GD10P IR
GAS DETECTOR AND MONITOR

Operating Manual

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1. PRODUCT DESCRIPTION

1.1 General description

The GD10P Gas Detector is a point detector for gas concentration monitoring in potentially hazardous and/or poisonous environments. The GD10P is based on infrared absorption and uses the latest developments in analogue and microprocessor technology. Solid-state design improves reliability, long-term stability and accuracy in continuous measurement of gas concentration in ambient air.

Compared with catalytic sensors, the GD10P has the following advantages:

- The gas flow-rate has no influence on accuracy and can only speed up the response time.
- The presence of oxygen is not required for correct measurement, which makes the GD10P suitable even in an inert gas atmosphere. There is no possibility of poisoning of the detector since no chemical reaction occurs, i.e. silicon vapors and H2S have no effect on the detector or the measurement.
- The detector has the utmost resilience to vibration.
- There are no saturation effects which could lead to false measurements. Thus, the detector is capable of measuring gas concentrations up to 100% vol.
- The detector has a continuous self-test function, and reports faults to the central system.

Total system costs can be dramatically reduced with the GD10P:

- High reliability results in low-test frequency and no calibration costs.
- Voting systems to increase reliability are not required, which reduces the number of detectors up to 66 %.

1.2 Construction

A complete GD10P Gas Detector consists of the following:

- An external gas measuring path where gas is measured by means of IR radiation. A weather protection enclosure is mounted around the measuring path to protect the optical surfaces from rain and dust.
- An opto-electronic unit, which generates IR radiation to the gas measuring path, measures the reflected IR radiation from the gas measuring path and calculates the gas concentration. This unit is enclosed by an EExd certified housing.
- A terminal compartment with cable entry and mini-terminals for electrical connection. The compartment is protected by a cover and is EExe certified.

1.3 Application areas

The GD10P was designed for detection of hydrocarbon gases in hazardous areas on offshore platforms and petrochemical plants, but it can also be used in a variety of other applications.

Due to the unique features and operational excellence of the GD10P, Schauenburg has entered into a technical and commercial collaboration with Simrad Optronics to adopt the detector for underground use worldwide. The mining industry and associated machinery, being the primary market.
The GD10P is housed in a compact stainless steel enclosure, which is certified flame-proof, meeting the requirements of EN 50018.

1.4 Technical data (0-100% LEL methane, 5 sec. response time)

Specification for other types on request

Detection range	0-100% LEL (0-5% Vol.) methane
- option	0-100% Vol. methane
- option	Other gases on request
Long-term stability	Better than ±5% of full scale reading
Accuracy, standard 5 sec.	Better than ±3% of full scale between 0-50 % reading Better than ±5% of full scale between 50-100 % reading
Response time, standard 5 sec.	T50 = 2.5 sec. T90 = 6 sec.
Response time, option 1 sec.	T50 = 1 sec. T90 = 2 sec.
Start-up time	<60 sec.
Self-test	Continuous
Calibration	Factory set
Sensor warnings:	
- Early clean optics	Dirt accumulation on windows (gas measurements interrupted by following signal: 1 mA for 3 sec. at 5 min. intervals)
- Clean optics	Dirt accumulation on windows (1 mA output signal)
- Sensor failure	Internal malfunction in the sensor (0 mA output signal)
Output signal:	
- Standard	Current source 4-20 mA, max. load impedance 500 Ω
- Option	Current sink 4 - 20 mA
Electrical:	
- Power supply	18-32 V DC
- Power consumption	Approx. 3.5 W
- Start-up current	0.3 A for 0.3 sec.
- Electrical connection	3 wires (M20 EExe cable gland)

Temperature range:	
- Storage	-40°C to +70°C
- Operating	-20°C to +45°C
- Operating (option)	-40°C to +60°C
- Humidity (operation)	99% RH non-condensing
Explosion-proof housing:	
- Main compartment	EExd IIC T6
- Terminal compartment	EExe
Protection category	IP66/IP67 DIN 40050
Housing material	Stainless steel SIS2343 (ASTM 316)
Weight, incl. Weather Protection	Approx. 2.9 kg
Accessories	Weather Protection Sample Flow Housing

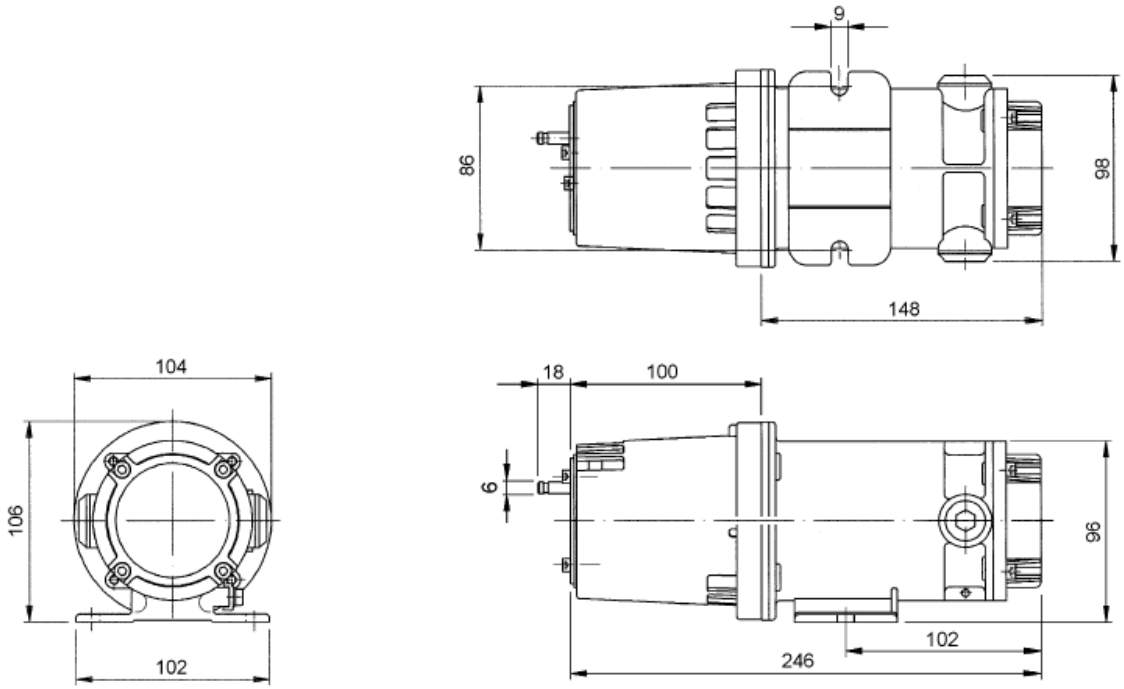


Figure 1.1 GD10P, outline dimensions (mm)

1.5 Certification

The GD10P has been certified according to the requirements for "Electrical apparatus for explosive atmospheres" given by CENELEC in the following standards:

EN 50014 (1977)	Electrical apparatus for potentially explosive atmospheres. General requirements Amendment No. 1 (July 1979) Amendment No. 2 (June 1982) Amendment No. 3 (December 1982) Amendment No. 4 (December 1982) Amendment No. 5 (February 1986)
EN 50018 (1977)	Electrical apparatus for potentially explosive atmospheres. Flame-proof enclosure “d” Amendment No. 1 (July 1979) Amendment No. 2 (December 1982) Amendment No. 3 (November 1985)
EN 50019 (1977)	Electrical apparatus for potentially explosive atmospheres. Increased safety “e” Amendment No. 1 (July 1979) Amendment No. 2 (September 1983) Amendment No. 3 (December 1985)
EN 50054 (1991)	Electrical apparatus for the detection and measurement of combustible gases. General requirements and test methods
EN 50057	Performance requirements for Group II apparatus indicating up to 100 % lower explosive limit
EN 50081-1	Electromagnetic compatibility - Generic emission standard Part 1: Residential, commercial and light industry
EN 50082-2	Electromagnetic compatibility - Generic immunity standard Part 2: Industrial environment
*	Currently being certified for underground use in South Africa with international recognition.

1.6 Certificates

Epsilon x Certificate of Conformity:	NEMKO No. Ex96D321
SIRA Certificate of Conformity No.:	Ex 97Y8025

2. TECHNICAL DESCRIPTION

2.1 Introduction

The GD10P Gas Detector is a point detector for use in hazardous areas. A high stability infrared radiation source combined with the latest developments in optical and electronic design have led to the realization of a compact, accurate and cost-effective instrument able to monitor explosion dangers in real-world environments.

2.2 The GD10P concept

The concept is based on measurement of infrared radiation passing through a volume of gas. The GD10P employs a dual beam, dual wavelength measuring principle with separate optical detectors for maximum stability and reliability.

Since different types of gas have unique absorption spectra, they can easily be identified by proper selection of an infrared wavelength at which absorption is measured. Radiation at another wavelength measures the overall transmission through the optical system and the air volume. By comparing the transmission at the two wavelengths, the gas concentration in the air is determined. Having chosen a wavelength that is characteristic of one type of gas, other types of gas will not cause false alarms.

Using a solid-state IR source instead of a lamp ensures high reliability and long-term stability with no regular maintenance required during equipment lifetime.

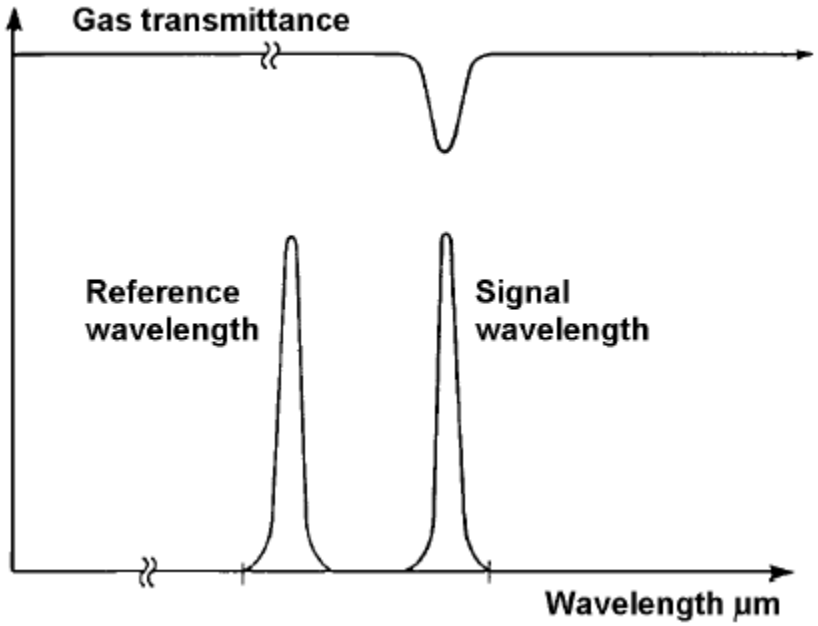


Figure 2.1 Transmittance as a function of wavelength

Refer to Figure 2.2 below:

Radiation from two infrared sources passes through two narrowband filters selecting a measuring wavelength and a reference wavelength. The sources are electronically chopped. Radiation is divided by a beam-splitter into an internal and external path. The internal path is viewed by the compensation detector, and the external path is viewed by the measuring (main) detector. The compensation detector monitors and compensates for drift in sources or detectors. The main detector monitors the external measuring path and detects whether the selected gas is present.

The four signals, two from the compensation detector and two from the main detector, are amplified, digitized and fed to the microprocessor. The signals are used by the microprocessor to calculate the gas concentration. The gas response is then linearized and presented as either a voltage, a current or a digital output signal. Internal signals are compared with test limits to monitor electronics and optical parts. If values outside the test limits are found, specific error messages are given.

Optical filter characteristics remain constant over time, and drift in the other components is monitored and compensated by the dual wavelength, dual path concept. This means that the zero and gas span factory calibration will remain stable regardless of component drift, and that the detector needs no manual recalibration after factory calibration.

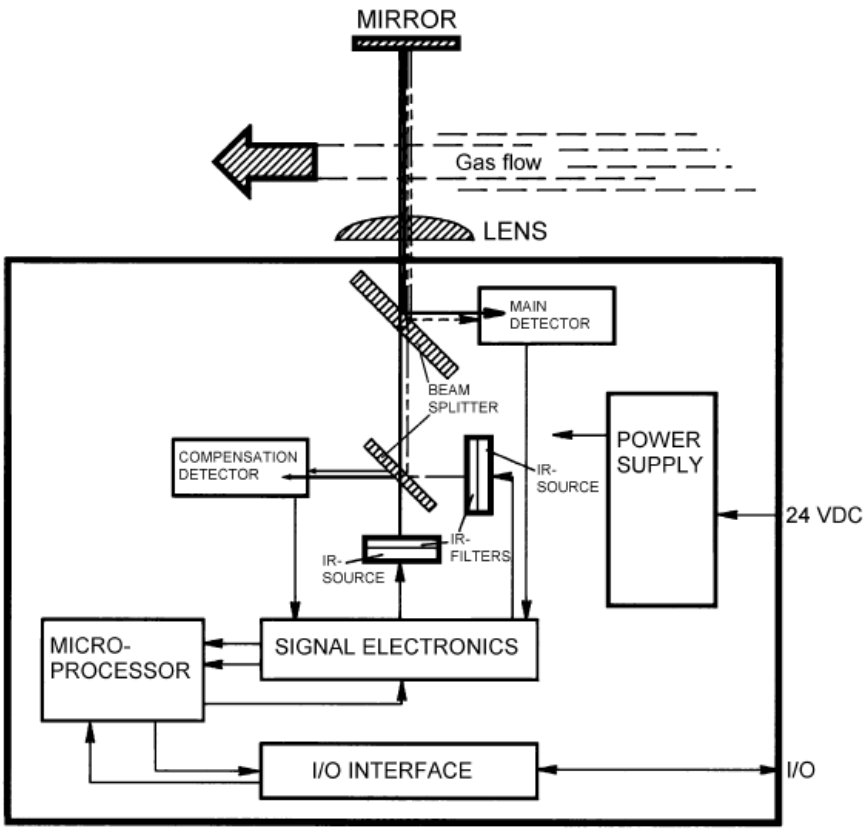


Figure 2.2 Block diagram, GD10P

2.3 Performance characteristics

2.3.1 Gas data

The GD10P standard version is factory calibrated and linearized with methane gas in the 0-100 % LEL range. Calibration / linearization to other gases or concentrations can also be done.

Accurate measurements can only be achieved by having the detector calibrated for the gas it is intended to measure.

Gases such as ethane, propane and butane are also detected by the GD10P. A GD10P calibrated for methane has a higher sensitivity to these gases than to methane. This means that explosion danger from other HC-gases will always be detected by the GD10P.

Because of tolerances in the infrared filters, readings of other gases than methane will not be exact when the detector is calibrated to 100% LEL methane.

Converting % LEL to % v/v is based on ISO 10156, Second edition 1996-02-15: “Gases and gas mixtures - Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets”.

The GD10P is designed for normal atmosphere pressure variation, but it is certified for pressure limits from 86 to 108 kPa.

2.3.2 Cross interference to other gases

Hydrocarbon gases such as methane, ethane, propane and butane are absorbing at a signal wavelength of 3.3 μm. These gases do not interfere at the reference wavelength at 3.0 μm. If the atmosphere to be monitored contains gases such as acetylene that absorb at the reference wavelength of 3.0 μm, misleading measurements may be obtained depending on the interfering gas concentration. A modified GD10P using another reference wavelength will eliminate the problems.

Water vapor, carbon dioxide, oxygen, nitrogen and other gases, which are present in normal air will not influence the measurements.

2.4 Gas detection system

Since the GD10P is a point detector, it must be mounted where gas leakage is most likely to occur. It should be considered whether the gas in question is heavier or lighter than air. The number of sensors recommended depends on room size, shape, airflow and so on. The GD10P can also be mounted on an air duct wall. For this purpose, duct mounting kits are available.

Owing to high reliability and extensive self-testing, the GD10P dramatically reduces the number of sensors needed, and voting between sensors is no longer necessary. As a result, maintenance routines can be relaxed without loosing system confidence and repair work is reduced to a minimum.

3. INSTALLATION

3.1 Mounting the GD10P

3.1.1 Location

The location of each detector should preferably be determined at the system design stage.

NOTE:	The area in which the detector may be mounted must be in accordance with the certification of the detector, and in accordance with the standards of the appropriate authority in the country concerned.

Choice of mounting area:

- The detector should be mounted in a place where maintenance, i.e. cleaning of the optics, is easily performed.
- The detector may be mounted in areas where no oxygen is present.
- The detector may be mounted in areas with strong airflow for example on a vehicle.
- The detector should NOT be mounted where it could be exposed to water drenching.
- The detector may be installed on any mining machinery.

3.1.2 Orientation

The detector should be mounted so that the longitudinal axis of the detector is horizontal. This will prevent accumulation of water and dust on the optics. The Weather Protection must always be oriented correctly for optimal performance.

See “Flow Direction Indicator” in Fig. 3.3 below. Orientation of the Weather Protection is performed as follows:

- Use a screwdriver to loosen the two screws on the Weather Protection
- Rotate the Weather Protection to correct position
- Tighten the screw with a torque of max. 0.5 Nm

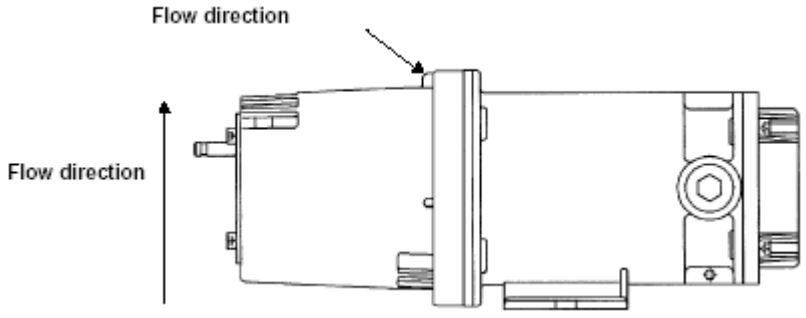


Fig. 3.1 Orientation of GD10P in relation to flow direction

3.1.3 Mounting the GD10P

The detector is mounted by means of a projecting mounting leg using two M8 screws and washers, or by means of the Duct Mounting Flange Kit (4 x M8 screws).

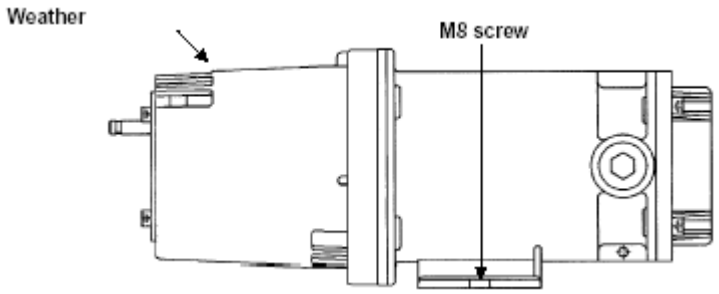


Fig. 3.2 GD10P mounted by means of mounting leg

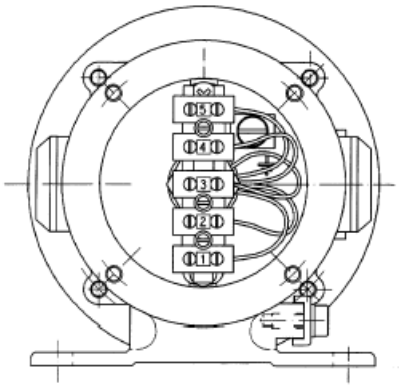
3.2 Electrical connections

3.2.1 Terminal compartment

The terminal compartment is accessible by removing the circular terminal cover. (Loosen the four M5 screws.) Refer to Figure 3.5.

The terminal compartment, including the 5 mini-terminals for electrical connection, is shown in Figure 3.6 below.

The installation wiring enters the terminal compartment via a single M20 EExe cable gland, which can be mounted on either side of the compartment. The unused entry is blanked with an EExe cover.



Terminal 1	+24 V DC
Terminal 2	24 V return (0 V)
Terminal 3	4-20 mA output
Terminal 4	Not used
Terminal 5	Not used

Figure 3.3 Terminal compartment

3.2.2 Output cable connections

The detector has two output modes:
- Current source 4-20 mA (standard)
- Current sink 4 - 20 mA (option)

The mode is factory set.

3.2.2.1 3-wire output cable connection

The cable connections are as follows:

Terminal No l: +24V DC
Terminal No 2: 0 V DC (24 V and signal return)
Terminal No 3: Signal output

The shield of the cable should be connected to instrument earth in the central control module.

3.2.2.2 Retrofit wiring

The GD10P Gas Detector has been designed to be fully interchangeable with existing catalytic sensors, using the same 3-wire cable. In this application however, the detector diagnostics are not available. The Schauenburg Monitoring Unit should always be used in conjunction with the GD10P.

3.2.2.3 Recommended cable types

The cable selected for interfacing the control equipment should be approved for use in the actual area.

It is recommended to use shielded cables. Cables should be of a fine multi-strand type with a cross-section between 0.5 mm² and 1.5 mm²

The cable enters the terminal compartment via an EExe cable gland. Several options of gland fittings are available.

3.2.2.4 Initial wiring checks

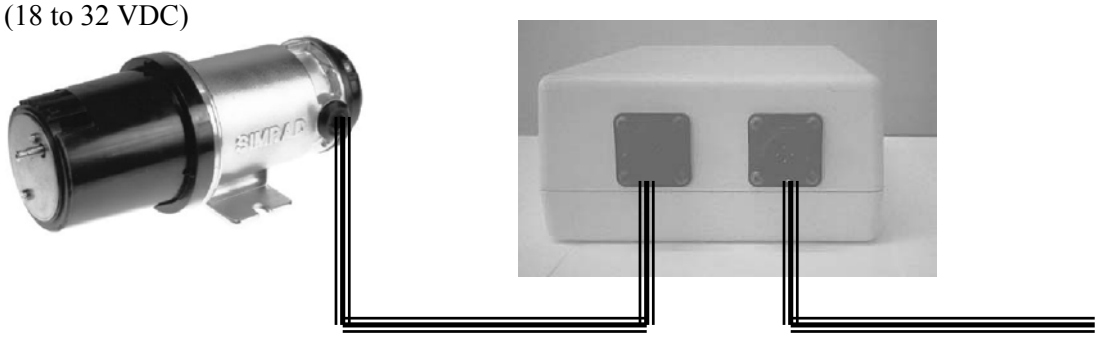
After wiring as detailed above, and before applying power, ensure that:

- +24V DC is connected to terminal l
- 0 V DC is connected to terminal 2
- Signal output is connected to terminal 3

4. Schauenburg GD10P Monitor/Display Unit (Optional supply)

When the GD10P unit is supplied with a display unit, the GD10P device must be connected and wired at the terminal compartment to facilitate the display functionality.

In this case, the power supply cable will be connected to the display unit which will in turn supply the GD10P with power, and only the display unit will require connection to mains supply. (18 to 32 VDC)



Output Connector (Female LHS)
Pin 1 – Positive (18 to 32 VDC)
Pin 2 – Negative (18 to 32 VDC)
Pin 3 – No Connection
Pin 4 – 4 – 20mA Return signal

Input Connector (Male RHS)
Pin 1 – Positive (18 to 32 VDC)
Pin 2 – Negative (18 to 32VDC)
Pin 3 – Potential Free N/C Contact
Pin 4 - Potential Free N/O Contact

When all connections have been made and checked, the display unit may be powered "On". The display will initially indicate no gas readings as the sensor will at first perform a self-test and signal adjustment as described earlier. Once this is done the display will indicate the gas reading either in % LEL or % volume, dependant on the GD10P device purchased. The setting may be altered by, either inserting "Link 1" (%LEL) or removing "Link 1" (% volume) on the internal PCB.

Alarm Setting

In display unit provides a potential free 10 Amp relay contact which is activated when the gas reading exceeds the preset alarm point. The red indicating LED and audible alarm will be activated when the internal relay has been triggered.
The alarm point setting is adjusted as follows:

- Insert supplied key into key slot and turn clockwise to second position. This will activate the alarm setting procedure

- By turning clockwise further to positions 3 (Increment) or 4 (Decrement) the alarm point will be increased and decreased respectfully.
- When the desired level has been obtained the key is to be turned anticlockwise immediately to the first position.
- The alarm level will automatically be saved and will not be lost even when power is disconnected.

Another feature of the display unit, is that it will give an intermittent indication via the LCD display as well as the yellow "LED" indicator and audible alarm, should the sensor require cleaning. (Refer to section 5.3).
The unit will also display a fault status and both "LED" indicators as well as the audible alarm will be activated should the sensor experiences any critical fault condition.

5. OPERATION

5.1 Start-up procedure

Ensure that system wiring and control system are in working order before switching on power to the detector.

The detector will then perform self-test and internal signal adjustments lasting for approx. 60 seconds and switch to measuring mode.

The output signal from the detector during this period is shown in Figure 4.1 below (current output of the GD10P standard version). Signal output before 60 seconds is 0 mA, and signal output after 60 seconds is 4 mA (if no gas is present).

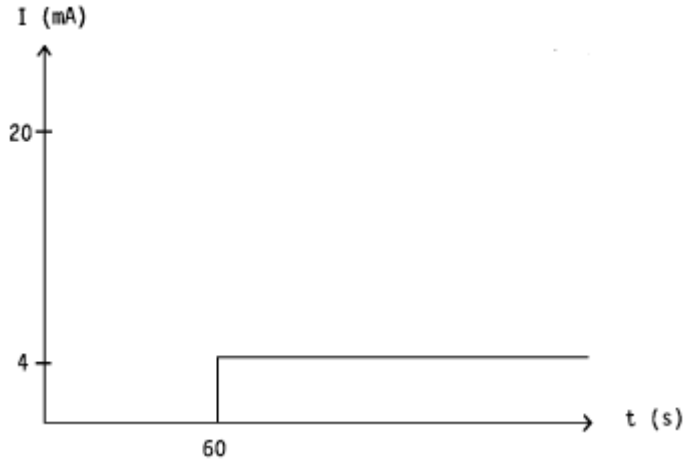


Figure 5.1 Signal output during start-up period

6. MAINTENANCE

NOTE:	The GD10P has no user adjustable parts. It is not recommended to open the GD10P, as this will change the internal atmosphere, and the initial calibration could be affected.

6.1 General

The GD10P has been designed to require a minimum of maintenance. The only necessary maintenance is to inspect visually that the Weather Protection is not clogged in heavily contaminated areas.

6.2 Failure indications

The internal microprocessor performs continuous self-testing of optical and electronic functions.

If a fatal error should occur in the electronics or optics, the processor will generate a 0 mA output signal, indicating sensor failure. The detector should then be checked according to Figure 5.1 on the next page.

Do not return the instrument for repair if this test has not been performed.

NOTE: Avoid direct light on lens and mirror if testing without the Weather Protection.

NOTE: Ensure that no gas is present in the measuring chamber when testing.

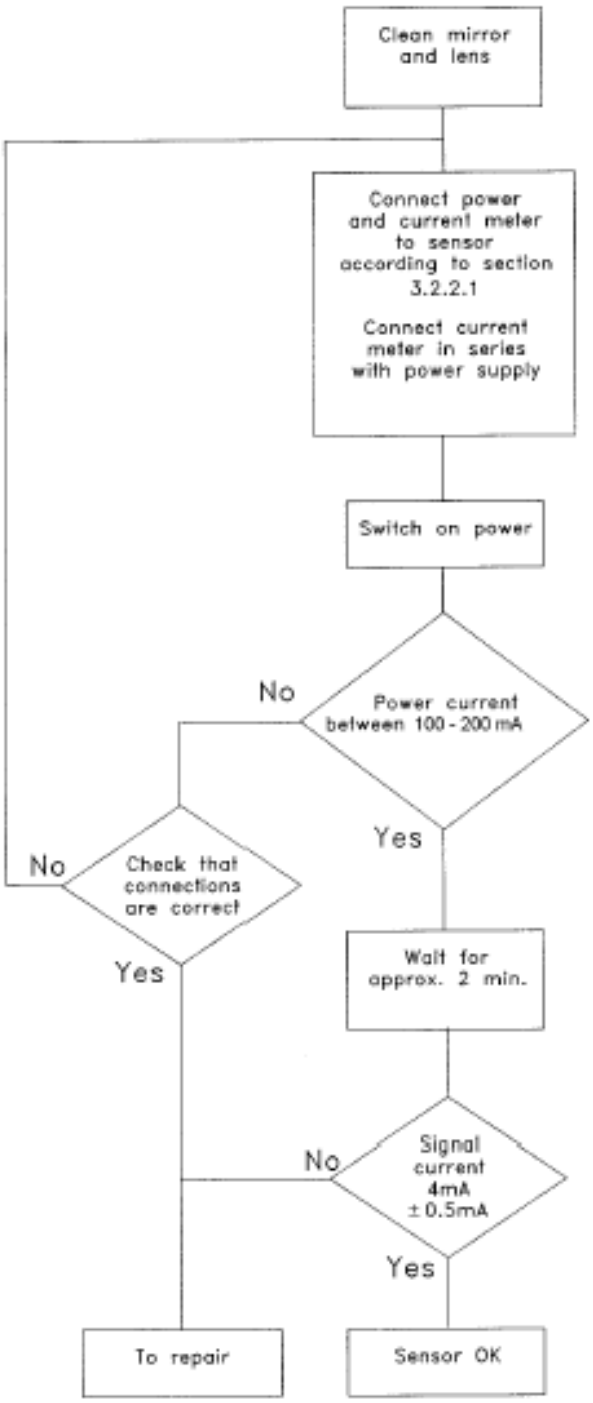


Figure 6.1 Test procedure.

6.3 Cleaning of optical window and mirror

If the optical window and mirror have to be cleaned, use a soft and clean tissue to rub off the contamination. The window and mirror are made of sapphire, which is highly resistant to rubbing. Make sure that the whole optical surface is clean.

NOTE:	For difficult contaminants the mirror and lens can be cleaned with an equal-part mixture of isopropyl alcohol and water. Do not perform any testing of the sensor before cleaning solution is dried away.

6.4 Functional test

In order to perform functional test of the detector a test gas can be applied through a 6 mm test nozzle on the front of the Weather Protection housing. Read the effect on the sensor output signal or through the gas detection system.

The GD10P has been designed for long-term stability, and in order to retain the high reliability of the GD10P it is only necessary to monitor the detector's zero point and error messages from the detector. To avoid inhibiting the response time of the detector, the Weather Protection has been designed as open as possible to facilitate gas flow-through. Therefore, it is difficult to fill the gas-measuring path completely with test gas, especially in windy weather.

Functional test of the GD10P can be performed as follows:

- If there is no air movement, a test gas flow of minimum 4 liters/minute will give approximately the same value as the test gas.
- If there is an air movement of 0.5 m/sec., the test gas flow must be increased to 20 liters/minute to show the same value.
- At high air velocities, when it is difficult to obtain sufficient output using test gas in the LEL area, a test gas in the 50 - 100% vol. range can be employed. This gas can be applied at high flow for 2 - 5 seconds to acquire a concentration of test gas in the gas measuring path for a short period.

Figure 6.2 Set-up of functional test

6.5 Calibration test

- Remove the Weather Protection and replace it with the Sample Flow Housing. In order to perform calibration test, use a calibrated gas and apply it to the Sample Flow Housing.
- Ensure that optical surfaces are clean before mounting the Sample Flow Housing.
- Apply a certified test gas of approx. 50 % of full-scale methane as shown in Fig. 5.3.
- Gas flow should be approx. 1 liters/minute, wait approx. 2 min. to ensure that the Sample Flow Housing is completely filled with gas.
- Read sensor output or read output through the gas detection system.

NOTE: Use the same type of gas as the detector has been calibrated for.

Figure 6.3 Set-up of calibration test