

SAFETY MANUAL

PointWatch Eclipse® Infrared Hydrocarbon Gas Detector SIL 2 Certified Model PIRECL

SAFETY CERTIFIED MODEL PIRECL POINTWATCH ECLIPSE IR GAS DETECTOR

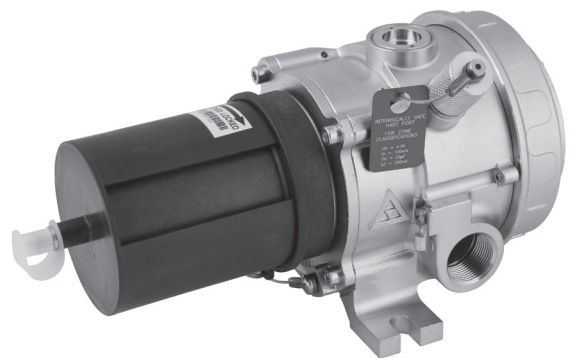
This manual addresses the specific requirements and recommendations applicable to the proper installation, operation, and maintenance of all Safety-Certified (SIL-Certified) PIRECL Pointwatch Eclipse® IR Gas Detector product versions. For complete information regarding performance, installation, operation, maintenance and specifications of the PIRECL, refer to the PIRECL instruction manual. For information regarding the PIRECL EQP Model, refer to the EQP Safety Manual.

SUPPORTING DOCUMENTATION

Description	Document Number
PIRECL Instruction Manual	95-8526
EQP Safety Manual	95-8599

QUALITY POLICY STATEMENT

All quality assurance control measures necessary for safety management as specified in IEC 61508 Part 1 have been implemented. The quality management system of Det-Tronics is based on the requirements of EN ISO 9001 and ANSI/ASQC Q9001 through the application of the United Technologies Company Achieving Competitive Excellence (ACE) program. In addition, the Quality Management System complies with the European ATEX Directive, EN ISO/IEC 80079-34, and supervised testing requirements per ISO 17025.



SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of personnel performing the operations. Information that raises potential safety issues is indicated by the word “Warning”. Always read and understand these safety messages.

WARNING

The PIRECL is intended for use in hazardous environments that may include explosive levels of flammable gases and vapors. This product must be properly installed, operated and maintained. Improper installation or use could result in an explosion or fire resulting in death or serious injury.

- *Do not remove the transmitter cover in explosive environments when device power is on and circuits are live.*
- *Detector must be properly installed, and wiring compartment cover must be fully engaged to meet hazardous area explosion-proof/non-incendive requirements.*

DESIGN

The PIRECL is an infrared hydrocarbon gas detector that is classified as Type B smart device according to IEC61508. It provides an isolated 4-wire 4-20 mA output that is proportional to hydrocarbon vapor concentrations from 0-100% lower flammable limit (LFL). The PIRECL contains extensive self-diagnostics and is programmed to send the current output to a specified failure state (3.6 mA or less) upon internal detection of a failure. Optional Alarm and Fault relay contact outputs are available in addition to the analog signal output, and can be programmed in the field by the user. The Safety Certification for the PIRECL includes both the standard version with analog output only and the version with analog output and optional relay outputs.

Safety-Certification of the PIRECL includes:

- the High Alarm, Low Alarm, and Fault relay outputs
- the 4-20 mA output.

RS-485 Modbus signal output is not part of the SIL certification.

Det-Tronics FlexVu® UD20 Universal Display Unit has been evaluated as a loop-powered device approved for use in-line with a Safety-Certified PIRECL. Failure rates for the PIRECL when connected to a UD20 are listed in the Failure Rates table at the end of this manual.

Non-Interfering Interfaces

Safety-Certification of the PIRECL includes the following non-interfering interfaces:

- LEDs
- Magnetic switches
- HART Communication

The HART communication protocol is non-interfering and is to be used for diagnostics within the SIL 2 safety loop in the Safety operation mode. Diagnostics are defined as read only information. Local HART communication with the PIRECL via the onboard intrinsically-safe communication port using a handheld HART field communicator, or AMS program connected to the 4-20 mA output, is acceptable. Proper analog signal loop resistance must be installed as documented in the instruction manual to enable local HART communication. The end user must perform calibration after any configuration changes.

VALID INPUT RANGE

PIRECL fault and alarm annunciation is provided on the 4-20 mA signal output loop by signaling to a specific mA current output level. The user SIF must monitor the 4-20 mA output for fault and alarm conditions and take appropriate action according to the specific requirements of the SIF. The receiving device must be programmed to indicate a fault condition when current levels reach under-current of 3.6 mA or less or over-current of 21 mA or more.

NOTE

The PIRECL analog signal output is not safety-rated during detector warm-up, configuration mode, calibration mode, and during signal output loop testing. Alternative means should be used at the job site to ensure facility safety during these activities.

DIAGNOSTIC RESPONSE TIME

The PIRECL will perform all critical diagnostic functions within one hour, worst case diagnostic detection time.

CERTIFICATION

The PIRECL Safety-Certified version is certified SIL 2 Capable by *exida*® to IEC61508 for single input use in low demand, SIL 2 Safety Instrumented Systems.

SAFETY-CERTIFIED PRODUCT IDENTIFICATION

Safety Certification of all PIRECL models meeting SIL 2 safety standards is clearly identified on the product label.

INSTALLATION

NOTE

For complete information regarding performance, installation, operation, maintenance and specifications of PIRECL, refer to the PIRECL instruction manual.

No special or additional detector installation requirements exist above and beyond the standard installation practices documented in the PIRECL instruction manual.

Environmental operating specifications for the PIRECL are applicable as published in the general specifications section in the PIRECL instruction manual. The device shall not be exposed to environments that exceed its specified environmental limits.

The PIRECL operating power distribution system should be designed and installed so that the terminal voltage does not drop below 18 Vdc when measured at any specific location. The external system providing power to the PIRECL must have over-voltage protection that ensures supply voltage does not exceed 33 Vdc.

The user shall correctly install all shielding and grounding for the device and ensure that maximum cable lengths are not exceeded.

NOTE

All safety functions of the PIRECL are active within 2 minutes of power-up without any user action required.

COMMON MISUSE SCENARIOS

Refer to the Installation, Startup, and Maintenance sections of the instruction manual for information on avoidance and resolution of common misuse scenarios. No special application restrictions are necessary to meet the safety certification requirements.

NOTE

If the user suspects that damage or misuse has occurred to the PIRECL, a full proof test shall be performed.

GENERAL APPLICATION CONSIDERATIONS

- The user shall understand the effects of and limit the number of devices that are voted to declare alarm.
- The user shall understand the effects of the Alarm Level set points and limit the threshold so that desired SIF hazard detection is achieved.

START-UP AND COMMISSIONING

Commission Personnel

The Safety Certified PIRECL can be commissioned by any qualified person with knowledge of gas detection instruments and the configuration device being used. Refer to the Start-Up and Commissioning section provided in the PIRECL instruction manual.

Relay Configuration Requirements

The end user must provide transient and current limiting on the output contacts of the relays. The maximum relay contact output must be limited to 2 amperes at 30 Vdc. The load must be a resistive load. The user must protect against transients by using standard protection methods such as proper grounding of shielded wire and separation of relay load wires from other lines carrying rapidly switched high current (e.g. large motor power supply lines).

If the 4-20 mA analog output is not being monitored for fault conditions, the status of the fault relay must be monitored and appropriate action taken.

The fault relay is configured for normally energized operation.

Table 1—Frequency for Performing Proof Tests

PIRECL Proof Test Name	Commissioning	Frequency
Visual Field Inspection Proof Test	Yes	As needed, depending on level and type of contaminants present
Response Proof Test	Yes	1 year

Configuration

A HART handheld communication device can be used to monitor internal status or to modify the factory settings of the PIRECL. Refer to the PIRECL HART Communication Appendix in the PIRECL instruction manual for guidance on using HART communication.

Alternate protection measures must be used as needed while modifications to safety related parameters are being made.

While in the process of calibrating the detector, it is not able to signal an alarm. During this time, the device is not performing its safety function.

NOTE

Prior to device configuration, all alarm outputs must be bypassed. The device is not safety certified during configuration change activities.

NOTE

All configuration changes to the PIRECL must be verified by the user via a proof test, power cycle and re-check of settings, or other appropriate method. The safety functionality must be validated prior to reliance on the product for safety protection.

Configuration Protection

Upon completion of installation and commissioning, it is required that the user password-protect the safety related parameters that are accessible via HART in order to prevent accidental or deliberate change of configuration data during normal operation. To password protect the PIRECL, the user must set the write-protect function to “on” and enter an 8 character password. The user should check the write protect status to ensure that it is set to “on”.

The user will be required to disable write protect prior to any future configuration changes, and must re-enable write protect upon completion of these changes to ensure that HART communication remains non-interfering.

OPERATION, MAINTENANCE, INSPECTION AND PROOF TESTING

All normal installation and startup recommendations as documented in the STARTUP section of the PIRECL instruction manual are applicable to the Safety Certified PIRECL.

Safety-Certified PIRECL models require Proof testing to be performed in all cases.

Personnel performing Proof Test procedures shall be competent to perform the task. All proof test results must be recorded and analyzed. Any corrective actions taken must be documented in the event that an error is found in the safety functionality. The proof tests must be performed prior to commissioning the device and at least as often as specified in Table 1.

 **WARNING**

Failure to perform the specified testing and inspection may lower or void the SIL rating for the product or system.

VISUAL FIELD INSPECTION PROOF TEST

Tools Required: None

Visual inspection of all Safety-Certified PIRECL models shall be conducted as needed to confirm that no external blockage of gas/vapor path into the sensing chamber exists, eg. debris, trash, snow, mud, external equipment, etc. Corrective action shall include removal of such impediments should they exist. All gas detectors must be inspected to ensure that they are capable of providing expected performance and protection. PIRECL provides an onboard status LED that indicates Green color upon inspection when internal operational parameters are normal. Abnormal operating parameters are indicated by Amber color (Fault) or Red color (Gas Alarm).

Completion of Visual Field Inspection Proof test must be recorded and documented in the SIS logbook.

RESPONSE PROOF TEST

Tools Required: Compressed Calibration Gas Kit provided by Det-Tronics

This proof test, commonly referred to as a “gas bump test”, requires application of high accuracy compressed calibration gas to the detector while in NORMAL operational mode and inspecting the signal output level to ensure that the signal output is accurately indicative of the applied test gas concentration.

WARNING

Any external alarm equipment, systems or signaling devices that could be automatically initiated by performing this test must be disabled or bypassed before performing this test!

NOTE

If proof testing a PIRECL model without the optional relay outputs, disregard those parts of the proof test sequence.

Response Proof Test Sequence

1. Inhibit alarm and fault response at the control device.
2. Apply test gas to the PIRECL. The test gas concentration should be sufficient to trip both the Low and High alarm relay outputs.
3. Verify correct change of state at the control device for both the alarm relay outputs and the 4-20 mA output. Criteria for the 4-20 mA inspection pass of a gas detector is a response signal within $\pm 3\%$ of applied gas concentration (generally, a 50% LFL test concentration is applied).
4. Remove the test gas and ensure that the unit returns to normal operation.
5. Relay output only: induce a fault to the PIRECL. Suggested fault induction methods are listed below:
 - Remove the weather baffle, then block the beam.
 - Remove input power to the PIRECL.
6. Relay output only: verify correct change of state at the control device for the fault relay output.

7. Relay output only: correct the fault condition and ensure that the unit returns to normal operation.
8. Re-activate the alarm and fault response at the control device.

If the response test is not within acceptable limits, a Full Calibration procedure must be performed and Response Proof Test re-performed.

Full Calibration

Tools Required: Compressed Calibration Gas Kit provided by Det-Tronics
MagnetorHARTFieldCommunicator

Full Calibration shall be conducted when required as documented in the Calibration section of the PIRECL instruction manual. It is permissible to conduct the Full Calibration using either the onboard magnetic calibration switch or using an approved HART handheld field communicator. In all cases the PIRECL should be allowed to warm up for one hour minimum before conducting calibration.

NOTE

The last seven (7) Full Calibration procedures are logged with a time stamp (operating hour units) in the PIRECL onboard memory.

Successful completion of the Response Proof Test must be recorded and documented in the SIS logbook.

WARNING

Any external alarm equipment, systems or signaling devices that were disabled must be re-activated at the conclusion of proof testing activities.

NOTE

The use of the Full Calibration test shall be limited to maintenance and proof test activities.

FAULT/FAILURE ACTION PLAN

In the event that a Full Calibration does not result in acceptable Response Proof test, then the standard Maintenance, Troubleshooting, and Device Repair and Return procedures as listed in the PIRECL instruction manual must be followed. Any failure to successfully complete the Response Proof Test must be recorded and documented in the SIS logbook.

PRODUCT REPAIR

The PIRECL is not field repairable, and any internal device repairs must be conducted at the factory. No firmware changes are permitted or authorized. All failures detected by the transmitter diagnostics or by the Proof Test that cannot be resolved through the procedures described in the FAULT/FAILURE ACTION PLAN section must be reported to the manufacturer.

OPERATING, ENVIRONMENTAL, AND PERFORMANCE SPECIFICATIONS

The operating temperature range for the Safety Certified PIRECL is -55°C to $+75^{\circ}\text{C}$ for the analog output and -40°C to $+75^{\circ}\text{C}$ for the relay outputs. Other environmental operating specifications are applicable as published in the general specifications section in the PIRECL instruction manual. The Safety-Certified PIRECL product versions fully comply with, and must be operated in accordance with the functional, environmental, and performance specifications provided in the PIRECL instruction manual. A 24 hour mean time to repair should be assumed for safety availability calculations.

SPARE PARTS

Refer to "Ordering Information" in the PIRECL instruction manual. Safety Certification is based on a sufficient number of spares to achieve a 24 hour mean time to repair.

CERTIFICATION AND FAILURE RATE DATA

All Safety-Certified PIRECL models are certified compliant to:

IEC61508: 2010

Type B Element

Systematic Capability: SIL 2 certified

HFT: 0

Low Demand Mode

PFDavg should be calculated for any safety instrumented function using the PIRECL. (Refer to FMEDA report for necessary information, including DU rate.)

Safety accuracy: $\pm 10\%$ of applied gas concentration

Safety Response Time: Refer to the PIRECL instruction manual for details.

Product Life (Typical): 45 years @ 40°C
15 years @ 75°C

(Based on database 217 Plus, Version 2, 'Industrial' profile).

All failure rate data for SIL verification is in the FMEDA report, which is available upon request.

ADDITIONAL CERTIFICATIONS

FM, CSA, ATEX, CE, and others.

Refer to the PIRECL Instruction Manual for details.

For complete information regarding performance, installation, operation, maintenance and specifications of PIRECL, refer to instruction manual 95-8526.

TERMS AND DEFINITIONS

AMS	Asset Management System
DU	Dangerous Undetected
FMEDA	Failure Mode Effects and Diagnostics Analysis
HART	Highway Addressable Remote Transducer
HFT	Hardware Fault Tolerance
LFL	Lower Flammable Limit
PFD	Probability of Failure on Demand (Probability of Dangerous Failure)
PFDavg	Average Probability of Failure on Demand
PIRECL	Pointwatch Eclipse® IR Gas Detector
SFF	Safe Failure Fraction
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
UD20	FlexVu® Model UD20 Universal Display

IEC 61508 Failure Rates in FIT¹

Failure Category	λ_{sd}	λ_{su}^2	λ_{dd}	λ_{du}	SFF ³
PIRECL IR Gas Detector, Analog Output	0	46	1655	123	93.3
PIRECL IR Gas Detector, Relay Output	106	222	1335	130	92.7
PIRECL IR Gas Detector with UD20 Universal Display, Analog Output	0	46	1691	142	92.5
PIRECL IR Gas Detector with UD20 Universal Display, Relay Output	106	222	1371	149	91.9

¹ FIT = 1 Failure / 10⁹ Hours

² It is important to realize that the No Effect failures are no longer included in the Safe Undetected Failure category according to IEC 61508, ed2, 2010.

³ Safe Failure Fraction needs to be calculated on (sub)system level.



95-8630



FlexSonic® Acoustic
Leak Detector



X3301 Multispectrum
IR Flame Detector



PointWatch Eclipse® IR
Combustible Gas Detector



FlexVu® Universal Display
with GT3000 Toxic Gas Detector



Eagle Quantum Premier®
Safety System

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Det-Tronics manufacturing system is certified to ISO 9001—
the world's most recognized quality management standard.



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