

Minox i Oxygen Transmitter

User Manual PST-UM-2010-EN-2.2



Plug & Play
Technology



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Minox i Oxygen Transmitter

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Before using your Minox i

Safety information

Please read this manual, ensuring that you fully understand the content before attempting to install, maintain or use the Minox i. Important safety information is highlighted throughout this document as follows:



The warning symbol indicates instructions that must be followed to avoid minor, serious or even fatal injury to personnel.



The caution symbol indicates instructions that must be followed to avoid damage to equipment (hardware and/or software) or the occurrence of a system failure.

NOTE: Highlights an essential operating procedure, condition, or statement.

Abbreviations

AC	Alternating current
DC	Direct current
°C	Degrees celcius
°F	Degrees fahrenheit
EC	Electrochemical
g	Grams
GND	Ground
kg	Kilogram
LED	Light emitting diode
LPM	Liters per minute
mA	Milliampere
oz	Ounces
PC	Personal computer
PCB	Printed circuit board
PLC	Programmable logic controller
PPM	Parts per million
SCFH	Standard cubic feet per hour
S-S	Solid-state
SS	Stainless steel

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1 Introduction to Minox i

This manual is applicable to Minox i oxygen transmitter with electrochemical (EC) or solid-state (S-S) sensors; and KF40 flange, flow-through or 2" tri-clamp process connections.

1.1 Overview

ATEX, IECEx-certified and UKCA compliant, the Minox i is an intrinsically safe (I.S), 2-wire, loop-powered oxygen transmitter with a 4...20 mA output. It is designed with proven sensor technology to accurately measure O₂ in a variety of gases, in the most demanding applications and hazardous environments.

Minox i has a small footprint and offers a variety of process connections for oxygen measurement. With an industry standard electrical plug, this compact transmitter can be installed in any OEM application simply and cost-effectively.

Minox i is available with the process connections shown below.

NOTE: You must provide suitable mating flange and clamp for KF40 and 2" tri-clamp connections.



Figure 1. Process connections for Minox i

Minox i can be used with a Programmable Logic Controller (PLC) or suitable equipment capable of providing a 4...20 mA loop-power interface. For operation in hazardous Ex-rated areas, the interface must be provided via a suitable isolation barrier device.

! The Minox i oxygen transmitter must only be operated in the way set out in this user manual. Always verify electrical interface circuit compatibility before connection.

1.2 Components

The Minox i oxygen transmitter consists of an oxygen sensor and inbuilt microprocessor. They are encased in stainless steel, with a process connection on the removable housing and an electrical signal connector on the main housing.

The sensor is replaceable and can be accessed via the removable housing, as shown in [Figure 2](#):

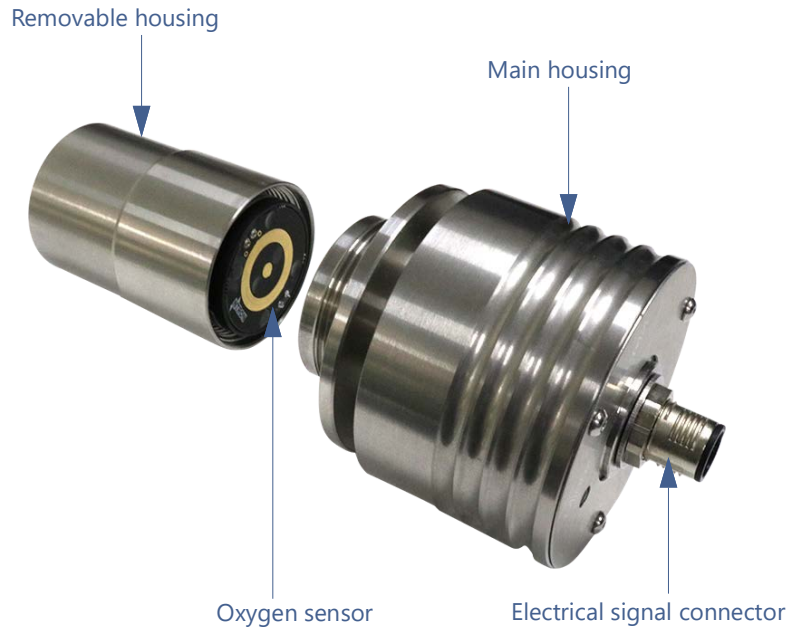


Figure 2. Structure of Minox i with EC sensor (KF40 flange pictured)

1.3 Sensors

1.3.1 Electrochemical % (EC %)

The Minox i EC % oxygen sensor is a galvanic fuel cell capable of superior performance, accuracy, and stability. Its operational life is typically up to 18 months in ambient air. The sensor is designed to be unaffected by the presence of other background gases.

The Minox i is required to be mounted in a vertical orientation with the electrical signal connector at the top. For gases with a composition of hydrocarbons and/or CO₂, the solid-state sensor should be used when % level O₂ measurements are required.

1.3.2 Electrochemical ppm (EC ppm)

The Minox i can be specified with a choice of EC ppm oxygen sensors. Both are galvanic fuel cells with different chemistry. With both EC ppm sensors, the Minox i must be mounted vertically with the electrical signal connector at the top.

The OC-60 sensor is the ppm version of the EC% and is suitable for inert, H₂ and He gases. The OC-69 sensor is compatible with gases that have a hydrocarbon composition or CO₂ element.

1.3.3 Solid-state (S-S)

The Minox i S-S sensor is not gas-dependent or specific, and offers a robust measurement capability on process gas streams or in containment environments. It can operate with or without sample flow, making it ideal for in-situ monitoring, and it is not orientation-specific.

With the tri-clamp and KF40 process connections, the Minox i can be mounted on a T-piece of pipe-line or on the vertical panel of a containment system without concern. The transmitter provides a linear output with a sensitivity that is constant throughout its operating range.

1.4 Applications

Typically, the intrinsically safe Minox i oxygen transmitter can be used in the following applications:

- Inerting
- Hydrogen and nitrogen gas generation
- Glove box and containment solutions
- Sieving and powder transfer systems (PTS)
- Additive Manufacturing
- Biogas and biomethane
- Pharmaceutical.

2 Installation

Before installing your Minox i oxygen transmitter, ensure that its specifications are suitable for the process or pipeline where it will be installed.

See "2.2.1 KF40 flange and 2" tri-clamp process connections with dimensions" on page 5 or "2.2.2 Flow-through process connection with dimensions" on page 6 for more guidance.

! This product is not approved for use in applications where the sample gas is greater than 21 % volume O₂.

2.1 Unpack the Minox i

NOTE: The sensor is packed in a sealed package that has been purged to remove O₂ from the packed environment. It should not be removed from the package until the transmitter has been installed at the measurement point and you are ready to perform measurements.

Your Minox i oxygen transmitter pack is comprised of the following equipment:

1. Minox i oxygen transmitter
2. Electrochemical or solid-state oxygen sensor
3. A MagTip calibration tool
4. Certificate of calibration
5. Cable fitted with M12 connector.



Figure 3. Contents of Minox i package

! Leaving a sensor in ambient air conditions will reduce sensor life.

2.2 Mount the Minox i

The Minox i transmitter requires a two-wire industry-standard 4...20 mA loop-powered connection, which you must provide. It must be installed in the measurement point before the sensor is removed from its sealed package.

For flow-through connection, continue to "2.2.2 Flow-through process connection with dimensions" on page 6.

2.2.1 KF40 flange and 2" tri-clamp process connections with dimensions

A suitable mating flange and seal/centering ring will be required to install the KF40 flange or tri-clamp Minox i. These are not included in the pack.

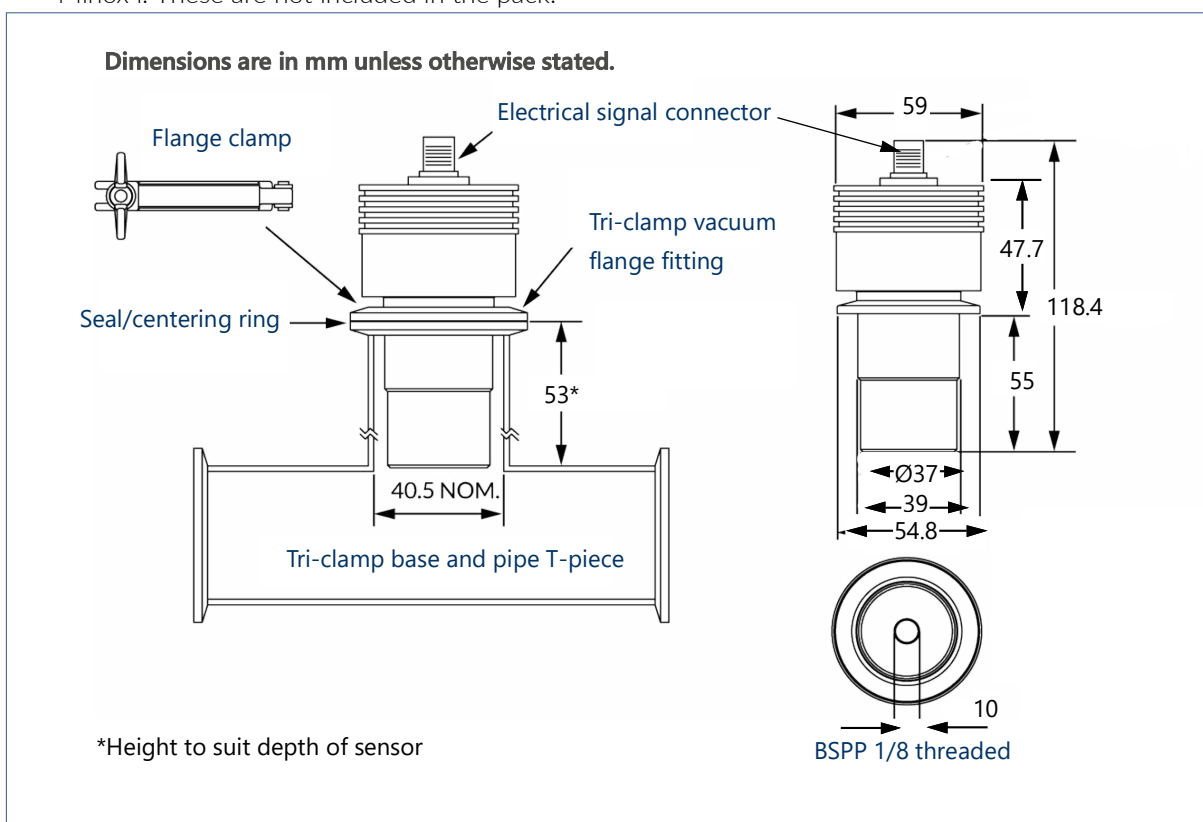


Figure 4. Technical drawing of 2" tri-clamp flange and KF40 process connections

1. Place the seal/centering ring on the pipe where the Minox i will be installed.
2. Put the process connection end of the Minox i into the pipe.
3. Place your flange clamp or tri-clamp over the seal/centering ring and the Minox i where they meet the pipe.
4. Fasten the flange or tri-clamp until finger-tight.
5. Continue to "2.2.3 Electrical connection" on page 7.

2.2.2 Flow-through process connection with dimensions

The flow-through Minox i is designed for measurement on an extracted sample gas. The sample gas should be at atmospheric pressure ± 100 mbar, and a flow-rate of 250...500 ml (0.5...1.0 SCFH) is required.

If the sample gas is at a pressure regulator, a flow-meter must be placed before the transmitter. The transmitter must be able to vent the gas to atmosphere or an atmospheric vent.

If the sample gas is at sub-atmospheric pressure, the sample must be drawn through the flow-through block. PST-Ntron can supply systems to aid this installation upon request.

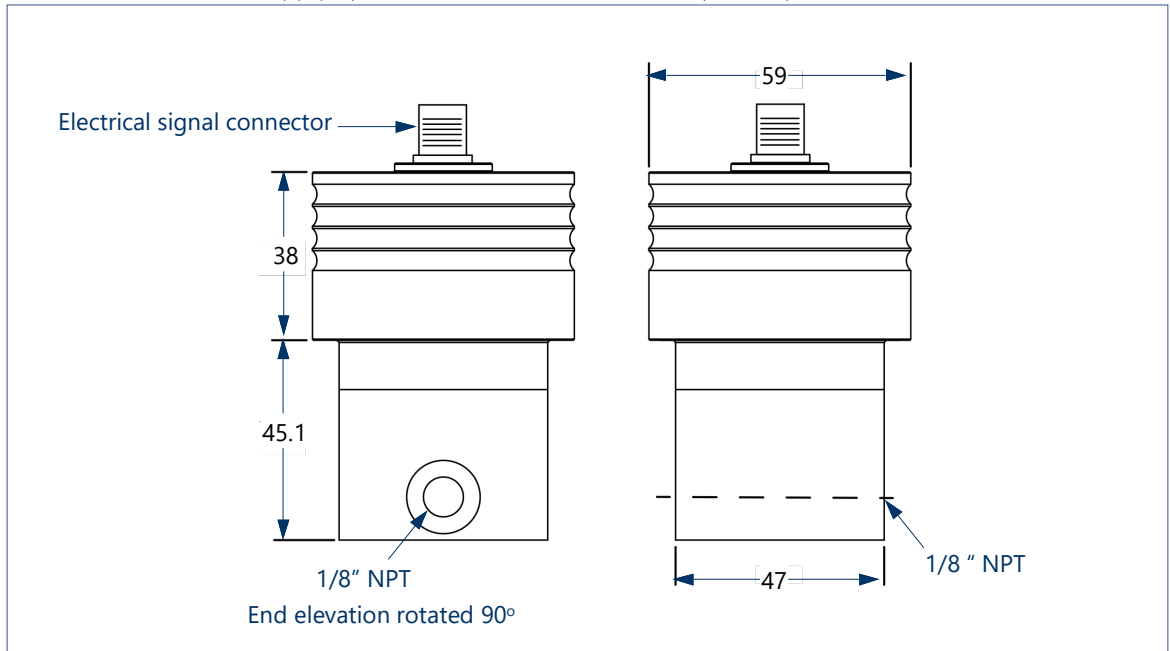


Figure 5. Technical drawing of flow-through process connection

1. Align the flow-through Minox i 1/8" NPT with your pipe fitting.
2. Fasten screws to adapt to pipe fitting.

2.2.3 Electrical connection

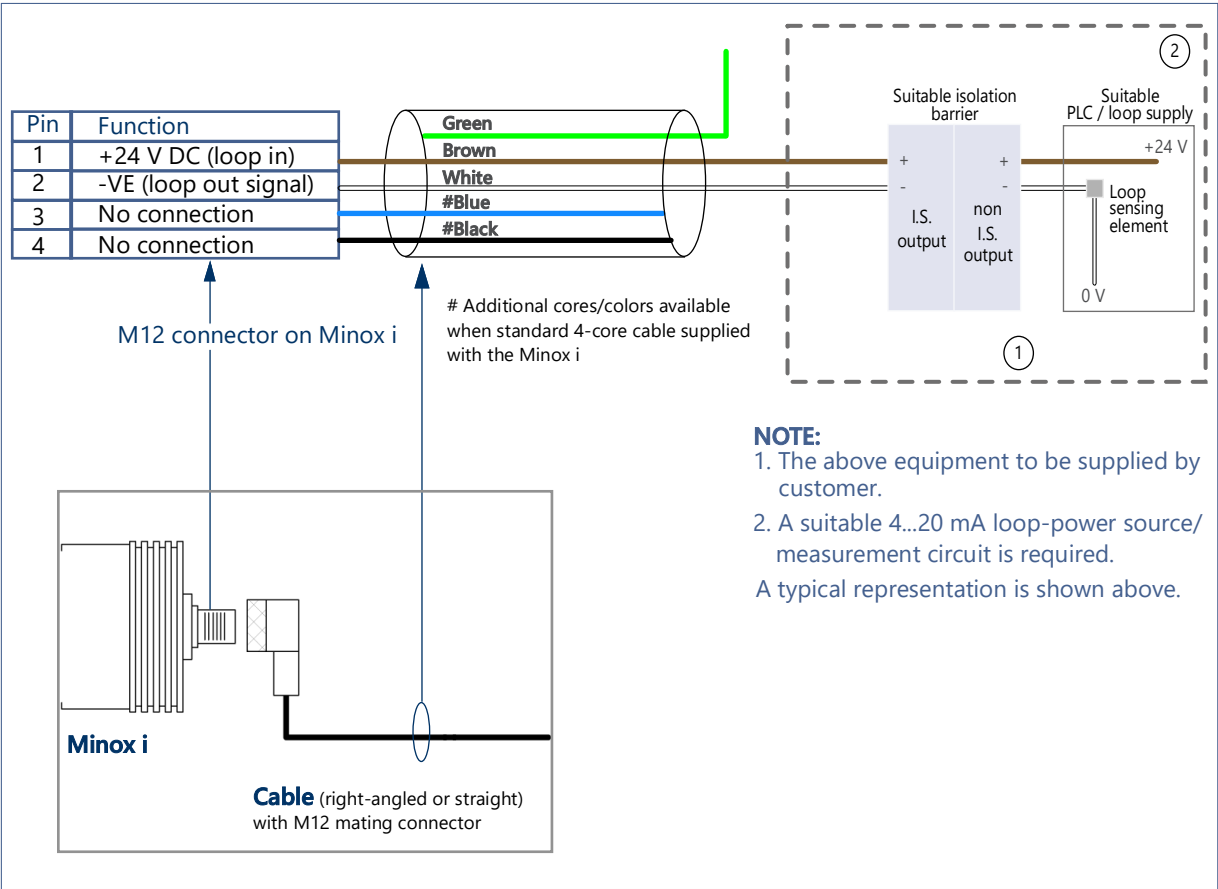


Figure 6. Typical connection cable wiring



A suitable galvanic isolation barrier is required if the Minox i is located in an Ex area.

Consult the EC-type examination certificate Baseefa19atex0200 for Parameter Matching.

The Minox i oxygen transmitter operates using a 2-wire industry-standard 4...20 mA loop-powered supply which you must provide.

Once the Minox i is connected to your process, it is ready to be connected to your power supply. To do this:

1. Align the pins in the Minox i electrical signal connector with the M12 mating connector on the cable.
The cable connector can then be gently pushed into place.
2. Rotate the fastener clockwise until finger tight. Your Minox i oxygen transmitter is now connected. A pulsing red LED will indicate it is operating correctly.

2.2.4 Install your sensor

The sensor supplied should only be removed from the sealed package when the transmitter is installed and ready to make a measurement.

Installing the sensor is straightforward, but should be done quickly to limit exposure to ambient O₂ levels, this is particularly important for the EC ppm sensors. Prolonged exposure to air will shorten the operational life of the sensor.

As a guideline, you should install the sensor into the Minox i, and then mount the transmitter in the measurement environment in 15-30 seconds. To install the sensor, please see "4.2 Replace the sensor" on page 13.

3 Calibration

NOTE: Calibration should be carried out by an appropriately trained or suitably qualified person.

The oxygen sensor output will decrease over time, and periodic calibration will be required. This is a non-intrusive procedure, achieved by using the MagTip one-touch calibration tool included with your Minox i.

Calibration cycles for the Minox i depend on the application, the applied gases, and the sensor type. They can be carried out in-situ or after safely removing the oxygen transmitter from your process in a bench test.

NOTE: For optimal calibration, the atmosphere surrounding the sensor must be ambient air (20.9 % volume O₂) with no contaminants present. This can be achieved using an oxygen analyzer or by flushing the system with clean, oil-free compressed air.

 The Minox i ppm must be calibrated in a controlled environment. Calibrating the Minox i % in ambient air will significantly reduce sensor life.

When the MagTip tool is applied, the indicator LED will flash six times in rapid succession. This confirms calibration is in progress.

During normal operation, the indicator LED will flash once every two seconds. This slower flash confirms Minox i is powered up and operational.

NOTE: The number of times the indicator LED flashes will vary on earlier models of Minox i.

3.1 In-situ

3.1.1 Minox i %

Please read the information on the previous page before proceeding.

The Calibration gas used should match the gas concentration that was used during the factory calibration. **The recommended gas concentration can be found on the calibration certificate that was supplied with the transmitter.**

1. Apply the calibration gas for a minimum of 15 minutes.

NOTE: The pressure flow should replicate that applied to the Minox i during normal operation. This will ensure calibration is accurate, and avoid over-pressurizing the oxygen sensor.

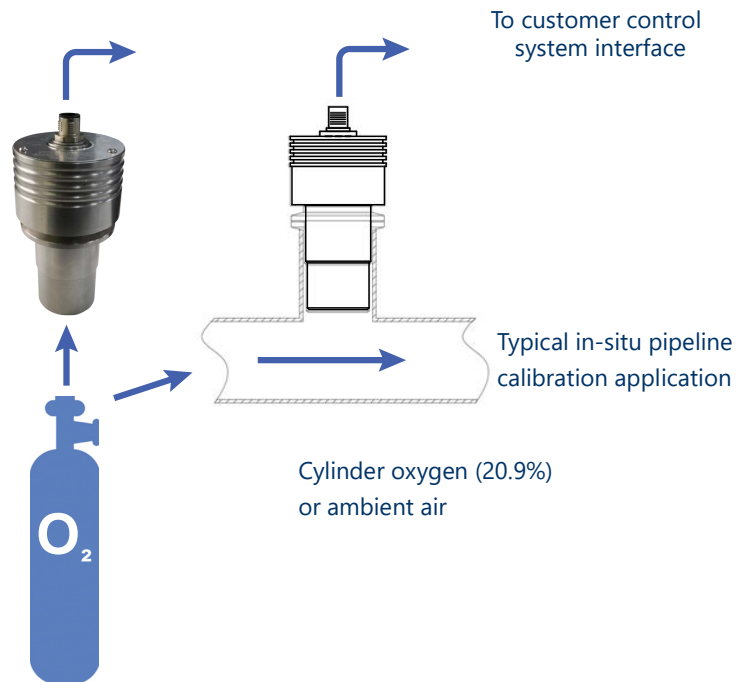


Figure 7. Calibration for Minox i %

2. Allow one to two minutes for the output to stabilize (i.e reach its ambient air concentration value and remain at the value). An independent portable oxygen analyzer can be used to check this.
3. Observe the O₂ concentration on your oxygen analyzer display. It should read 20.9 % volume O₂.
4. Place the MagTip on the Minox i main housing, adjacent to the red indicator LED, as shown in [Figure 8](#).

The indicator LED will begin to flash rapidly.



Figure 8. Minox i with MagTip calibration tool

5. When calibration is complete, the indicator LED will resume flashing at a steady pulse. For the standard 0...25 % O₂ range, the 4...20 mA output will be automatically adjusted to 17.376 mA. This value, or the reading 20.9%, must be observed to confirm calibration is complete. When calibration is complete, the Minox i LED will resume flashing at a steady pulse.

3.1.2 Minox i ppm

Please read the information in "3 Calibration" on page 9 before proceeding.

The Calibration gas used should match the gas concentration that was used during the factory calibration. **The recommended gas concentration can be found on the calibration certificate that was supplied with the transmitter.**

The pressure flow should replicate that applied to the Minox i during normal operation. This will ensure calibration is accurate, and avoid over-pressurizing the oxygen sensor.

1. Apply the calibration gas until the reading stabilizes. Please allow a longer purge period to achieve a lower oxygen reading, the table below can be used for guidance.

Reading	Recovery time Air to 0 ppm with N ₂ purge
100 ppm	30 minutes
10 ppm	60 minutes
>10 ppm	<60 minutes

3.2 Air calibration

The following method of air calibration should only be performed on a Minox i %.



Figure 9. Minox i indicator LED

1. Unfasten and remove the Minox i from your process, and leave it in an ambient air environment. Ensure the environment has normal oxygen concentration, an independent portable oxygen analyzer can be used to check this.
2. Observe the O₂ concentration on your oxygen analyzer display. When the concentration has stabilized it should read 20.9 % volume O₂. This usually takes between five and ten minutes.
3. Place the MagTip on the Minox i main housing, adjacent to the indicator LED, as shown in [Figure 8](#). The red indicator LED will begin to flash rapidly.
4. When calibration is complete, the indicator LED will resume flashing at a steady pulse.
5. Re-install your Minox i following the instructions "2.2.1 KF40 flange and 2" tri-clamp process connections with dimensions" on page 5 or "2.2.2 Flow-through process connection with dimensions" on page 6, depending on your process connection.

4 Maintenance

4.1 General

To maintain performance, the sensor in Minox i will require replacement. Please check the Technical Specifications for frequency. During sensor replacement, it is recommended that light cleaning of the external housing is carried out, as well as the checks outlined in this section.

! Never use chemical cleaning agents or high pressure water or steam to clean the equipment. Do not submerge in water.

4.2 Replace the sensor

The Minox i oxygen sensor is replaceable. When it reaches the end of serviceable life, calibration can no longer be performed and the sensor must be replaced.

A regular program of calibration will mitigate against sudden sensor failure. It is advisable to establish a program of preventative maintenance to ensure process downtime is kept to a minimum or avoided.

The sensor supplied should only be removed from the sealed package when the transmitter is installed and ready to make a measurement.

Installing the sensor is straightforward, but should be done quickly to limit exposure to ambient O₂ levels, this is particularly important for the EC ppm sensors. Prolonged exposure to air will shorten the operational life of the sensor.

As a guideline, you should install the sensor into the Minox i, and then mount the transmitter in the measurement environment in 15-30 seconds.

To replace your sensor:

1. Unscrew the removable housing from the main housing of Minox i by turning it clockwise. The sensor will be located in the removable housing, as shown.
2. Gently tip the sensor out of the removable housing into your hand or onto a soft surface.



Figure 10. Oxygen sensor placement in removable housing

3. Place your new EC or S-S oxygen sensor into the removable housing, ensuring the sensor's brass

rings are facing out of the removable housing as shown in [Figure 10](#).

4. Screw the removable housing back onto the main housing, by turning it counter-clockwise.

NOTE: The brass slip rings on the sensor must face into the main housing and out of the removable housing as shown above.

4.3 Check your Minox i

The following checks will ensure your Minox i oxygen transmitter is operating at its optimum.

- Check for any damage to the connecting cable
- Depending on process conditions and location, check the gas entry orifice at the face-end of the Minox i.
This is to ensure there is no build-up of particulate matter, and that moisture is not being retained at the orifice.

Typically, the Minox i will require removal from the process to carry out checks, cleaning and sensor replacement.

4.4 Operational spares

The only replaceable part for Minox i is the sensor. Sensor model details can be found in "Appendix A - Technical Specifications" on page 15.

The replacement sensor must be the same as the installed sensor, for example, it is not possible to replace an OC-90 EC sensor with an OC-60 EC sensor.

NOTE: The sensors have a shelf life. Please see "Appendix A - Technical Specifications" on page 15 for details.

5 Appendices

Appendix A - Technical Specifications

Sensor				
	Solid-state	Electrochemical (%)	Electrochemical (ppm)	Electrochemical (CO ₂ gases, ppm)
Model	OC-92	OC-90	OC-60	OC-69
Measuring Range	0...25 %		0...10, 0...100, 0...1000 ppm _v	
Accuracy	Please see Accuracy Table below			
Output Resolution (4...20 mA)	0.01 %		1 ppm _v	
Lower Detection Limit (LDL)	0.05 %		1 ppm _v	
Sample Flow Rate (application dependent)	Flow-through / extractive: 100...500 ml/min (250 ml/min optimal) in a vented atmosphere			
Pressure Range	Direct insertion: Up to 6 m/s 900...1100 mBar _{abs}			
Response Time (T90)	< 15 seconds @ 25 °C (77 °F) within selected range			
Operating Temperature Range	-20...+50 °C (-4...+122 °F)	+5...+45 °C (+31...+113 °F)	+5...+45 °C (+31...+113 °F)	-10...+45 °C (+14...+113 °F)
Life Expectancy (application dependent)	Up to 2 years	Up to 18 months	Up to 12 months	
Humidity	0...95 %rh non-condensing (with normal use)			
Shelf Life	Up to 12 months	Up to 6 months	Up to 3 months	
Calibration Interval (application dependent)	6 months	6 months	3...6 months	
Transmitter				
Electrical				
Output Signal	4...20 mA loop-powered			
Electrical Interface	Industry standard M12			
Power Supply	24 V DC +/- 10 % (a suitable I.S barrier is required)			
Mechanical				
Ingress Protection	IP66 (NEMA4)			
Housing Material	316 Stainless steel			
Process Connection	Flow-through (1/8" NPT), KF40 flange, Tri-clamp			
Gas-wetted Materials	316 Stainless steel			
O-ring Material	Nitrile			
Hazardous Area Classification				
IECEx: Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +55°C)				
ATEX: Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +55°C), Ex ia IIIC T ₂₀₀ 135°C Da (-20°C ≤ Ta ≤ +55°C)				
cQPSus: Class 1 Zone 0 AEx ia IIC T4 Ga, Class 1 Zone 20 AEx ia IIC T135°C Da				
UKEX, and JPN Ex: Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +55°C), Ex ia IIC T ₂₀₀ 135°C Da (-20°C ≤ Ta ≤ +55°C)				



Accuracy Table

Accuracy at standard temperature and pressure (STP)

Range	
10 ppm	+/- 0.5 ppm
100 ppm	+/- 1 ppm
1000 ppm	+/- 3 ppm @ 100 ppm +/- 1 ppm @ 10 ppm
25 %	+/- 0.03 % @ 1 %

Dimensions (mm)

	Flow-through (%)	Flow-through (ppm)	Tri-clamp	KF40
a	59	59	59	59
b	54	54	54	54
c	-	-	55	55
d	47	47	37	37
e	129	100	118	118

Appendix B - Hazardous Area Certification

Region	Certification details	Standards
Europe & Japan	IECEX / ATEX / UKCA IECEX BAS 19.0013 / Baseefa 19ATEX0020 / BAS22UKEX0052  II 1 GD Ex ia IIC T4 Ga (-20 °C≤Ta≤+55 °C) Ex ia IIC T₂₀₀ 135°C Da (-20 °C≤Ta≤+55 °C) Ui=28 V li=93 mA Pi=0.65 W Ci=12nF Li=705uH	EN IEC 60079-0:2018 EN 60079-11:2012 IEC 60079-0 ed. 7 2017 IEC 60079-11 ed. 6 2011
North America/Canada	 Class I Division 1 Group A-D T4 Class II Division 1 Groups E-G T135°C Class I Zone 0 AEx ia IIC T4 Ga / Ex ia IIC T4 Ga Class 1 Zone 20 AEx ia IIC T135°C Da / Ex ia IIC T135°C Da Ta = -20°C≤Ta≤+55°C Ui/Vmax=28 V li/lmax=93 mA Pi=0.65 W Ci=12nF Li=705uH	CSA C22.2 No. 60079-0-19 CSA C22.2 No. 60079-11-14 UL 60079-0-7th ed. UL 60079-11-6th ed.

Appendix C - Quality, recycling and warranty information

Ntron Gas Measurement is part of the Process Sensing Technologies (PST) Group. The PST Oxygen group of companies - Aii, Ntron and SST - comply with applicable national and international standards and directives.

Full information can be found on this website

<https://www.processsensing.com/en-us/resources/compliance/>

The compliance site contains information on the following directives:

- ATEX (equipment for explosive atmosphere, Europe)
- CE
- ETL (The ETL mark is proof of product compliance to North American safety standards)
- IECEx
- REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)
- Recycling policy
- RoHS (Restriction of Hazardous Substances in electrical and electronic equipment)
- UKCA
- WEEE (Waste Electrical and Electronic Equipment recycling).

