING! **Serial communications must not be used for critical safety functions such as process shutdown.**

Writing illegal data outside the register's acceptable limits is acknowledged with a reply, but the data is ignored. The modbus master should verify completion of write commands by a subsequent read of the register.

Data written to the COMMANDS register is cleared as soon as the command is executed. Reading the COMMANDS register most likely returns 00H data, even if the register has just been written. The host should verify COMMANDS by reading the STATUS register.

Data written to non-volatile registers are saved to the EEPROM sixty seconds later. When several write commands are received consecutively, that is, with less than 60 seconds between them, the EEPROM is written 60 seconds after the last command. The SAVE ALL command saves to the EEPROM immediately.

Some modbus master devices prefer to receive a reply with the register data formatted with the low order byte transmitted first. Read registers at pages 4 or 5 to get register data formatted "lo:hi."

Page#	Hexadecimal addresses	Accessible contents
00	0000H through 00xxH	Registers 1 through 64
01	0100H through 01xxH	Registers 257 through 272
04	0400H through 04xxH	Copy of registers 257 through 272, lo:hi format, effective register numbers 1025 through 1040
05	0500H through 05xxH	Copy of registers 1 through 64, lo:hi format, effective register numbers 1281 through 1344

12.3. Register Conversion Factors

After it is acquired, the serial port data is converted into engineering units using a conversion factor. For the following registers, the data is a signed 16-bit word. Negative numbers are in two's complement form. To convert the register data, multiply by the conversion factor in the table.

REGISTERS	Format	Conversion Factor
READING PEAK HI PEAK LO CAL RDNG WARNING DANGER MA TEST MA CAL MA FAULT	Reading	Standard unit[27] with 100%LFL measurement range, multiply by 0.00390625 %LFL
MA TEST MA CAL MA FAULT	Reading format expressed as milliamps	Multiply by 0.000625, then add + 4.0 Milliamps
HSG TEMP SET TEMP FLAME RAW ZERO RAW SPAN SPAN °C	Temperature	Multiply by 0.24426 °C
FLOW CHK FLOW LOW FLOW	Flow Rate	Multiply by 0.00172936 Liters per minute
4 MA ADJ 20 MA ADJ	Milliamps	0.1 Milliamps
VARIOUS	ON/off	ON = 1, active; off = 0, inactive

[27] Analyzers with air dilution options using software Version 5.08 and earlier have a 200%LFL range. For these analyzers multiply by 0.0078125.

12.4. Registers

	Register Name	#	Register Contents *Registers that can be written are indicated by this symbol: ✎.*
GAUGES MENU	READING	1 *50*	The flammability reading in Percent Lower Flammable Limit (%LFL) Register *50* is a copy of READING that includes the effect of MA CAL, MA FAULT and MA TEST register functions.
	STATUS	2	Device status messages, codes, and their meanings **Message** — **Code** — **Meaning** Normal — 0 — Normal operation, no alarms Warning — 1 — Warning alarm, reading above warning level Danger — 2 — Danger alarm, reading above danger level Downscale — 3 — Fault, reading lower than –10%LFL Zero On — 4 — Zero calibration or zero test in progress Span On — 5 — Span calibration or span test in progress Purging — 6 — Purging calibration gases Cal ends — 7 — Calibration ending Zero fail — 8 — Zero calibration failed, result unacceptable Span fail, low — 9 — Span calibration failed, result too low Span fail, high — 10 — Span calibration failed, result too high Warm-up — 11 — Power-on time delay for self diagnostics RAM test — 12 — Self diagnostic of RAM RAM fail — 13 — RAM has failed self diagnostic test Data lost — 14 — Checksum for nonvolatile data in EEPROM failed EE fail — 15 — Self diagnostic check of EEPROM failed Temp low — 18 — Temperature of analyzer is too low Temp high — 19 — Temperature of analyzer is too high Flow Low — 20 — Sample flow rate too low. Flow Hi — 21 — Sample flow rate too high. A/D fail — 24 — Self check of A/D converter failed. TC2 Fail — 25 — Thermocouple for temperature control failed. Flameout — 26 — Sensing flame is out. ROM fail — 27 — Continuous self-diagnostic of ROM has failed.
	PEAK HI	38	Highest reading taken since last reset command
	PEAK LOW	39	Lowest reading taken since last reset command
	HSG TEMP	9	Actual flame cell housing temperature in Degrees Centigrade
	SET TEMP ✎	24	Flame cell housing temperature set point in Degrees Centigrade Assembly — Min — Max — Default SNR671 — 50°C — 65°C — 60°C SNR672 — 100°C — 153°C — 120°C SNR674 — 100°C — 210°C — 200°C SNR675 — 100°C — 280°C — 250°C
	FLOW	15	Sample flow rate in Standard Liters per Minute
	LOW FLOW ✎	23	Sample flow rate at which “Low Flow” fault is activated, in standard liters per minute. Assembly — Min — Max — Default SNR671 — 1.4 — 3.0 — 1.4 SNR672 — 1.4 — 2.7 — 1.4 SNR674 — 1.4 — 2.5 — 1.4 SNR675 — 1.4 — 2.3 — 1.4
	CHK FLOW	42	Level at which the CHK FLOW “service needed” message and relay will activate. Do not write to this register via modbus.
	FLAME	11	Flame temperature (Thermocouple TC1 reading) in Degrees Centigrade

	REGISTER NAME	#	REGISTER CONTENTS
CAL MENU	RAW ZERO	29	Flame temperature from zero calibration in degrees Centigrade Minimum value is 450°C Maximum value is 550°C Default value is 500°C.
	RAW SPAN	30	Flame temperature from span cal minus the raw zero, in degrees Centigrade.
	CAL TIME	28	Duration of each calibration interval in minutes Minimum setting 1 minute, maximum 4 minutes. Default is 1 minute.
	CAL RDNG	7 *43*	%LFL reading for span calibration. Minimum value is 40%LFL except P type,which allows 25%LFL. Maximum value is 80%LFL. Default value is 60%LFL. Register 43 is a copy of CAL RDNG from the last successful calibration.
	SPAN °C	56	Setting for expected RAW SPAN temperature rise during span calibration Type / Standard / P-type / D- and K-type Minimum: 105°C / 68 / 50 Maximum: 140°C / 140 / 70 Default: 125°C / 80 / 60
	SPEED	20	Speed of response and noise filter Off 0 Slowest setting. Available with K type only. Low 1 Default setting for D type Med 2 Default setting for all but D type High 3 Fastest setting
	CAL LOCK	60	Indication of calibration lock. Read only. Hardware Lock Bit 0 Software Lock Bit 1
COMMANDS MENU	COMMANDS	8	Execute a command to control the device - 0 (no commands, inactive) Reset 200H Reset alarms Acknowledge 100H Silence the horn, clear “service needed” relay
			Calibrate analyzer with gas, adjust settings, activate faults if response unacceptable Zero Cal 300H Perform zero calibration and adjust zero Span Cal 400H Perform span calibration and adjust span Full Cal 500H Perform zero and span calibration and adjust
			Test analyzer response with gases, but do not adjust the settings, ignore faults Zero Test 600H Test zero with gas, do not adjust Span Test 700H Test span with gas, do not adjust Full Test 800H Test zero and span, do not adjust
			Commands affecting EEPROM Save All 900H Save all settings to EEPROM Cold Start 0A00 Force device into COLD START condition. Do not use.
			Commands for remote control - not on menu 0B00H Emulates “Menu” pushbutton 0C00H Emulates “Select” pushbutton 0D00H Emulates “Flashlight” activation
			Commands for security - not on menu - 0E00H “Momentary lock” - internal use only. Do not use. Lock 0F00H Locks out calibration, software lock. Unlock 1000H Unlocks calibration.

	REGISTER NAME	#	REGISTER CONTENTS
OUTPUTS MENU	RLY TEST	45	Relays activated for test. Format is identical to RELAYS register. Test is run through menu access only - do not write to this register with modbus (serial communication).
	MA TEST	44	Circuit test of milliamp output, in milliamps, increases output only, deactivates upon leaving menu. Test is run through menu access only - do not write to this register with modbus (serial communication).
	4 MA ADJ ✎	25	Circuit adjustment of milliamp output at the 0%LFL (4 milliamp) point – factory set Range is +/- 2 milliamps. Default value is 0.
	20 MA ADJ ✎	31	Circuit adjustment of milliamp output at the full scale (20 milliamp) point – factory set. Range is +/- 2 milliamps. Default value is 0.
	MA CAL ✎	26	Value for milliamp output during calibrations Minimum is 2.5 milliamps, maximum 22.7 milliamps, default is 22.1 milliamps.
	MA FAULT ✎	32	Value for milliamp output during faults Minimum is 2.5 milliamps, maximum 22.7 milliamps, default is 21.0 milliamps.
	CONTROL1 ✎	36	Assigns a COMMAND to the CONTROL1 input. (See COMMANDS register)
	CONTROL2 ✎	37	Assigns a COMMAND to the CONTROL2 input. (See COMMANDS register)
	RLY CNFG ✎	58	Configuration setting for the HORN relay 00 Default setting. The relay is used for the HORN function. 01 AIR/FUEL function. The relay energizes (contacts close) when flame cell is at proper operating temperature. 02 OVERRIDE function. Relay is always energized (contacts always closed)
COM PORT MENU	SET BAUD ✎	22	Default Baud Rate Setting (See below for allowable settings and Baud rates)
	BAUD RATE ✎	47	Baud Rate Currently In Use. Can differ from the default setting if AUTOBAUD is "on." The allowable settings are: 0010H 19200 0011H 9600 Standard value is 9600 Baud 0012H 4800 0013H 2400 0014H 1200 0015H 600 0016H 300
	AUTOBAUD ✎	48	Control for automatic baud rate detection feature (vs. fixed baud rate setting) 0 Off Baud rate fixed, equals "SET BAUD" value 1 On Device automatically seeks proper baud rate
	ADDRESS ✎	21	Port address of device Valid settings are 1 to 255, Default setting is 1. Note: the address in the modbus data packet is one less than that stored in the address register "address 1 = 0000H"
	ID NBR ✎	19	User-assigned identification number. Valid settings are 0 to 99. Default setting is 0.

	REGISTER NAME	#	REGISTER CONTENTS
ALARMS MENU	WARNING	5	The warning alarm level, in the same format as reading Default setting is 40% LFL Adjustable from 5% LFL to 60% LFL. Should be set below the DANGER level.
	DANGER	6	The danger alarm level, in the same format as reading Default setting is 50% LFL Adjustable from 10% LFL to 60% LFL
	RATE	61	Enables and disables the rate-of-rise alarm. ON = Rate-of-rise alarm is enabled OFF = Rate-of-rise alarm is disabled
	LATCHES	17	Alarms that will latch until manually reset, versus those that will auto reset Format is identical to RELAYS register. Default is WARNING, DANGER AND FAULT set to latching.
	FAILSAFE	18	Relays that are failsafe (normally energized) and which de-energize upon activation of the alarm. WARNING, DANGER AND FAULT relays are always failsafe. Format is identical to RELAYS register. Do not write to this register via modbus - change only through the operator panel.
	AUTO IGN	35	Automatic Re-ignition setting 0 = None, single attempt to ignite is made upon flameout, after reset. 1 to 120 = Number of re-ignition attempts at 15 second intervals. Default setting is 0, disabled.
	VERSION		Software version (for complete Version header see below registers 257 - 272)
	TYPE	62	Analyzer type - This register is written once at factory 0 Undefined – this value will cause DATA LOST fault 1 SNR671 2 SNR671D 3 SNR672P 4 SNR672 5 SNR672D 6 SNR672K 7 SNR674P 8 SNR674PL 9 SNR674 10 SNR674D 11 SNR675 12 SNR675D 13 SNR675K Options: D = Air dilution option P = Allows 0.6% volume Propane calibration gas K = Air dilution with ability to set SPEED to OFF L = Low flow adjustment option (now standard on all types)
	SERIAL	63	Serial number – displayed as year of production and serial, eg, 02-101 for year 2002 serial 101. Data in this register is the serial only. The year of production is stored in the ASCII text string registers 257 to 272. This register is written once, at the factory upon shipment.
	LANGUAGE	64	Display language 0 = English (default) 1 = German

REGISTER NAME	#	Register Contents **Note:** These registers are accessible through the serial port In some prior software versions LINEAR and MA SCALE were on menus.
FULLSCLE	3	Full scale measurement range. 100 for standard[28] units.
RELAYS	4	Logical state of the control relays. This data matches the corresponding LED indicators. A bit of 1 = "active", 0 = "inactive" Data is in binary format. Packed flags: 0000 0000 TISZ HFDW T Heater I Ignition S Span solenoid valve Z Zero solenoid valve H Horn relay F Fault relay D Danger relay W Warning relay
	49	Copy of RELAYS in low byte position and FAILSAFE register in high byte position.
DUMMY ✎	46	A register that performs no function, but can be used to debug serial communications
A/D REF	16	The reference voltage of the A/D converter. Should be 506 ± 25.
SERVICE	59	SERVICE NEEDED indication. A bit of 1 = "active", 0 = "inactive" Data is in binary format. Packed flags: 0000 0000 A0RD LSZF F CHK_FLOW Z CHK_ZERO S CHK_SPAN L CHK_LED - controls flashing of fault LED when any CHK_ bit is set D CHK_DATA R CHK_RDNG A AIR_FUEL
VERSION	257 thru 272	Device identification, in ASCII text string. „PREVEX „ Analyzer Model „VER 5.11" Software version „SNR67x „ Analyzer assembly number " 2005 „ Analyzer serial number – year of production
	40	Internal pointer used for display of version - do not use.
DISPLAY	51 thru 55	Copy of the LCD display buffer in ASCII.
MA SCALE	57	The %LFL reading equal to 20 milliamps. Always 100%LFL. Older air dilution types D or K at version 5.08 or lower adjusted to 100%LFL or 200% LFL.
LINEAR	41	For sensor with Air Dilution Option, type D or K, sets the linear range. OFF 40% LFL Standard setting without Air Dilution. ON 80% LFL Air Dilution installed and active.

[28] For analyzers with air dilution option - D or K in the TYPE (eg SNR675K, SNR674D. etc.) at software VERSION 5.08 and earlier, the full scale is 200.

Drawing Index:

FAX this form to 973-575-0013 (Questions? Call 973-575-9114)

Troubleshooting Worksheet for PrevEx Flammability Analyzers (SNR671, 672, 674, 675)

Please answer all questions. Use additional paper if needed.

Company Name

Person to Contact Email

Contact Phone Conta ct Fax

Equipment Serial Number(s) Sales Order Number

Serial numbers are indicated on the instruments serial plate, which is located on the side exterior of the instrument.

Describe the problem you are experiencing. What do you think is the cause of this problem?

Scroll through the instrument's display menus. Record the values shown below

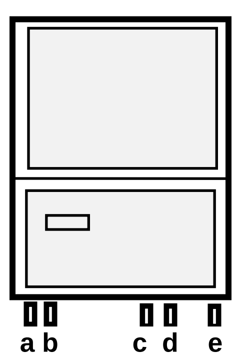
Gauges	Cal Menu	Alarms	Outputs	COM Port
Reading	Raw Zero	Warning	RLY Test	Set Baud
Status	Raw Span	Danger	mA Test	BaudRate
Peak Hi	Cal Time	Rate	mA Scale	AutoBaud
Peak Low	Cal Rdng	Latches	4mA Adj	Address
HSG Temp	Span °C	Fail Safe	20mA Adj	ID NBR
SET Temp	Linear	Auto Ign	mA Cal	
Flow	Speed	Version	mA Fault	
Low Flow	CAL Lock	Type	Control 1	
Chk Flow		Serial	Control 2	
Flame		Language	RLY Cnfg	

Record any LEDs that may be lit on the front panel. Identify any indicators that are lit by filling in the circles.
Use the following legend: Off = ○ On = ● Flashing = ⃠

Alarm ○	○ Scan	Fault	Danger	Warning	Horn	Zero	Span	Ignite	Heat
		○	○	○	○	○	○	○	○

Record the following values at the sensor:

a	Fuel Inlet Pressure		PSIG
b	Dilution Air Inlet Pressure		PSIG
c	Span Inlet Pressure		PSIG
d	Zero Inlet Pressure		PSIG
e	Compressed Air Inlet Pressure		PSIG
	Is the process under pressure or vacuum at the sample point? Fill in the value and the unit of measure		

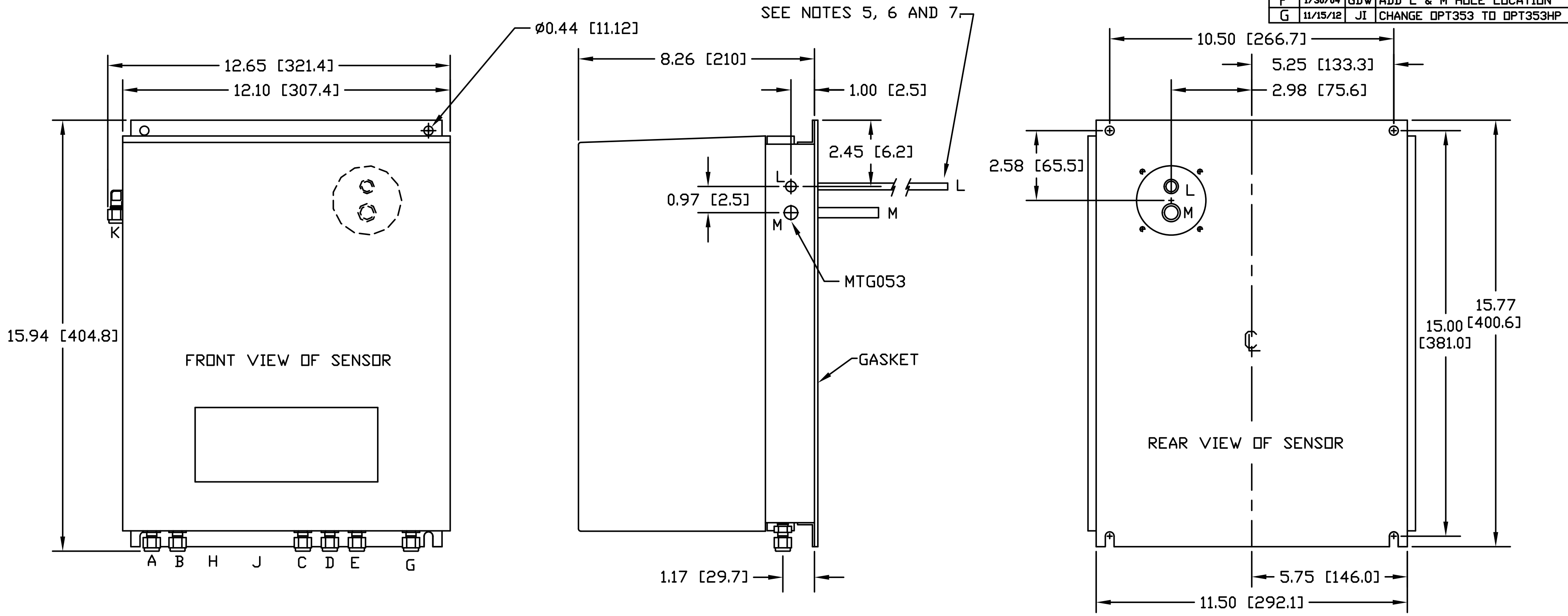


Where is the sample pickup tube located?

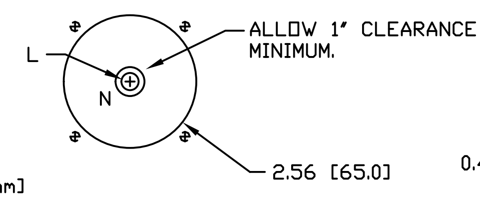
Where does the exhaust tube go to?

C7FTA114

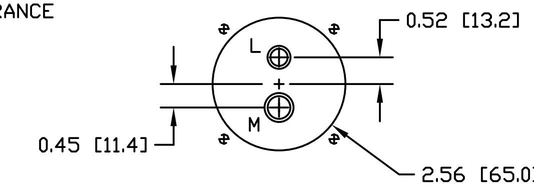
SYM	DATE	BY	REVISIONS
A	8/24/99	GDW	CORRECTED DRAWING
B	3/1/00	GDW	FMR APPROVAL
C	3/1/00	GDW	FMR APPROVAL
D	6/5/00	GDW	REMOVE DUCT VIEW
E	4/10/01	GDW	REMOVE "F" FITTING
F	1/30/04	GDW	ADD L & M HOLE LOCATION
G	11/15/12	JI	CHANGE OPT353 TO OPT353HP



HTR063
CONCENTRIC PROBE



SAMPLE/EXHAUST LOCATION
MTG054 WITHOUT HTR063



CONNECTIONS:

A.	FUEL	1/4" TUBE
B.	DILUTION AIR INLET (OPT353HP)	1/4" TUBE
C.	PURGE PRESSURE REFERENCE (OPTIONAL)	1/4" TUBE
D.	SPAN GAS	1/4" TUBE
E.	ZERO GAS	1/4" TUBE
F.		
G.	COMPRESSED AIR.	1/4" TUBE
H.	POWER INPUT.	3/4 NPT
J.	COMMUNICATION WIRING.	3/4 NPT
K.	PURGE EXHAUST (NO CONNECTION)	1/4" TUBE
L.	SAMPLE INLET (4 FT SUPPLIED)	1/4" TUBE
M.	EXHAUST (2 FT SUPPLIED)	3/8" TUBE
N.	EXHAUST, HTR063 (3.5 FT SUPPLIED)	3/4" TUBE

NOTES:

1. ALL DIMENSIONS = INCH [mm]
2. SAMPLE AND EXHAUST CAN BE TWO SMALL OR ONE LARGE CLEARANCE HOLE. A 2" [51mm] DIAMETER HOLE WILL CLEAR BOTH HOLES.
3. INSULATE OR SUPPORT TUBES SO THEY DO NOT CONTACT COOL SURFACES.
4. MTG053 HAS NO SAMPLE/EXHAUST TUBES SUPPLIED.
5. THE SAMPLE PROBE SHOULD BE LOCATED WHERE IT WILL GIVE A REPRESENTATIVE READING OF THE PROCESS.
6. THE EXHAUST TUBE SHOULD BE LOCATED WHERE IT WILL NOT DILUTE THE SAMPLE.
7. CUT SUPPLIED SAMPLE AND EXHAUST TUBES TO LENGTH.
8. SENSOR WEIGHT 35-40 LBS.

REQ	ITEM	PART NO.	DESCRIPTION

LIST OF MATERIALS

DO NOT CHANGE WITHOUT AGENCY APPROVAL

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE
TOLERANCES
DEC. ± 0.01" (0.25) FRACT. ± ANG. ±

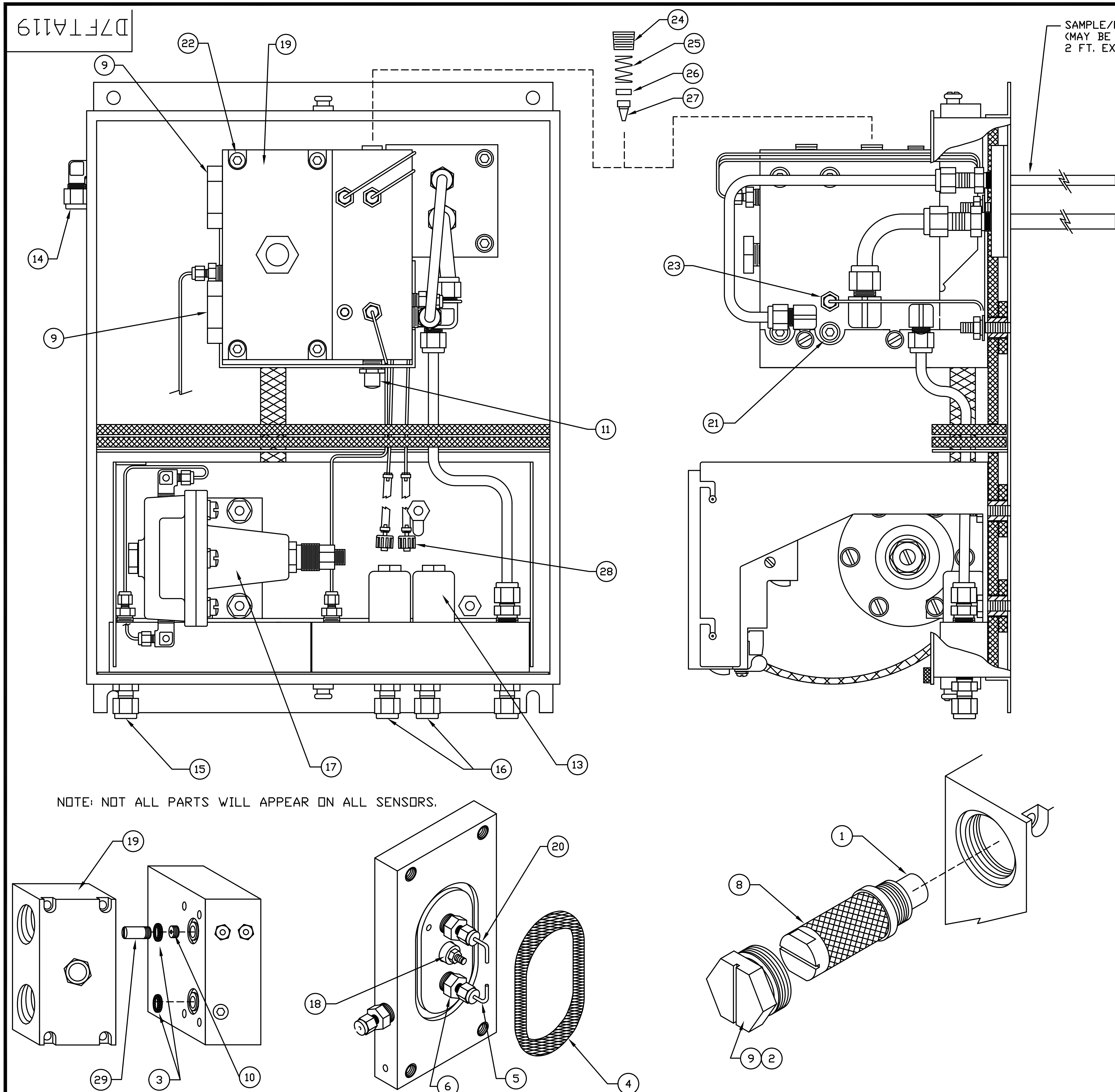
PREVEX SERIES
FTA MOUNTING

CLIENT
SPEC. NO.

CONTROL INSTRUMENTS Corporation
25 Law Drive
Fairfield, N.J. 07004 U.S.A.

DWN. S.A.A.	ENGR. G.D.W.	SCALE 1=3
DATE 8/9/99	DATE 8/9/99	REVISION G

DRAWING NO. C7FTA114



NOTE: NOT ALL PARTS WILL APPEAR ON ALL SENSORS.

SYM	DATE	BY	REVISIONS
A	3/1/00	GDW	FMR APPROVAL
B	7/12/01	PKP	ADDED FLT087 FILTER
C	6/25/03	PKP	ADDED KALREZ O-RINGS
D	8/9/05	JI	CORRECTED HEATER P/N's
E	11/15/12	JI	CORRECTED REPLACEMENT P/N's
F	7/29/13	GW	CORRECTED REPLACEMENT P/N

ITEM	PART #	DESCRIPTION
29	FLT087	ORIFICE FILTER
28	FNMLL1/16TR	FITTING, OPD PNEUMATIC (RED)
28	FNMLL1/16TBL	FITTING, OPD PNEUMATIC (BLACK)
27	NZL001	NOZZLE, ASPIRATOR
26	SPC009	SPACER, ASPIRATOR
25	SPR013	SPRING, ASPIRATOR
24	PLG002	PLUG, 1/4 NPT
23	THC002R	THERMOCOUPLE, BLOCK TEMPERATURE
23	FS1BZSS000	NUT, THERMOCOUPLE FITTING
22	MSC023	MACHENE SCREW, FLAME CELL TO BURNER PLATE
21	MSC007	MACHINE SCREW, BYPASS TO FLAME CELL
20	THC002R	THERMOCOUPLE, FLAME TEMPERATURE
19	SNP219H	FLAME CELL BLOCK
18	SPK021	SPARK PLUG
17	PRV058FR	FUEL REGULATOR
16	SNP366	RESTRICTOR, CALIBRATION GAS
15	SNP374	RESTRICTOR, FUEL INLET
14	FS40022000	AIR PURGE OUTLET
13	VLV083	SOLENOID VALVE OPERATOR, 230VAC
13	VLV079	SOLENOID VALVE OPERATOR, 120VAC
11	HTR078R	HEATER, 230VAC
11	HTR077R	HEATER, 120VAC
10	ORF024	ORIFICE, SAMPLE FLOW
9	SNP188	FLAME ARRESTOR CAP (2X)
8	SNP189	FLAME ARRESTOR (2X)
6	RSP018	FUEL RESTRICTOR, PROPANE
6	RSH001	FUEL RESTRICTOR, HYDROGEN(EXC.W/OPT353HP)
5	BRN006	BURNER, HYDROGEN FUEL(EXC.W/OPT353HP)
4	ORK046	O-RING, FLAME CELL, KALREZ, (SNR675 ONLY)
3	ORK047	O-RING, FLAME CELL TO BYPASS BLOCK (2X) KALREZ,(SNR675 ONLY)
2	ORK005	O-RING, FLAME ARRESTOR COVER, KALREZ, (SNR675 ONLY)
4	ORG044	O-RING, FLAME CELL
3	ORG041	O-RING, FLAME CELL TO BYPASS BLOCK (2X)
2	ORG005	O-RING, FLAME ARRESTOR COVER(2X)
1	FLT012	FILTER ELEMENT (2X)

REQ	ITEM	PART NO.	DESCRIPTION

LIST OF MATERIALS

DO NOT CHANGE WITHOUT AGENCY APPROVAL

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE

TOLERANCES
DEC. ± FRACT. ± ANG. ±

PREVEX SERIES ASSEMBLY

CLIENT

SPEC. NO.

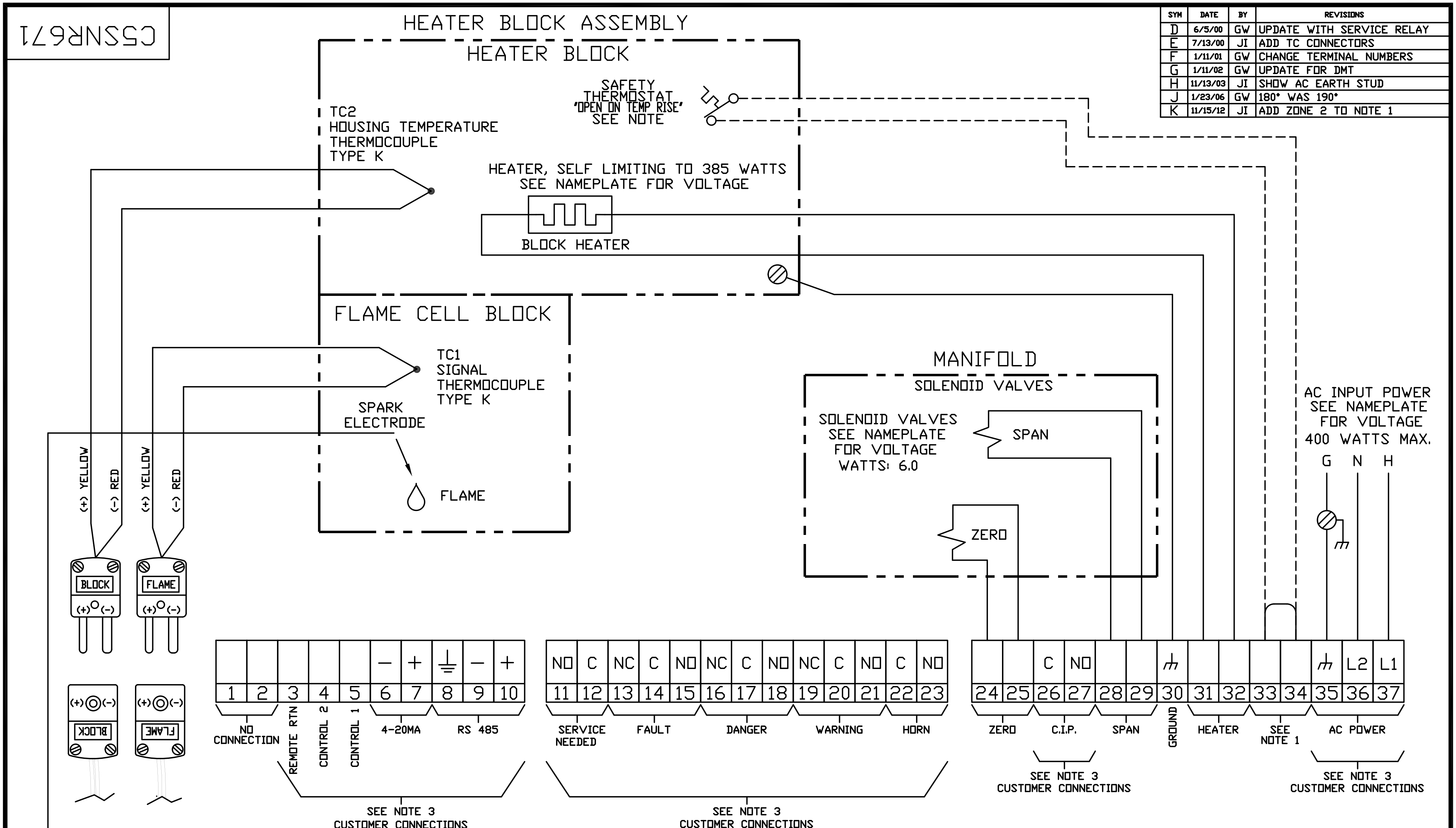
CONTROL INSTRUMENTS Corporation
25 Law Drive
Fairfield, N.J. 07004 U.S.A.

DWN. G.D.W.	ENGR. G.D.W.	SCALE 0.5=1
DATE 7/8/99	DATE 7/8/99	REVISION F

DRAWING NO. D7FTA119

C5SNR671

SYM	DATE	BY	REVISIONS
D	6/5/00	GW	UPDATE WITH SERVICE RELAY
E	7/13/00	JI	ADD TC CONNECTORS
F	1/11/01	GW	CHANGE TERMINAL NUMBERS
G	1/11/02	GW	UPDATE FOR DMT
H	11/13/03	JI	SHOW AC EARTH STUD
J	1/23/06	GW	180° WAS 190°
K	11/15/12	JI	ADD ZONE 2 TO NOTE 1



NOTE 1. THERMOSTAT IS REQUIRED FOR USE IN ZONE 1 OR ZONE 2 AREAS. JUMPER 33-34 MUST BE REMOVED.

MODEL NUMBER DESIGNATION	NORMAL OPERATING TEMPERATURE	SAFETY THERMOSTAT SETTING	IEC 79-8 T RATING
SNR671-T6	60C	82C	T6
SNR672-T4	100C	118C	T4
SNR672-T3	120C	200C	T3
SNR674-T3	180C	200C	T3
SNR674-T2	200C	300C	T2

NOTE 2. POWER IS FACTORY CONFIGURED EITHER FOR 120 VAC OR 230 VAC BUT NOT BOTH. USE OF INCORRECT VOLTAGE WILL CAUSE DAMAGE. SEE NAMEPLATE FOR CORRECT VOLTAGE.

NOTE 3. TERMINALS 3 - 10, 11 - 23, 26 - 27 & 35 - 37 ARE CUSTOMER CONNECTIONS. ALL OTHER TERMINALS ARE FACTORY WIRED AND COMPLETE.

REQ	ITEM	PART NO.	DESCRIPTION

LIST OF MATERIALS

DO NOT CHANGE WITHOUT AGENCY APPROVAL

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE
TOLERANCES DEC. ± FRACT. ± ANG. ±

INTERNAL WIRING PREVEX SERIES

CLIENT | SPEC. NO.

CONTROL INSTRUMENTS Corporation
25 Law Drive
Fairfield, N.J. 07004 U.S.A.

DWN. S.A.A. | ENGR. G.D.W. | SCALE
DATE 8/9/99 | DATE 8/9/99 | REVISION K
DRAWING NO. C5SNR671

C7CAL129

SOLVENT DATA
DRUM &/OR CALIBRATOR SYSTEMS

	CHEMICAL NAME	SYNOMYM OR TRADE NAME	FORMULA	MOLECULAR WEIGHT (M.W.)	FLASH POINT IN °F, CLOSED CUP	SPECIFIC GRAVITY	LFL (%) @ 77° F	LFL (%) @ 400° F USING NFPA CORRECTION FACTOR		55 GAL. DRUM CALIBRATION SYSTEMS: VOLUME OF SOLVENT REQUIRED FOR 50% LFL MIXTURE IN 55 GALLON DRUM USING LFL @ 77° F IN MILILITRE	55 GAL. DRUM CALIBRATION SYSTEMS: VOLUME OF SOLVENT REQUIRED FOR 50% LFL MIXTURE IN 55 GALLON DRUM USING LFL @ 400° F IN MILILITRE	GAS EQUIVALENT READINGS (%LFL) 1.15% ETHYLENE IN AIR: MODEL SNR674 & SNR675 SAMPLE TEMP=400F	MODEL SNR672 SAMPLE TEMP=400F	MODEL SNR671 SAMPLE TEMP=400F	MODEL SNR674 & SNR675 SAMPLE TEMP=77F	MODEL SNR672 SAMPLE TEMP=77F	MODEL SNR671 SAMPLE TEMP=77F
1	ACETONE	2-PROPANONE	CH_3COCH_3	58.08 [B]	0 [A]	.792 [B]	2.5 [C]	2.15		7.80	6.71	58	57	56	50	49	48
2																	
3	ETHANOL	ETHYL ALCOHOL	CH_3CH_2OH	46.07 [B]	55 [A]	.7893 [B]	3.3 [C]	2.84		8.20	7.05	56	55	54	48	47	46
4	ETHYL ACETATE		$CH_3COOC_2H_5$	88.11 [B]	24.9 [A]	0.901 [B]	2.0 [C]	1.72		8.32	7.16	59	58	57	51	50	49
5	HEPTANE		$CH_3(CH_2)_5CH_3$	100.20 [B]	27 [A]	.68376 [B]	1.0 [C]	0.86		6.24	5.37	56	55	54	48	47	46
6																	
7	HEXANE	HEXYL HYDRIDE	$CH_3(CH_2)_4CH_3$	86.17 [B]	-7 [A]	.6603 [B]	1.1 [C]	0.95		6.11	5.25	59	58	57	51	50	49
8																	
9	MEK	2-BUTONONE	$CH_3COCH_2CH_3$	72.10 [B]	21 [A]	.805 [B]	1.8 [D]	1.55		6.86	5.90	58	57	56	50	49	48
10	ISOPROPAL ALCHOL		$CH_3CH(OH)CH_3$	60.09 [B]	53 [A]	.7854 [B]	2.2 [A]	1.89		7.17	6.17	59	58	57	51	50	49
11	TOLUENE	TOLUOL	$C_6H_5CH_3$	92.13 [B]	40 [A]	.86694 [B]	1.2 [C]	1.03		5.43	4.67	57	56	55	49	48	47
12																	
13	XYLENE	1,2,DIMETHYL BENZENE	$C_6H_4(CH_3)_2$	106.16 [B]	90 [A]	.8802 [B]	1.1 [A]	0.95		5.65	4.86	58	57	56	50	49	48
14																	
15																	
16																	
17																	
18																	
19																	

DATA — CALCULATIONS — READINGS

NOTES:

1. REFERENCES:
   - (A) FLAMMABILITY CHARACTERISTICS OF COMBUSTIBLE GASES AND VAPORS; BUREAU OF MINES BULLETIN 627, 1965.
   - (B) HANDBOOK OF CHEMISTRY AND PHYSICS; 40TH EDITION 1958-1959.
   - (C) BULLETIN, NFPA 86, 1990 EDITION
   - (D) NABERT SCHON GERMANY

SYM	DATE	BY	REVISIONS
A	9/6/00	PKP	ADDED SNR675

EXAMPLE CALCULATIONS USING HEPTANE

1. DRUM CALIBRATION FOR 50% LFL MIXTURE:

$$VL(SOLVENT) = \frac{C \times 0.01 \times 208198(ML) \times MWL \times 273.15(°K) \times 760(mmHG)}{DL(gm/ML) \times 22414(CC/MOL) \times T(°K) \times P(mmHG)}$$

WHERE: C=CONCENTRATION 0-100% OF THE LFL OF THAT SOLVENT IN AIR

MWL=MOLECULAR WEIGHT OF SOLVENT
DL=DENSITY OF SOLVENT(g/ml)
T=ABSOLUTE TEMP. OF SOLVENT(°K)
P=PRESSURE-ASSUME 760 mmHg
DRUM VOLUME=208198 ML AIR
@STP=22414 CC/MOL
VL=VOLUME OF SOLVENT FOR 50% LFL MIXTURE IN 55 GAL. DRUM.

$$VL=\frac{1.0 \times 0.01 \times 208198 \times 100.20 \times 273.15 \times 760}{.68376 \times 22414 \times 298 \times 760}$$

VL=12.48ML LIQUID FOR 100% LFL
VL=6.24ML LIQUID FOR 50% LFL

SIMPLIFIED FORMULA

$$VL=\frac{MWL \times LFL}{DL} \times 0.04255=$$

@T=77°F

$$VL=\frac{100.20 \times 1.0}{0.68376} \times 0.04255=\underline{\underline{6.24cc/55\ GAL.}}$$

NOTE:

THE LFL VALUES ARE REPORTED AT 25°C(77°F) THE LFL VALUE DECREASES AT HIGHER TEMPERATURE. BUREAU OF MINES BULLETIN 627 SUGGESTS THAT THE LFL VALUE BE CORRECTED FOR TEMPERATURE ACCORDING TO THE FORMULA:

$$L_t = L_{25} * [\ 1 - 0.000784(t - 25°C)]$$

WHERE t = OVEN TEMPERATURE IN °C.
USING THIS FORMULA, LFL VALUES FOR OPERATING TEMPERATURES ABOVE 25°C NEED TO BE CORRECTED BY THE FOLLOWING FACTORS:

OVEN TEMPERATURE	LFL CORRECTIVE FACTOR
77°F(25°C)	1.00
212°F(100°C)	0.94
300°F(149°C)	0.90
400°F(204°C)	0.86
500°F(260°C)	0.82

REQ	ITEM	PART NO.	DESCRIPTION

LIST OF MATERIALS

DO NOT CHANGE WITHOUT AGENCY APPROVAL

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE
TOLERANCES: DEC. ± FRACT. ± ANG. ±

FM CALIBRATION GUIDE FOR SNR670 SERIES

CLIENT — SPEC. NO.

CONTROL INSTRUMENTS Corporation
25 Law Drive
Fairfield, N.J. 07004 U.S.A.

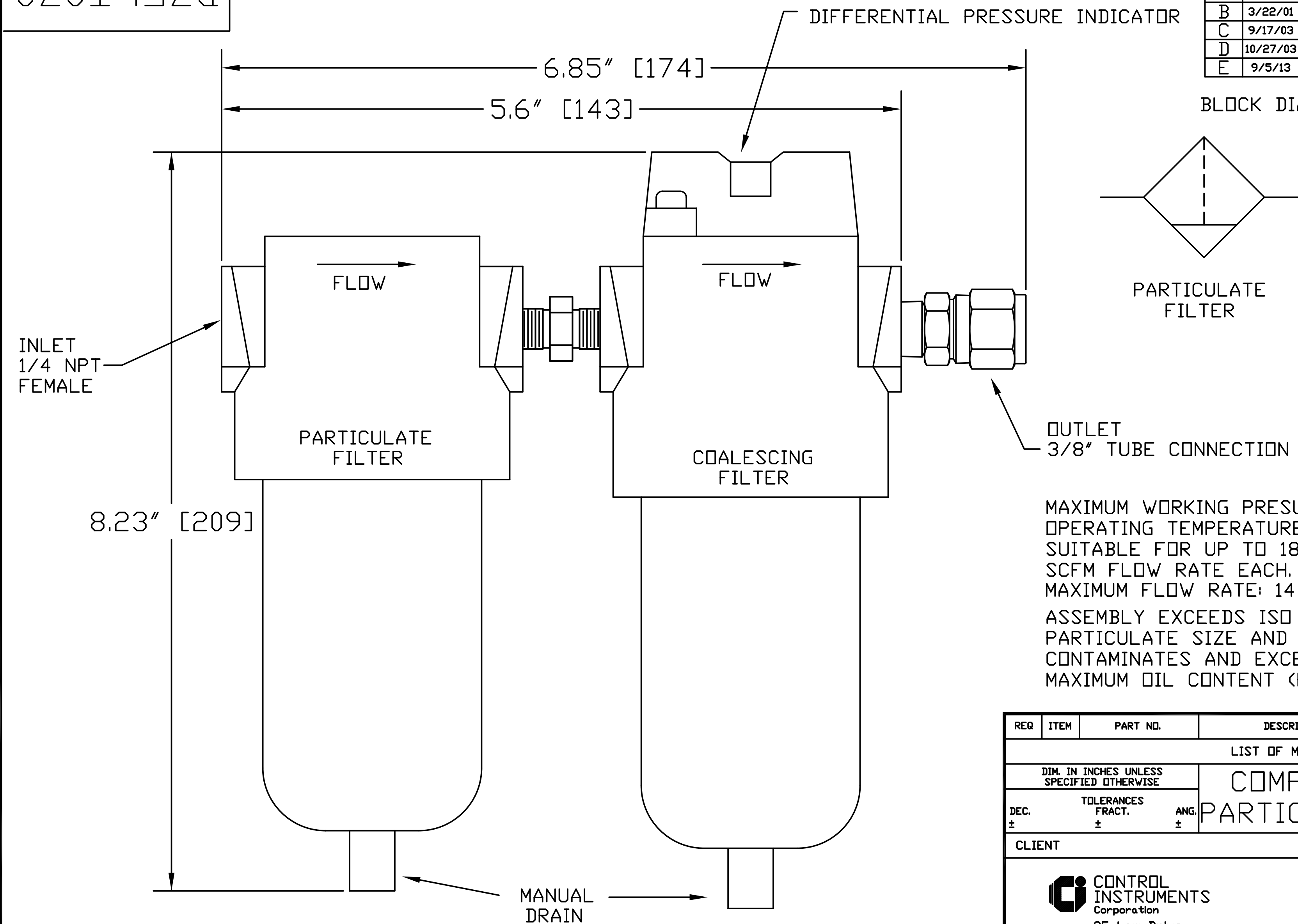
DWN.	PKP	ENGR.	PKP	SCALE	
DATE	03/21/00	DATE	03/21/00	REVISION	A
DRAWING NO.	C7CAL129				

Customer / Field Drawings

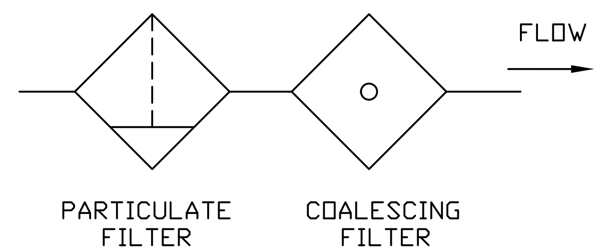
The drawings which follow represent field connections and wiring.

B7FLT070

SYM	DATE	BY	REVISIONS
A	2/10/00	JI	CREATED DRAWING
B	3/22/01	GW	ADD FLOW DIRECTION
C	9/17/03	GW	FITTING WAS 1/4"
D	10/27/03	GW	MAKE BOM FITTING CHANGE
E	9/5/13	GW	CHANGE TO "18" SERIES



BLOCK DIAGRAM



MAXIMUM WORKING PRESURE: 150 psig (10 bar)
OPERATING TEMPERATURE: 32° TO 150°F (0° TO 65°C)
SUITABLE FOR UP TO 18 ANALYZERS AT 0.75
SCFM FLOW RATE EACH.
MAXIMUM FLOW RATE: 14 SCFM (396 LPM)

ASSEMBLY EXCEEDS ISO CLASS 1 FOR MAXIMUM
PARTICULATE SIZE AND CONCENTRATION OF SOLID
CONTAMINATES AND EXCEEDS CLASS 1 FOR
MAXIMUM OIL CONTENT (PPM/WT).

REQ	ITEM	PART NO.	DESCRIPTION

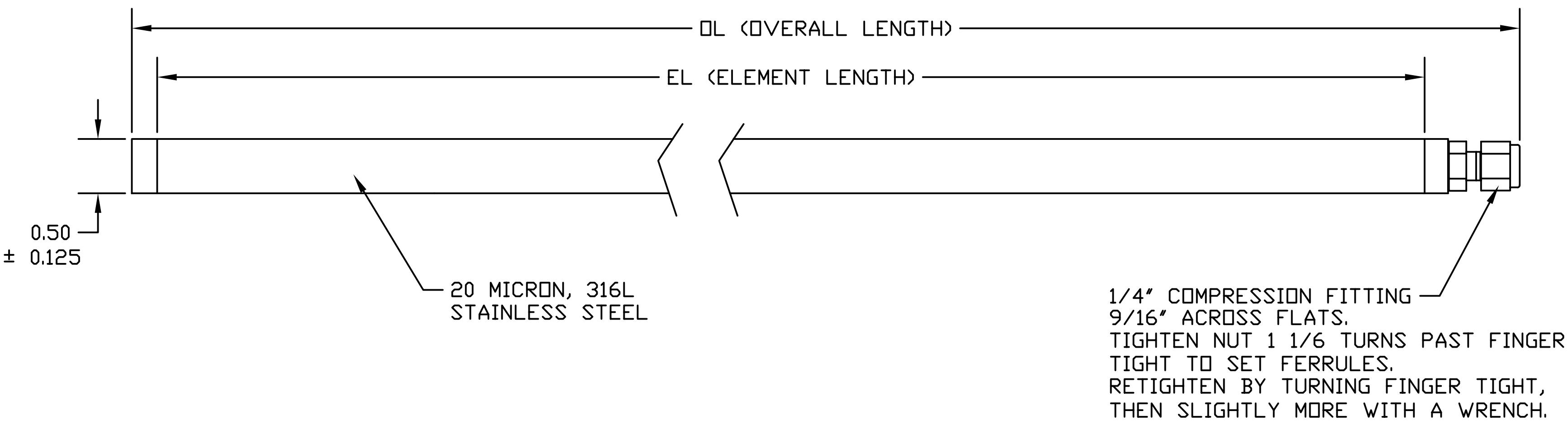
LIST OF MATERIALS

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE	COMPRESSED AIR LINE PARTICULATE/COALESCING
TOLERANCES DEC. ± FRACT. ± ANG. ±	
CLIENT	SPEC. NO.

CONTROL INSTRUMENTS Corporation 25 Law Drive Fairfield, N.J. 07004 U.S.A.	DWN. S.A.A.	ENGR. J.I.	SCALE 1=1
	DATE 2/10/00	DATE 2/10/00	REVISION E
	DRAWING NO. B7FLT070		

B7FLT067

SYM	DATE	BY	REVISIONS



FILTER NUMBER	DIMENSION EL	DIMENSION OL
FLT067	12"	13"
FLT083	6"	7"
FLT084	24"	25"

REQ	ITEM	PART NO.	DESCRIPTION

LIST OF MATERIALS

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE

TOLERANCES: DEC. ± FRACT. ± ANG. ±

END OF LINE FILTER

CLIENT

SPEC. NO.

CONTROL INSTRUMENTS
Corporation
25 Law Drive
Fairfield, N.J. 07004 U.S.A.

DWN. GW | ENGR. GW | SCALE
DATE 4/30/03 | DATE 4/30/03 | REVISION

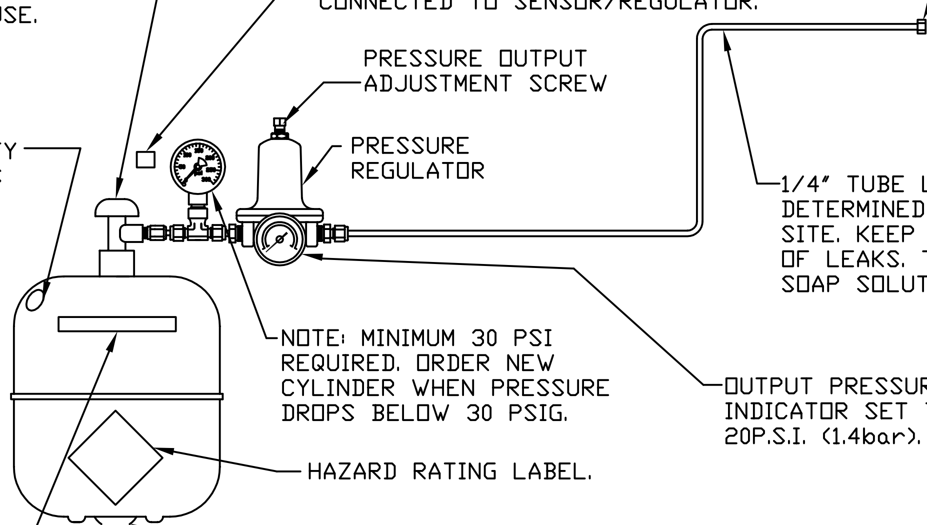
DRAWING NO. B7FLT067

B7CAL130

INSTRUCTIONS:

1. ATTACH REGULATOR INLET TO CALIBRATION CYLINDER.
2. ATTACH REGULATOR OUTLET TO SENSOR CALIBRATION INLET USING 1/4"O.D. TUBING.(NOT PROVIDED)
3. OPEN CYLINDER "SHUT OFF" VALVE.
4. SET REGULATOR OUTPUT PRESSURE TO 20p.s.i. (1.4bar).
5. LEAK TEST ALL LINES AND FITTINGS.

SYM	DATE	BY	REVISIONS
A	12/6/04	GW	ADD CAL. MINUTES



TO SENSOR CALIBRTION INLET

SHUT OFF VALVE MUST BE CLOSED SECURELY WHEN NOT IN USE.

PLUG-REPLACE WHEN NOT CONNECTED TO SENSOR/REGULATOR.

PRESSURE OUTPUT ADJUSTMENT SCREW

PRESSURE REGULATOR

POP-OUT SAFETY PLUG RELEASES AT 650 psi.

1/4" TUBE LINE. LENGTH DETERMINED AT INSTALLATION SITE. KEEP FITTINGS FREE OF LEAKS. TEST WITH LIQUID SOAP SOLUTION.

NOTE: MINIMUM 30 PSI REQUIRED. ORDER NEW CYLINDER WHEN PRESSURE DROPS BELOW 30 PSIG.

OUTPUT PRESSURE INDICATOR SET TO 20P.S.I. (1.4bar).

HAZARD RATING LABEL.

IDENTIFICATION LABEL CONTAINS: CONTENTS, KIT NUMBER, & REPLACEMENT CYLINDER NUMBER.

BULGE INDICATES OVER PRESSURIZED CYLINDER. PREVENTS STEADY POSITIONING. IF OBSERVED, EMPTY CYLINDER IN SAFE AREA & DISCARD.

NOTES:

1. CYLINDERS ARE DISPOSABLE NOT TO BE REFILLED. EMPTY IN SAFE AREA BEFORE DISCARDING.
2. HARDWARE KIT DOES NOT INCLUDE CYLINDER OR TUBING.

DIMENSIONS 9"X16 1/2" (23cmX42cm) CONTAINS 6.4 FT^3 @ 250psi (182 LITERS @ 17bar) OF USABLE GAS.
CYLINDER: 7LB (3.2 KG)
REGULATOR: 1LB (0.45 KG)

CONTAINES ABOUT 45 MINUTES OF CALIBRATION GAS WHEN USED WITH A PREVEX ANALYZER.

CONTENTS OF CYLINDER	REPL. CYL#	HARDWARE KIT#
1.15% ETHYLENE IN AIR	CYL018	PRV022
100% COMPRESSED AIR	CYL016	PRV022

LIST OF CALIBRATION KITS

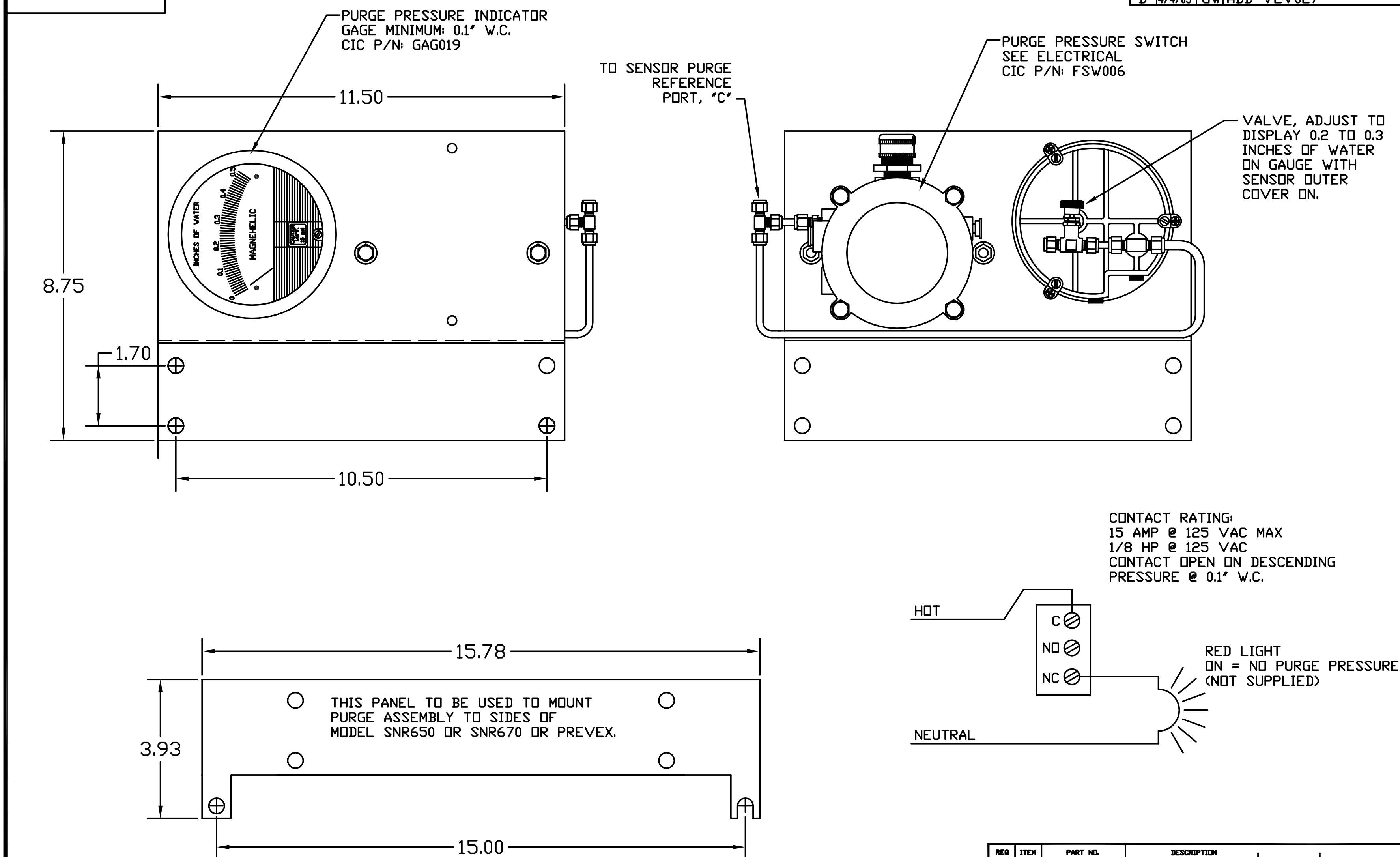
REQ	ITEM	PART NO.	DESCRIPTION

LIST OF MATERIALS

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE TOLERANCES DEC. ± FRACT. ± ANG. ±	CALIBRATION KIT
CLIENT	SPEC. NO.
CONTROL INSTRUMENTS Corporation 25 Law Drive Fairfield, N.J. 07004 U.S.A.	DWN. GW — ENGR. GW — SCALE A DATE 2/15/02 — DATE 2/15/02 — REVISION DRAWING NO. B7CAL130

C7SRV135

SYM	DATE	BY	REVISIONS
A	3/31/03	JI	ADDED PREVEX
B	4/4/05	GW	ADD VLV027

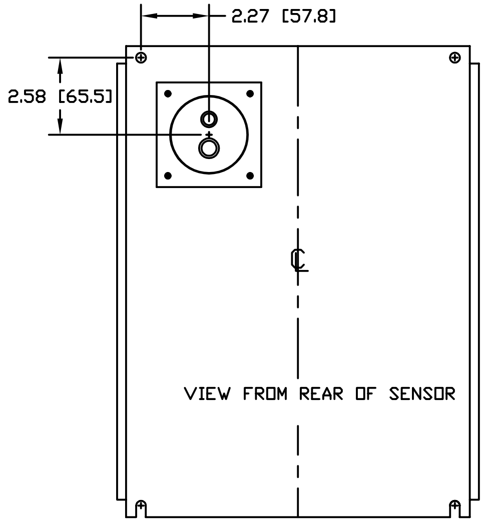


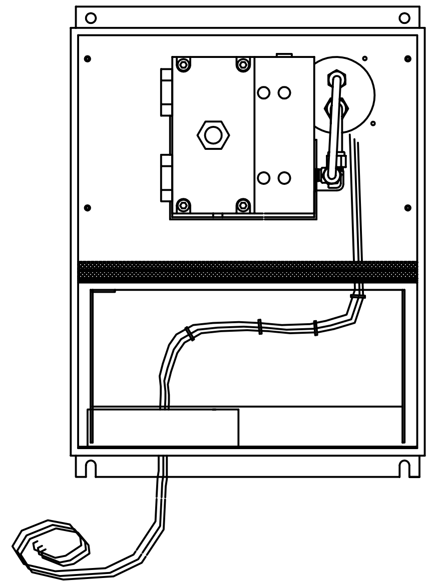
REQ	ITEM	PART NO.	DESCRIPTION
LIST OF MATERIALS			

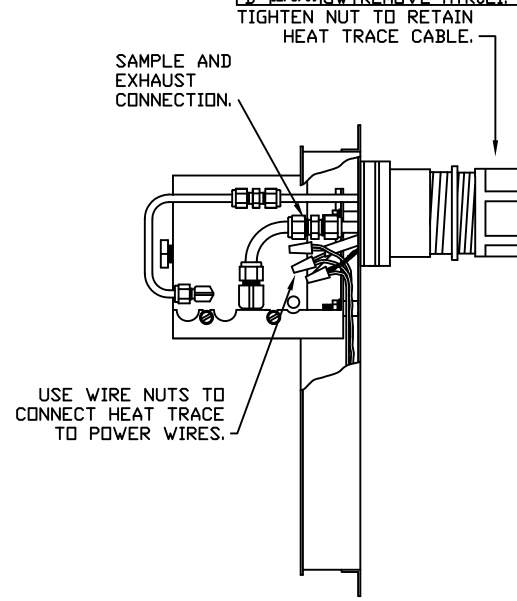
DIM. IN INCHES UNLESS SPECIFIED OTHERWISE TOLERANCES DEC. ± FRACT. ± ANG. ±	INSTALLATION ELECTRICAL "Y" PURGE
CLIENT	SPEC. NO.
CONTROL INSTRUMENTS Corporation 25 Law Drive Fairfield, N.J. 07004 U.S.A.	DWN. P.K.P · ENGR. P.K.P. · SCALE .5=1 DATE 06/02/00 · DATE 06/02/00 · REVISION B DRAWING NO. C7SRV135

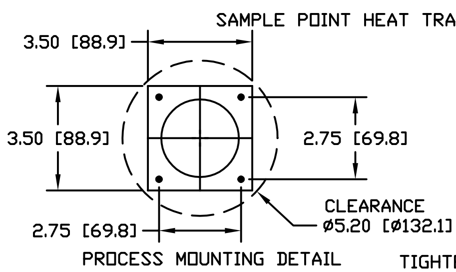
C7HTR070

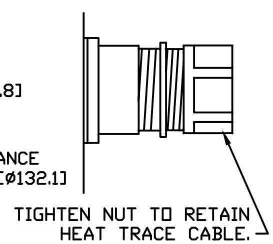
SYM	DATE		
A	6/27/00	GW	CREATE DRAWING
B	2/24/05	GW	ADD NOTE 7.
C	3/15/07	GW	ADD NOTE 8, 9.
D	12/3/09	GW	REMOVE HTR021.











GENERAL NOTES:

1. ALL DIMENSIONS = INCH [mm]

GUIDELINES FOR INSTALLING HEAT TRACE

1. A HEAT TRACED TUBE BUNDLE IS USED WHEN THE SENSOR CANNOT BE MOUNTED AT THE SITE TO BE SAMPLED.
2. THE PURPOSE OF THE HEAT TRACED TUBE BUNDLE IS TO TRANSPORT THE SAMPLE AND EXHAUST VAPORS TO AND FROM THE SOURCE WITHOUT LOSING ANY OF THE SAMPLE TO CONDENSATION.
3. CARE MUST BE TAKEN TO GUARD THE SAMPLE AND EXHAUST TUBES AGAINST COLD SPOTS.
4. CARE MUST BE TAKEN TO GUARD THE ELECTRICAL ENDS OF THE HEATER WIRES FROM WEATHER AND SHORTS.
5. USE HIGH TEMPERATURE ELECTRICAL TAPE WHEN PREPARING HEATER WIRE ENDS.
6. PREVENT EXHAUST GASES FROM MIXING WITH SAMPLE INTAKE.
7. SEE H7HTR066 TO SEAL HEAT TRACE ENDS.
8. INCLUDES SAMPLE POINT HUB, GASKET AND HEAT TRACE CABLE GRIP.
9. HEAT TRACE NOMINAL DIAMETER: 1.75"
   MINIMUM BEND RADIUS: 15"
   POWER CONSUMPTION: 20 WATTS/FT.

REQ	ITEM	PART NO.	DESCRIPTION
			LIST OF MATERIALS

DIM. IN INCHES UNLESS SPECIFIED OTHERWISE
TOLERANCES: DEC. ± 0.01" (0.25) FRACT. ± ANG. ±

SNR670 SERIES HEAT TRACE MOUNTING

CLIENT | SPEC. NO.

CONTROL INSTRUMENTS Corporation
25 Law Drive
Fairfield, N.J. 07004 U.S.A.

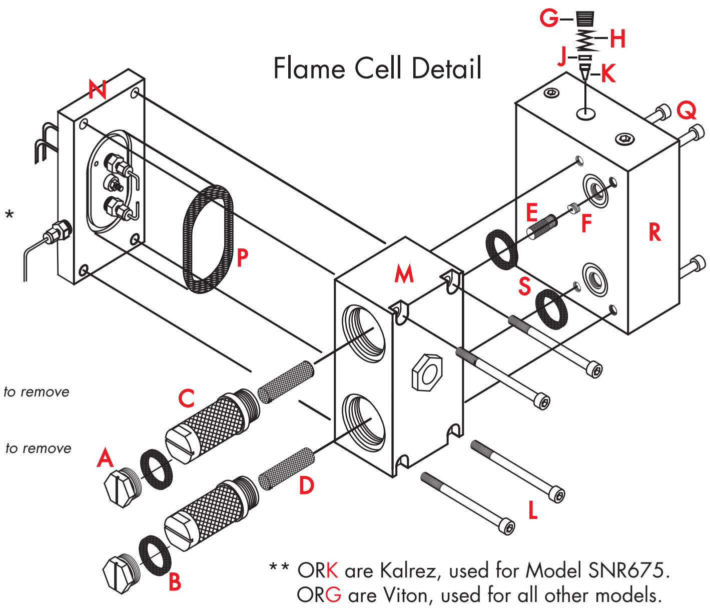
DWN. G.D.W.	ENGR. G.D.W.	SCALE 1=3
DATE 8/3/00	DATE 8/3/00	REVISION D
DRAWING NO. C7HTR070		

! Before disassembly make sure you have replacements for ALL O-Rings! Always replace O-Rings after removal, or if they are brittle or damaged.

! Check for leaks and recalibrate after any maintenance procedure to verify proper operation.

Disassembly Sequence	Preventative Maintenance *	Low Flow Troubleshooting *	Reassembly Sequence	Part Name, Quantity, and Number
Step 1	X	Step 1	Step 9	Sample/Exhaust Tube and Leak Check
Step 2	Step 1	Step 2	Step 8	A Flame Arrestor Cap (2) : SNP188
Step 3	Step 2	Step 3	Step 7	B Flame Arrestor O-Ring (2) : ORG005 or ORK005 **
Step 4	Step 3	Step 4	Step 6	C Flame Arrestor (2) : SNP189 *Hand tight -1/8th of a turn*
Step 5	Step 4	Step 5	Step 5	D Filter Element (2) : FLT012
Step 6		Step 6	Step 4	E Orifice Filter : FLT087 *Use 10" Quick Wedge screwdriver (TOL044) to remove*
X		Step 7	X	F Sample Flow Orifice : ORF024 *Use 1/8" Allen Key (TOL046) to remove*
X	* For each step in these procedures, remove, inspect, and clean part, if necessary replace it.	Step 8	X	Aspirator Nozzle G Plug : PLG002 *Use 1/4" Allen Key to remove* H Spring : SPR013 J Spacer : SPC009 K Nozzle : NZL001
Step 7			Step 3	Flame Cell L Bolts (4) : MSC023 *Use 5mm Allen Key to remove* M Flame Cell Block : SNP219 N Burner Plate : SNP215 P O-Ring : ORG044 or ORK046 **
Step 8			Step 2	Aspirator Q Bolts (4) : MSC007 *Use 5mm Allen Key to remove* R Aspirator Block : SNP359 S O-Ring (2) : ORG041 or ORK047 **
			Step 1	Thermocouple Alignment Detail: Use Gap tool TOL047

Flame Cell Detail



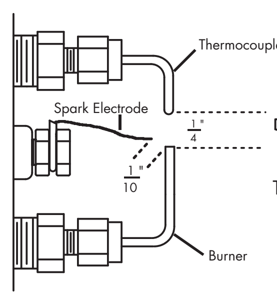
** ORK are Kalrez, used for Model SNR675. ORG are Viton, used for all other models.

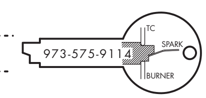
Leak Check

! Check the analyzer for leaks. Plugging the sample inlet tube should reduce the sample flow to near 0 LPM, as indicated in the GAUGES menu.

Thermocouple Detail

! The thermocouple is aligned directly above the burner, 1/4" away.





Thermocouple Gap Tool

! The electrode is located 1/10" behind and above the back edge of the burner.

How to Display and Change a Setting

- Press Menu to move between menus → Press Select to enter menu
- Press Menu again to display registers → Press Select again to display register's value
- Press Select yet again, to change a setting → ! *Wait until flashing stops to keep the new setting* / ! *Press* Menu *to escape and keep the old setting*
- Press Menu to go to next register

Press Select on EXIT register to leave menus

! After 3 minutes of inactivity the display automatically exits the menu

Menu Explanations

Menus	Registers	
COMMANDS	RESET	*Clear latched alarms and peak readings, retry ignition*
Reset latched alarms	ACKNWLDG	*Clear service needed messages*
Acknowledge service needed messages	ZERO CAL	*Start calibration of zero using air = 0% LFL*
Initiate and control calibrations	SPAN CAL	*Start span calibration using test gas, typically 1.15% Ethylene = 60%*
	FULL CAL	*Automatically zero and then span using test gases*
	ZERO/SPAN/FULL TEST	*Similar to calibration, except no adjustment is made*
	LOCK CAL	*Lock out calibration*
GAUGES	READING	*Flammability reading in % LFL (Lower Flammable Limit)*
Display the reading and status, flow and temperatures, and other operating parameters	STATUS	*Device status, alarms and faults*
	PEAK HI	*Highest reading since last RESET command*
	PEAK LOW	*Lowest reading since last RESET command*
	HSG TEMP	*Operating temperature of the flame cell housing in °C*
	SET TEMP	*Temperature setting for the flame cell housing in °C*
	FLOW	*Sample flow rate in standard liters per minute (LPM)*
	LOW FLOW	*LOW FLOW fault occurs if flow goes below this LPM setting*
	CHK FLOW	*CHK FLOW service needed occurs if flow goes below this LPM setting*
	FLAME	*The temperature of the flame in°C*
CAL MENU	RAW ZERO	*The temperature of the flame in air (at 0% LFL) - from zero calibration*
Calibrate the analyzer reading	RAW SPAN	*Flame temperature increase expected from span calibration*
Display the calibration settings	CAL TIME	*Duration of the calibration in minutes*
	CAL RDNG	*Flammability of the span gas, for example, 1.15% Ethylene = 60% LFL*
	SPAN °C	*Flame temperature increase expected from span gas, for example: 125°C*
	SPEED	*Speed-of-response setting*
	CAL LOCK	*Present state of the calibration lock (ON/OFF)*
ALARMS	WARNING	*Warning alarm setting, % LFL*
Configure alarms	DANGER	*Danger alarm setting, 50% LFL or less*
	RATE	*Rate-of-rise alarm setting (ON/OFF)*
	LATCHES	*Alarm latches - hold until RESET*
	FAIL SAFE	*Relays in failsafe mode - normally energized*
	AUTO IGN	*Automatic reignition of sensing flame, number of retries*
	VERSION	*Software version*
	TYPE	*Analyzer type*
	SERIAL	*Serial number of the analyzer*
OUTPUTS	RLY TEST	Used to activate relays for testing alarms
Test relays and the 4-20 milliamp output	MA TEST	Used to test 4 to 20 milliamp output
Configure relays and controls	4 MA ADJ, 20 MA ADJ	Factory adjustment for milliamp output
	MA CAL	Overrides milliamp output during calibration
	MA FAULT	Overrides milliamp output during faults
	CONTROL 1, CONTROL 2	COMMAND that executes from CONTROL input
	RLY CNFG	Horn relay can be configured as AIR/FUEL cutoff
COM PORT	(See Manual)	
For serial communications settings only		

Monthly Maintenance

Calibration

! Calibrate safely - never calibrate if combustible gases or vapors might be present.

- Turn calibration cylinders on and set pressure at analyzer inlet to 20 PSIG. Do not over or under pressurize.
- Use FULL CAL on COMMANDS menu to initiate the automatic calibration sequence.
- For each analyzer, observe the reading during the calibration process:
  1. Zero LED is on.
  2. Reading is near 0% LFL.
  3. After about one minute (CAL TIME on CAL MENU) reading adjusts to 0% LFL.
  4. Zero LED is off. Span LED comes on.
  5. Reading climbs up to near CAL RDNG, typically about 60% LFL.
  6. After about one minute reading adjusts to CAL RDNG.
  7. Span LED off. Zero LED back on for about 30 seconds to purge. Reading falls back to 0% LFL.

Gauges

- Regularly check the settings and reading on the GAUGES menu.

Alarms

- Use RLY TEST in OUTPUTS menu to activate relays. Verify that the FAULT and DANGER relays activate the E-Stop (shut-down, or machine stop).

Notes

- 20 PSIG compressed air allows the analyzer to use fuel safely. Keep the fuel and power off until the air is on and checked. Compressed air drives the sample flow. Keep air pressure steady and at 20 PSIG or else LOW FLOW may occur.
- The sensing flame is fed by a small flow of fuel. The fuel pressure at the inlet must be high enough to make a stable sensing flame or else the reading may drift.
- The analyzer uses AC power for its heater and electronics. When first turned on, the STATUS will be TEMP LOW and the heater LED will be on until the analyzer temperature (HSG TEMP) reaches its operating temperature setting (SET TEMP). When analyzer reaches operating temperature, the heater LED cycles on/off. Analyzer may still be in fault condition FLAMEOUT.
- When in FLAMEOUT (FLAME temperature less than 450°C), use RESET command to re-ignite sensing flame.