BARBEN ANALYTICAL

AMETEK®

BOS SAFETAP II OPTICAL OXYGEN SENSOR

SafeTap II™

SafeTap II - BOSx Oxygen Sensor

BOSx Oxygen Sensor Ranges		
BOS1 Oxygen Range	0 % to 4.2 % (gas)*	0 ppb to 1.8 ppm (liquid)
BOS2 Oxygen Range	0 % to 25 % (gas)	0 ppb to 22 ppm (liquid)
BOS3 Oxygen Range	0 to 300 ppm with 1000 ppm over range (gas)	

** With over-range to 5 % O_2*

PRODUCT OVERVIEW

The Barben Analytical SafeTap II is a retractable or “hot tap” Optical Oxygen Sensor. It is used with the OXYvisor Oxygen Analyzer for in situ sampling methods. Designed for use in liquids and dry or wet gases, the SafeTap II can be manually inserted and retracted from the process line. The SafeTap II provides the capability of in situ installation of a selectable BOSx Oxygen sensor ranges into the process pipe or vessel.

TYPICAL APPLICATIONS

- Biogas - wet digester gas. 100 % compatible with typical stream compositions CH_4, CO_2, H_2O, H_2S, N_2, O_2, NH_3 & H_2
- Biogas - H_2S removal/sweetening, amines or bio scrubber
- Renewable Natural Gas (RNG) - upgraded biomethane trace O_2 (ppm) measurement for transmission quality pipeline gas
- Carbon capture processes in CO_2 (trace and % level O_2)
- EOR - Enhanced Oil Recovery - Waterflood PPB Dissolved O_2 for seawater down hole injection
- General replacement of E-Chem (electrochemical / fuel) cells for Trace O_2 ppm to % level measurement.
  1. Not affected by typical e-chem poisons (H_2S, CO_2, H_2)
  2. Measurement accuracy independent of flow rate
  3. Not affected with exposure to air or high O_2
  4. Accurate measurement in particulate (dirty) streams

FEATURES & BENEFITS

- Uses optical quench luminescent technology, no cross-sensitivity to CO_2, SO_2, NH_3, and H_2S, not affected by high O_2 levels and moisture, as compared to an E-Chem sensor
- Eliminates sample handling conditioning systems typical in extractive sampling methods. Lowers installation costs, complexity and maintenance.
- Adjustable BOSx sensor insertion length for variety of process pipe diameters
- RTD integrated at sensor tip for accurate temperature measurement and compensation
- Optional pressure transmitter allows for automatic compensation for accurate in-line measurements
- T-Handle and safety hook prevents blow-outs in-case of unplanned overpressure and ensures safe operation during insertion and retraction
- Replaceable BOSx sensor cap—simple and quick sensor cap service replacement design
- Approved for Hazardous Location installations
  - Fiber Optic O_2 light energy is certified “op is” (optically inherently safe)
  - RTD is simple apparatus for C1D2 or Zone 2 and carries OXYvisor specifications**
  - RTD in Zone 1, requires special Exd considerations

*** See OXYvisor datasheet or drawings for hazardous location*

BOS SAFETAP II OPTICAL OXYGEN SENSOR

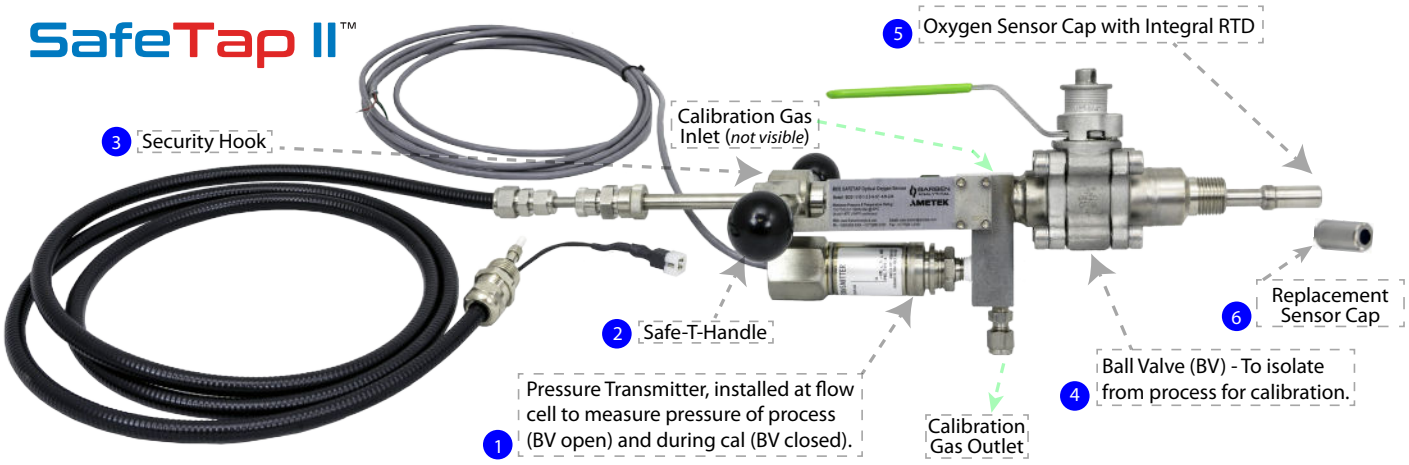


Figure 1
BOS SAFETAP II, retractable or "hot-tap" Optical Oxygen Sensor

PRINCIPAL OF OPERATION

Figure 1 above illustrates the SafeTap II assembly with optional pressure transmitter (1) installed on the flow cell for continuous measurement of pressure in the process line and during calibration process for gas phase measurements. The BOS SafeTap II oxygen sensor comes standard with integral Pt100 RTD (5) temperature sensor suitable for Class 1 Div 2, or without using an external RTD for Zone 1. The SafeTap II is rated up to pressures of 750 psig (51.7 Bar). Built in tubing ports are included as part of the welded retraction housing so that purge and complete in situ calibration, in normal process operating conditions, and 450 psig (31.0 Bar) during Insertion and Retraction of the SafeTap II, may be performed without removal of the oxygen sensor.

For inserting and retracting, the free rotating Safe-T-Handle (2) provides a secure gripping surface to manually insert and retract the optical sensor assembly into the process. The SafeTap II includes a security hook (3) that catches the safe-T-handle to prevent unintended retraction. The 316SS Ball Valve (4) eliminates the need for a secondary isolation valve for retracting or maintenance of the sensor. Optional calibration gas inlet and outlet 316SS needle valves provide ease of manual calibration.

The SafeTap II is supplied with a replaceable luminophore window sensor cap (6), making sensor service simple and low cost. When sensor cap replacement is required, the removable luminophore tip can be retracted through the ball valve (4), which is used to isolate the sensor from the process. The sensor cap can be simply unscrewed with your fingers or hand and the replacement screwed back on hand tight, do not use any tools.

For a more thorough and detailed process on inserting, retracting the sensor assembly, calibration, and sensor cap replacement, please review the SafeTap II Oxygen Sensor Manual.

EFFECTIVE FORCE VS PROCESS PRESSURE

The SafeTap II utilizes a 3/8" insertion rod for insertion/ retraction. The small diameter rod helps to significantly reduce the force required during normal operation, insertion /retraction or during process upsets.

For example, Figure 2, shows the Effective Force (lbf) required to insert the sensor into process with various Process Pressure (psig).

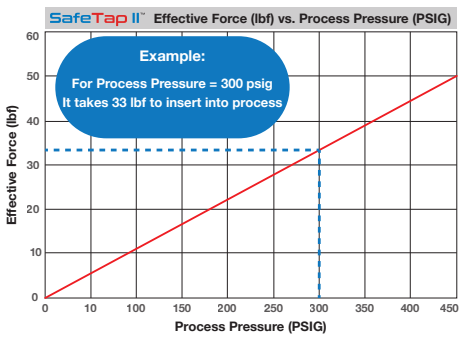


Figure 2

INSTALLATION EXAMPLES

This section references hazardous location installation examples (see Figure 3 and 4) with measurements for liquid or gas phases. The OXYvisor oxygen analyzer with SafeTap II has agency approvals for Zone 1, Zone 2, and Class 1 Div 2 installation locations, see below for listed approval agencies. The SafeTap II is rated up to pressures of 750 psig (51.7 Bar) in normal process operating conditions, and 450 psig (31.0 Bar) during insertion and retraction of the SafeTap II.

OXYvisor Analyzer is shown in both Figure 3 and 4 are mounted in a hazardous location with the pipe mount kit and optional sunshade accessory. The recommended cable length is 5 meters with options to 10 meters (for greater lengths please consult the factory). For all installation requirements, review the OXYvisor and SafeTap II manuals mentioned in the Standard Documentation section.

Agency approvals for OXYvisor Oxygen Analyzer with SafeTap BOSx Optical Oxygen Sensor

OXYvisor® SafeTap II™

Hazardous Area Approvals*

IEC Ex, ATEX, NA - Zone 1 & Zone 2 IIC
cULus (NRTL) - Class I, Div 2, Groups A, B, C, D T4

*For complete list of agency approvals, refer to the OXYvisor Datasheet.

Typical Zone 2 and Class 1 Div 2 - installation in a pipe or vessel.
The pressure transmitter (not required for Liquid Phase) and RTD are integrated to the SafeTap II flow cell and rated for Zone 2 and Class 1 Div 2 locations.

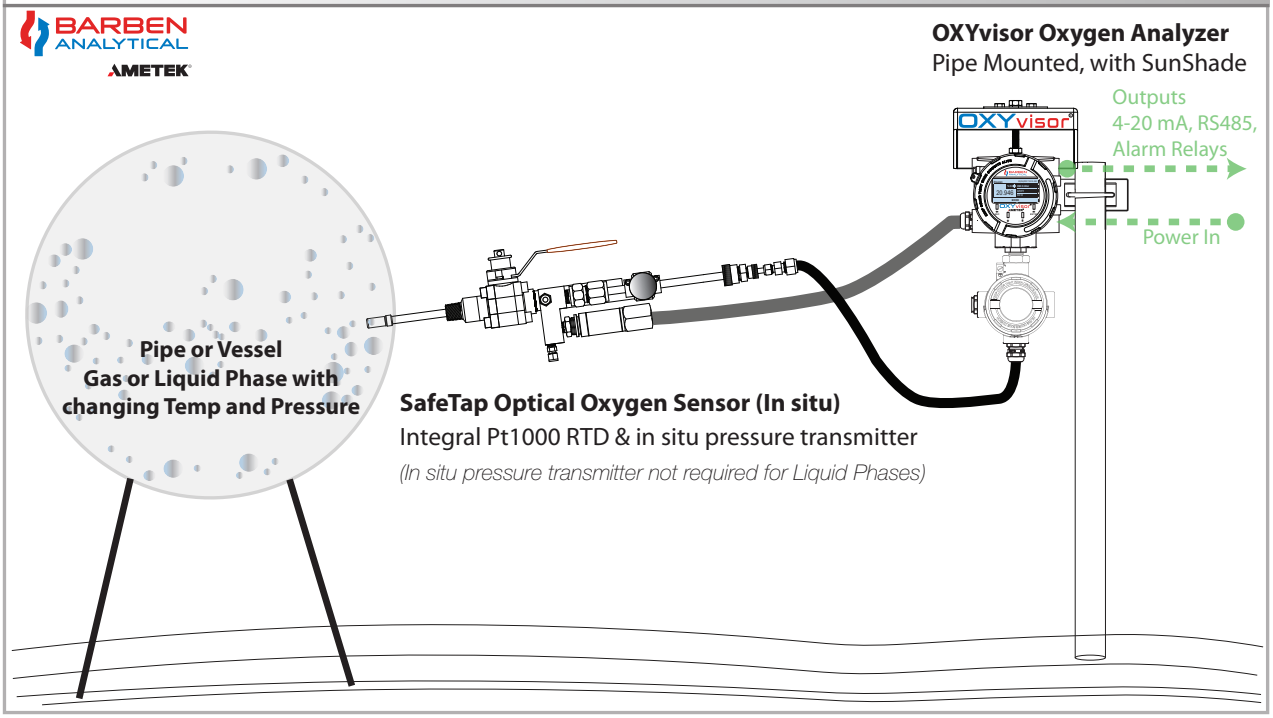


Figure 3: Zone 2 and Class 1 Div 2 Installation Examples

Typical Zone 1 - installation in a pipe or vessel.

The O_2 sensor, via SafeTap II, installed in situ within process line. The RTD and pressure transmitter are permitted connection to OXYvisor, using Ex d methodology. (Pressure transmitter is not required for Liquid Phases).

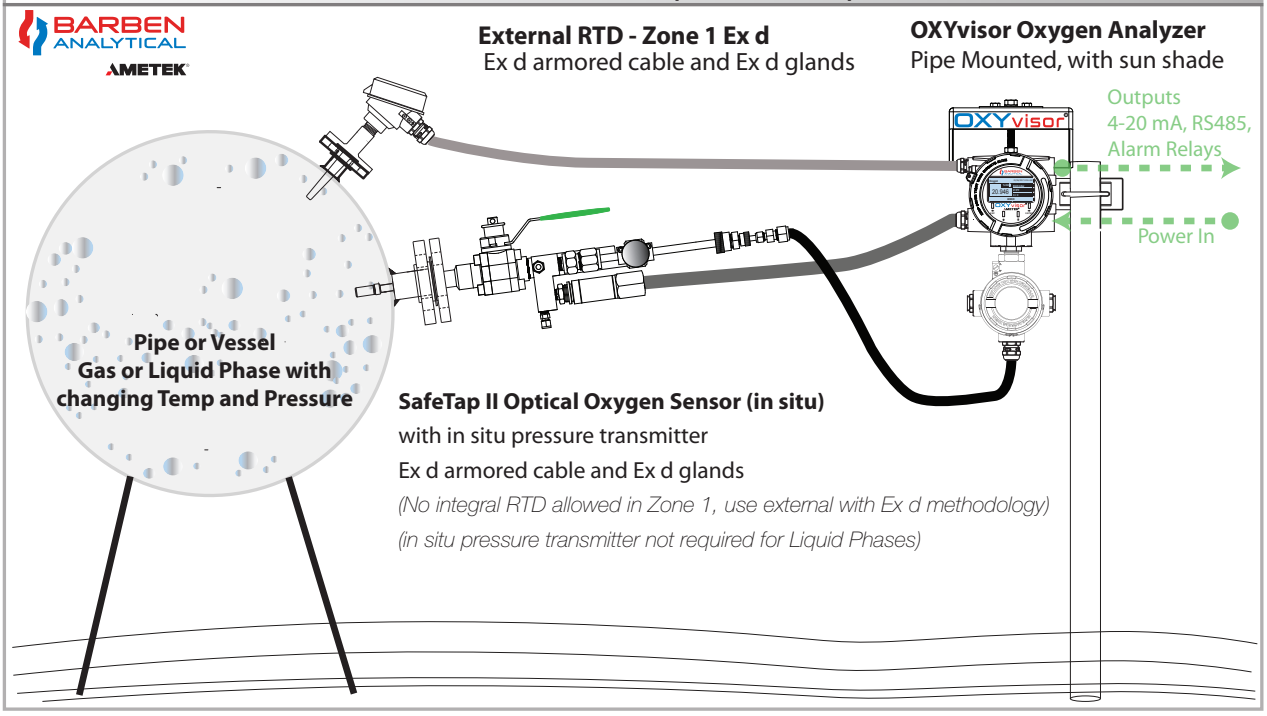


Figure 4: Zone 1 Installation Example

STANDARD DOCUMENTATION

Table 1 references our standard documentation for the OXYvisor oxygen analyzer and BOS SafeTap II optical oxygen sensor. Barben recommends referring to our standard documentation as it serves as a comprehensive resource in providing detailed product information, installation, and guidelines for best practices. If you encounter any specific questions, please call us +1-775-883-2500 or visit our website: https://www.barbenanalytical.com/

Document	Document Type	Description
BA-DAT-OXY	OXYvisor Datasheet	Technical overview of OXYvisor Oxygen Analyzer
BA-MAN-OXY-IM	OXYvisor Installation Manual	Installation, operation & maintenance information for the OXYvisor Oxygen Analyzer
BA-MAN-OXY-SW	OXYvisor Software Manual	Provides setup, configuration, data logging, calibration, diagnostics and more via PC software
BA-MAN-BOSST-IM	SafeTap II Installation Manual	Installation, operation & maintenance information for the SafeTap II

Table 1: Standard Documentation

BOS SAFETAP II
OPTICAL OXYGEN SENSOR

PRODUCT NOMENCLATURE

Sensor Range	Sensor & Seals	Body Material	Process Connection	Cable Armor	Sensor Length	Lead Length	Agency Approval	ID	FC	PT	Padlock
BOSx Sensor Element / Range (optode selection)											
BOS1 BOS2 BOS3	Mid Range Sensor: Gas Phase: 0-5.0 % O_2, 0-50 hPa with LOD 20 ppm O_2 and/or Liquid Phase Dissolved Oxygen: 0-1.8 ppm with LOD of 1 ppb High Range Sensor: Gas Phase: 0-25.0 % O_2, 0-250 hPa with LOD 300 ppm O_2 and/or Liquid Phase Dissolved Oxygen: 0-22 ppm with LOD of 15 ppb Trace Range: Gas Phase: 0-300 ppm with 1000 ppm over-range, with LOD of 0.5 ppm O_2 (0.0005 hPa) [Dissolved O_2 reading not avail. for this sensor]										
	Sensor & Seals (wetted elastomers)										
	V E K	Viton O-ring seals - Standard EPDM O-ring seals FFKM (perfluoroelastomer) O-ring seals									
		Body Material (wetted metallics)									
		1 2 3 4	316 Stainless Steel (Standard) Titanium Grade 2 Hastelloy C-276 Stainless Steel 2507 Super Duplex								
			Sensor Type & Process Connection								
			D	SafeTap: 1/2” MNPT Nipple for Process Connect, Insert/retract with 1/2” MNPT BV, Class 800, Vacuum = 10^{-6} Torr, Nace MR0175							
			F = 150#/G = 300# RF Flange, Process Connect, Insert/retract with 1/2” Full Port BV, Class 800, Vacuum = 10^{-6} Torr, Nace MR0175							
			F10/G10 F15/G15 F20/G20 F30/G30	SafeTap - 1.0” SafeTap - 1.5” SafeTap - 2.0” SafeTap - 3.0”							
				Cable Armor							
				1	Armor Jacketing Protection						
					BOS Sensor Overall Length (Refer to “OXYvisor Oxygen Analyzer & BOS Sensors Datasheet”)						
					2.5 5.0 10 X	2.5 m (8.2’) 5 m (16.4’) 10 m (32.8’) (BOS1 & BOS2 Sensors only) Special Length (If > 10 m, consult factory) (BOS1 & BOS2 sensors only)					
						PVC Jacket Length, Select “N” for BOS SafeTap Sensors.					
						N	Standard - direct connect to OXYvisor Analyzer				
							Agency Approval				
							ST SN	Standard, Integral RTD for SafeTap No integral TC, and Zone 1 (see accessories for external RTD options)			
								Insertion Depth			
								4 F X	Std SafeTap Insertion Depth = 4” past end of nipple or Flange SafeTap insertion depth = 12” past end of nipple or Flange Customer defined insertion depth		
									Fittings & Cal Valves - 316 Stainless Steel		
									N C	None - 1/4” T (Open) Calibration Valves Included and Fittings	
										Pressure Transmitter - 316 Stainless Steel	
										N 1 2 3 4 5 X	None - Plug 1/4” NPT 0-15 psia - Pressure Transmitter 0-30 psia - Pressure Transmitter 0-60 psia - Pressure Transmitter 0-100 psia - Pressure Transmitter 0-150 psia - Pressure Transmitter >200 psia - Pressure Transmitter - consult factory
											Padlock
											N V H	None Padlock 3/16” Padlock 5/16”
	Seals	Body MTL	Sensor Type	Cable	Length	Cut	Agency	ID	FC	PT	P	
BOS3	**V**	**1**	**D**	**1**	**2.5**	**N**	**ST**	**4**	**N**	**N**	**N**	**<--- SafeTap II - Typical Sensor Configuration**

BOS SAFETAP II OPTICAL OXYGEN SENSOR

PRODUCT SPECIFICATIONS

BOS1 Sensor Specifications - Liquid Phase / Gas Phase		
	Dissolved Oxygen (DO)	**Gas Phase @ 1 atm, 20ºC**
Measurement Range	0-1.8 mg/L (ppm)	0-4.2 % O_2 (0-41.4 hPa)
Limit of Detection	1.0 µg/L (ppb)	0.002 % O_2 (0.02 hPa)
Resolution @ 20ºC and 1013 hPa	±0.30 at 1 µg/L (ppb) ±0.63 at 200 µg/L (ppb)	±0007 % O_2 at 0.002 % O_2 , ±0.0015 % O_2 at 0.02 % O_2, ±0.007 hPa at 0.023 hPa, ±0.015 hPa at 2.0 hPa
Response Time (T_{90})	< 30 sec.	< 6 sec.
Accuracy @ 20ºC	1 ppb (l), 0.002 % O_2 (g), or 3 % of the measured value, whichever is greater	
Drift from Photo-decomposition	< 1.0 ppb within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50ºC (32 to 122ºF)	
Allowable Sensor Temperature	90ºC (194ºF) non-continuous	

BOS2 Sensor Specifications - Liquid Phase / Gas Phase		
	Dissolved Oxygen	**Gaseous & Dissolved Oxygen @ 1 atm, 20ºC**
Measurement Range	0-22 mg/L (ppm)	0-25 % O_2 (0-1013 hPa)
Limit of Detection (LOD)	15 ppb	0.03 % O_2
Resolution @ 20ºC and 1013 hPa	±4.5 at 90 µg/L (ppb) ±0.15 at 23 mg/L (ppm)	±0.01 % O_2 at 0.21 % O_2, ±0.1 hPa at 2 hPa ±0.1 % O_2 at 20.9 % O_2, ±1 hPa at 207 hPa
Response Time (T_{90})	< 30 sec.	< 6 sec.
Accuracy @ 20ºC	±0.4 % O_2 at 20.9 % O_2, ±0.05 % O_2 at 0.2 % O_2	
Drift from Photo-decomposition	< 0.03 % O_2 within 30 days (1 min sample rate)	
Operating Temperature Range	0 to 50ºC (32 to 122ºF)	
Allowable Sensor Temperature	90ºC (194ºF) non-continuous	

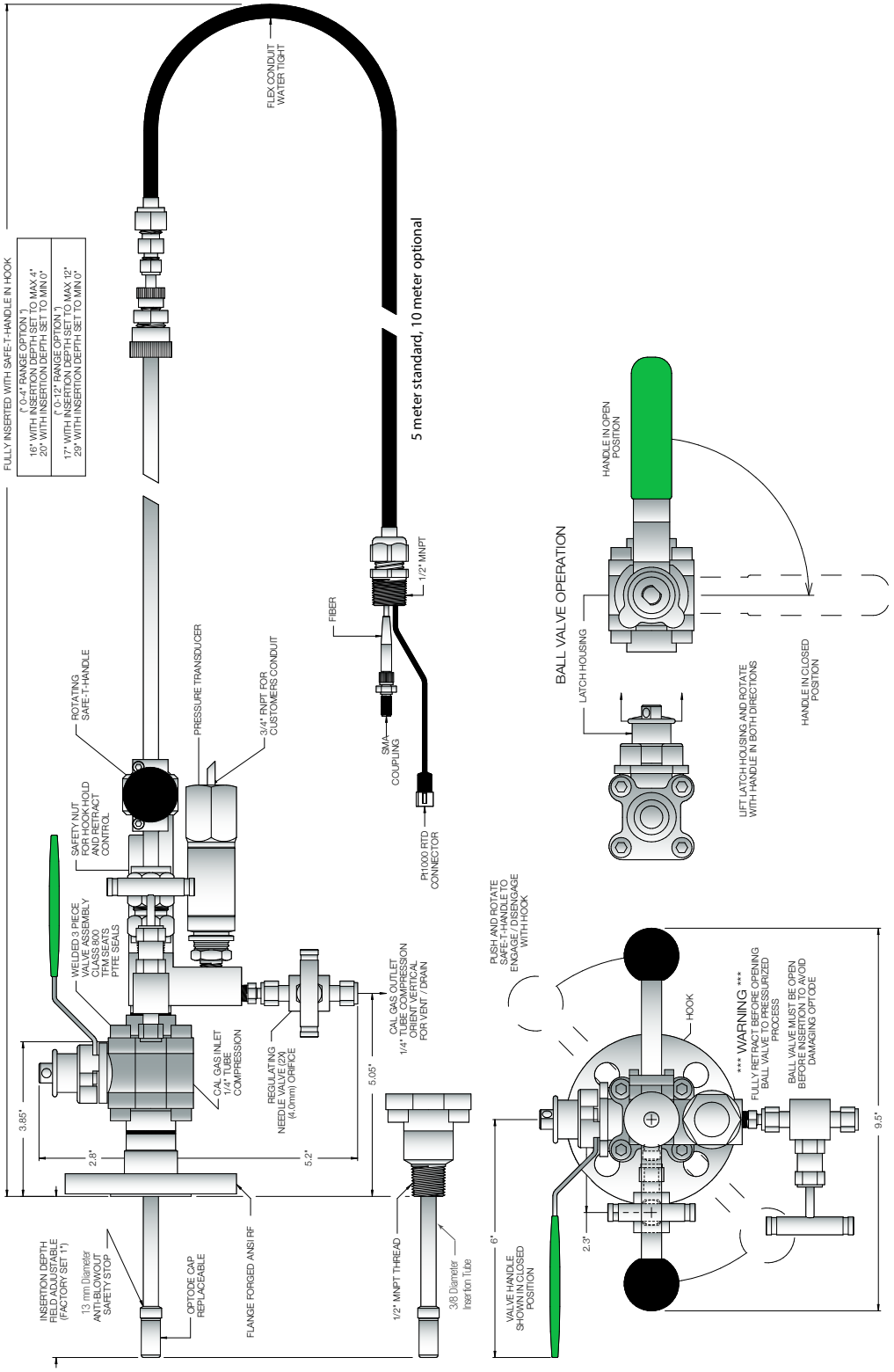
BOS3 Sensor Specifications - Liquid Phase / Gas Phase	
	Gas Phase Oxygen @ 1 atm, 20ºC
Measurement Range	0-300 ppm with over-range of 1000 ppm
Limit of Detection (LOD)	0.5 ppm O_2
Resolution @ 20ºC & 1013 hPa	10 ±0.5 ppm; 100 ±0.8 ppm; 200 ±1.5 ppm
Response Time (T_{90})	< 3 sec. based on 0-300 ppm measurement range
Accuracy @ 20ºC,1 atm	±2ppm or ±5% of measured value, whichever is greater (or as partial pressure, ±0.002 hPa)
Drift from Photo-decomposition	< 1.5 ppm within 30 days (1 min sample rate)
Operating Temperature Range	0 to 50ºC (32 to 122ºF)
Allowable Sensor Temperature	90ºC (194ºF) non-continuous

Cross Sensitivity for BOS1, BOS2, BOS3 Sensors Listed above
No interference or degradation from carbon dioxide (CO_2), hydrogen sulfide (H_2S), ammonia (NH_3), gaseous sulfur dioxide (SO_2) or ionic species like sulfide, sulfate, or chloride. Compatible with many hydrocarbons, such as natural gas (with/H_2S & CO_2) along with ethylene, propylene and polypropylene. Also compatible with methanol and ethanol mixtures. Incompatible with organic solvents, like benzene, chloroform, toluene, acetone, and methylene chloride along with any strong oxidizers such as gaseous chlorine (Cl_2).

BOS SAFETAP Retractable Optical Oxygen Sensor Specifications	
Valve Options	316 stainless steel ball valve W.O.G., Optional 29" Hg full vacuum NACE MR0175 certified ball valve
Operating Pressure Rating	750 psig (51.7 Bar)
Insertion / Retraction Pressure Rating	450 psig (31.0 Bar)
Temperature Rating	0 to 50ºC (32 to 122ºF) operating, 90ºC (194ºF) non-continuous
Internal Seal Options	Viton, EPDM, FFKM (Kalrez)

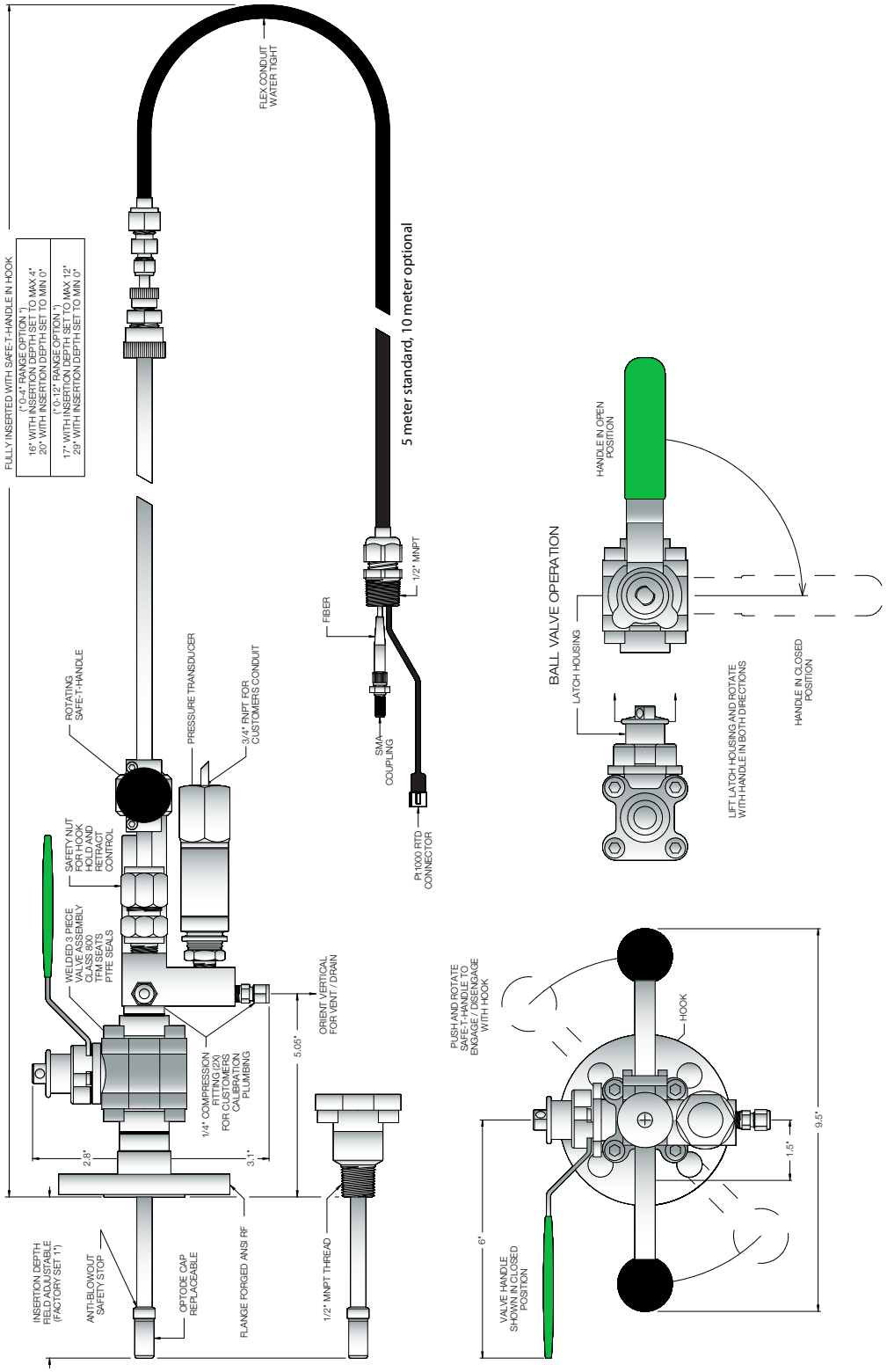
BOS SAFETAP II
OPTICAL OXYGEN SENSOR

PRODUCT DIMENSIONS - SAFE TAP II WITH MANUAL CALIBRATION VALVE



BOS SAFETAP II
OPTICAL OXYGEN SENSOR

PRODUCT DIMENSIONS - SAFETAP II WITHOUT MANUAL CALIBRATION VALVE



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