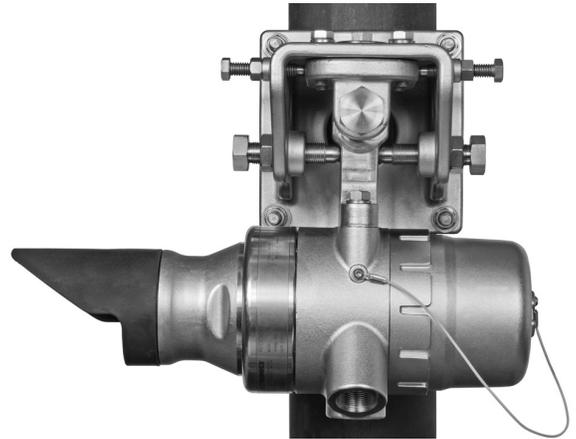
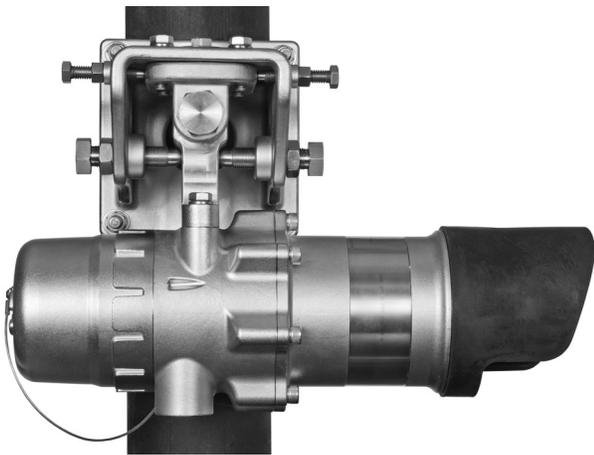


## **SAFETY MANUAL**

### FlexSight™ Line-of-Sight Infrared Hydrocarbon Gas Detector Model LS2000



#### **SAFETY CERTIFIED MODEL LS2000 LINE-OF-SIGHT 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) FlexSight™ Line-of-Sight IR Gas Detector product versions. For complete information regarding system overview, performance, installation (including alignment), operation, maintenance and specifications of the Model LS2000, refer to instruction manual 95-8714.

#### **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 Model LS2000 Gas Detector 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 wiring compartment 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.*
- *Before connecting a HART field communicator to the LS2000 IR Gas Detector in a potentially explosive atmosphere, make sure the field communicator is suitable and approved for use in the specific area.*

## DESIGN

The Model LS2000 Line-of-Sight Gas Detector 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 0-5 LFL-meters. The LS2000 contains extensive self-diagnostics and is programmed to send the current output to a specified failure state upon internal detection of a failure (see LS2000 instruction manual for fault output level details). 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 LS2000 Gas Detector includes both the standard version with analog output only and the version with optional relay outputs. The relay output and analog output are not to be used in combination for the safety function.

Safety-Certification of the LS2000 includes:

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

The HART communication protocol is non-interfering and can 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 LS2000 IR Gas Detector is acceptable. Proper analog signal loop resistance must be installed as documented in the instruction manual to enable local HART communication.

## VALID INPUT RANGE

LS2000 fault annunciation is provided on the 4-20 mA signal output loop by signaling to a specific mA current output level. The receiving device must be programmed to indicate a fault condition when current levels reach an under-current level of 3.6 mA or less, or an over-current level of 21 mA or more.

### NOTE

*The LS2000 analog signal and relay outputs are not safety-rated during detector warm-up, alignment mode, calibration mode, or 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 LS2000 Infrared Gas Detector will perform all critical diagnostic functions within 1 hour, worst case diagnostic detection time.

## CERTIFICATION

The LS2000 Safety-Certified version is certified by *exida*® to IEC 61508 Ed. 2 for single input use in low demand, SIL 2 Safety Instrumented Systems.

## SAFETY-CERTIFIED PRODUCT IDENTIFICATION

Safety Certification of all LS2000 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 Model LS2000, refer to instruction manual 95-8714.*

No special or additional detector installation requirements exist above and beyond the standard installation practices documented in the Model LS2000 instruction manual.

Specifications regarding environmental operating conditions for the LS2000 Detector are applicable as published in the general specifications section in the instruction manual. The device shall not be exposed to environments that exceed its specified environmental limits.

The LS2000 operating power distribution system should be designed and installed so the terminal voltage does not drop below 18 Vdc when measured at any specific location. The maximum current limit per transmitter or receiver must be less than 2 amperes. The external system providing power to the LS2000 must have over-voltage protection that ensures supply voltage does not exceed 30 Vdc.

## Common Misuse Scenarios

- Do not install the LS2000 on unstable or vibration prone structures; a 3 meter maximum height is recommend when using a vertical post.
- Do not install the LS2000 below the height of typical human activity unless absolutely necessary in order to prevent nuisance beam block faults.
- Do not install the LS2000 receiver where multiple transmitters are in the line of sight - this is a common concern for pipeline system installations.

### NOTE

*The above common misuse scenarios will cause the LS2000 to announce a fault if the condition is severe enough to compromise the safety function.*

## START-UP AND COMMISSIONING

### Commissioning Personnel

The Safety Certified LS2000 gas detector can be commissioned by any qualified person with knowledge of gas detection instruments and the configuration device being used. Refer to the Start-Up, Alignment and Calibration sections provided in the LS2000 instruction manual.

### Configuration

Digital communication with the LS2000 is necessary to monitor internal status and to modify the factory settings. Appendix D of the LS2000 instruction manual provides guidance on establishing HART communication, and describes the communication menu structure when using the LS2000 with the HART Handheld Communicator.

### NOTE

*Prior to device configuration (setting alarm thresholds, latch/non-latch function, etc.) all alarm outputs must be bypassed. The device is not safety certified during configuration change activities.*

## Relay Configuration Requirements

The LS2000 gas detector's Low Alarm, High Alarm and Fault relay outputs may be used as part of a Safety Certified system. 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 5 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).

### Configuration Protection

Upon completion of installation and commissioning, it is recommended to password-protect the LS2000 programming and setup function using a HART Field Communicator or AMS program to prevent accidental or deliberate change of detector configuration data during normal operation.

## OPERATION, MAINTENANCE, INSPECTION AND PROOF TESTING

All normal installation, start-up, and field calibration recommendations as documented in the STARTUP section of the LS2000 instruction manual are applicable to the Safety Certified LS2000 gas detector.

Safety-Certified LS2000 gas detectors require additional 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 at a frequency as shown in Table 1.



### WARNING

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

Table 1—Frequency for Performing Proof Tests

LS2000 Proof Test Name	Commissioning	Frequency per Year
Gas Response Proof Test	Yes	1
Output Response Proof Test	Yes	1

## GAS RESPONSE PROOF TEST



### 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!*

### Optical Test Film Method (Recommended)

Tools Required: LS2000 System Test Film  
P/N: 012673-001

The test film provides a means of testing the operation of the Model LS2000 IR Gas Detector. When the test film is placed in the beam of the line-of-sight detector, the detector output will rise to a specific value.

The LS2000 test film packet consists of five separate test film cards. A single card can be used, or the cards can be “stacked” to simulate up to five different gas concentrations. Light shining through one card corresponds to the lowest LFL-m for a particular gas, while light shining through all five cards corresponds to the highest LFL-m reading for a particular gas. Table 2 shows the response of the three standard LS2000 gas type settings to each of the five test film values.

Proper operation can be confirmed by bypassing all system alarms, then placing the optical test film into the light beam and checking for the appropriate 4-20 mA output level or relay actuation.

Alarm conditions, if present, should clear when the test film is removed from the beam (in non-latching mode, see LS2000 instruction manual for details).

The test film is typically used to verify the factory calibration of the LS2000. The test film is not intended for routine use. It does, however, demonstrate in a very direct way the response of the detector to hydrocarbons along with the resulting control action. This is particularly useful when required by regulatory authorities.

For complete information regarding proper use of the test film and testing of the LS2000 detector, refer to the LS2000 manual number 95-8714.

## Zero Calibration

Tools Required: Magnet

Zero Calibration shall be conducted when required as documented in the Calibration section of the LS2000 instruction manual. It is permissible to initiate the Zero Calibration using the onboard magnetic switch, digital communication via HART or MODBUS communication, or the remote calibration line. In all cases, the LS2000 gas detector should be allowed to warm up for one hour minimum before conducting calibration.

### NOTE

*The last hundred (100) Calibration procedures are logged with a time stamp in the LS2000 onboard memory.*

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

Table 2—Typical System Response\* in LFL-M (% Full Scale) Using Gas Test Films

Test Film (Number of Cards)	Methane	Butane	Propane
1	0.6 (12%)	1.1 (22%)	1.3 (26%)
2	1.5 (29%)	2.3 (46%)	2.6 (52%)
3	2.5 (50%)	3.6 (72%)	3.9 (78%)
4	3.7 (74%)	4.9 (98%)	5.4 (108%)
5**	5.0 (100%)	6.0 (120%)	6.0 (120%)

\*Accuracy =  $\pm 0.2$  LFL-M or  $\pm 15\%$  LFL-M from typical system response, whichever is greater.

\*\*A HART handheld device is needed to read over-range values.

## OUTPUT RESPONSE PROOF TEST

### NOTE

*The requirements for the Output Response Proof Test can be waived for the 4-20 mA output if a successful Gas Response Proof Test was completed using the 4-20 mA output during the required time frame. Details must be recorded in the SIS logbook.*

### 4-20 mA Output Model

1. Inhibit alarm response at the control device.
2. Use a HART handheld communicator to perform a Loop Test function at 20 mA, or place an Optical Test Film into the detector light beam (refer to Optical Test Film Method section above). Verify correct output at the control device.
3. Remove the optical test film, if necessary, and re-activate alarm response at the control device.

### Relay Output Models

The following should be performed to verify correct alarm and trouble relay activation.

#### Fault Relay

1. Inhibit fault response at the control device.
2. Completely block the light beam with a solid object such as a piece of cardboard until a beam block fault is generated. Verify correct change of state at the control device.
3. Re-activate fault response at the control device.

#### Alarm Relays

1. Inhibit alarm response at the control device.
2. Place the test film into the light beam and verify appropriate relay actuation for the number of cards being used (see Table 2).
3. Remove the test film to return the device to its original state (in non-latching mode). Re-activate alarm response at the control device.

## FAULT/FAILURE ACTION PLAN

In the event that a Calibration does not result in acceptable Gas Response Proof test, then the standard Maintenance, Troubleshooting, and Device Repair and Return procedures as listed in the LS2000 instruction manual must be followed. Any failure to successfully complete the Gas Response Proof Test must be recorded and documented in the SIS logbook and reported to the manufacturer.

## PRODUCT REPAIR

The LS2000 transmitter and receiver electronics modules can be replaced in the field as listed in the Replacing LS2000 Transmitter/Receiver Electronics Module section of the LS2000 instruction manual. Any internal device repairs other than electronics module replacement must be conducted at the factory. No firmware changes are permitted or authorized. All failures detected by the internal diagnostics or by the Proof Test must be reported to the manufacturer.

## OPERATING, ENVIRONMENTAL, AND PERFORMANCE SPECIFICATIONS

The Safety-Certified LS2000 product versions fully comply with, and must be operated in accordance with, the functional, environmental (including EMC considerations), and performance specifications provided in the LS2000 instruction manual. A 24 hour mean time to repair should be assumed for safety availability calculations.

## SPARE PARTS

Refer to "Spare Parts" in the LS2000 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 LS2000 models are certified compliant to:

IEC61508: 2010

Type B Device

Systematic Capability: SIL 2 certified

HFT: 0

Low Demand Mode

PFDavg should be calculated for any safety instrumented function using the LS2000. (Refer to FMEDA report for necessary information, including DU rate.)

4-20mA SFF = 96.0%

Relay SFF = 90.9%

Safety Accuracy:  $\pm 0.2$  LFL-meters or  $\pm 10\%$  of applied gas concentration, whichever is greater.

Safety Response Time: <2 seconds with 5.0 LFL-Meters applied

Product Life (Typical):

Receiver

Transmitter

20 years @ 40°C

30 years @ 40°C

4 years @ 75°C

7 years @ 75°C

(Based on database Windchill Quality Solutions, Jan. 2015, 'Industrial' profile).

Maximum Misalignment:  $\pm 0.8$  degrees.

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

## ADDITIONAL CERTIFICATIONS

FM, CSA.

Refer to the Model LS2000 Instruction Manual for details.

For complete information regarding performance, installation, operation, maintenance and specifications of Model LS2000, refer to instruction manual 95-8714.

## TERMS AND DEFINITIONS

FMEDA	Failure Mode Effects and Diagnostics Analysis
HART	Highway Addressable Remote Transducer
HFT	Hardware Fault Tolerance
LFL	Lower Flammable Limit
LS2000	Line-of-Sight IR Gas Detector
PFD	Probability of Failure on Demand (Probability of Dangerous Failure)
PFDavg	Average Probability of Failure on Demand
SFF	Safe Failure Fraction
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System



FlexSonic® Acoustic Leak Detector



X3301 Multispectrum IR Flame Detector



PointWatch Eclipse® IR Combustible Gas Detector



FlexVu® Universal Display with GT3000 Toxic Gas Detector



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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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